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How reliable are cointegration-based estimates for wealth effects on consumption? Evidence from Switzerland*

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Abstract

According to economic theory, the intertemporal budget constraint of households implies that a permanent increase in wealth should have a positive effect on consumer spending. Given the comparatively strong increase in Swiss household wealth over the past few years, the question of the extent to which changes in wealth influence expenditures of households has become of special interest for Switzerland. In this paper, I show that while the link among consumption, wealth and income was quite strong from 1981 to 2000, it has been very unstable since 2001. This fact suggests that the gap among the three variables, i.e., the deviation from long-run equilibrium, that has opened over the last few years is less likely to close. The results apply to aggregate wealth effects as well as to separate financial and housing wealth effects. Furthermore, I document several fragility issues related to the use of the cointegration approach to estimating wealth effects. These issues highlight the importance of carefully checking the robustness of the results, instead of looking just at one cointegration estimation method and only one time period. They also highlight the need for a non-cointegration approach to estimating wealth effects.

JEL classification: D12, E21, E44

Keywords: Wealth effects, consumption-to-wealth ratio, cointegration, cay residual

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1 Introduction

According to economic theory, the intertemporal budget constraint of households implies that a permanent increase in wealth should have a positive effect on consumer spending. The quantification of such wealth effects, i.e., the estimation of marginal propensities to consume (MPC) out of wealth, is crucial to understanding the transmission mechanism of wealth effects from stock market booms and busts as well as from changes in housing wealth on consumer spending. Given the importance of these issues for conducting monetary policy and the interpretation of economic business cycles, the number of studies looking at this topic has increased over time.

An important issue when analyzing such wealth effects is the possible difference in the strength of consumer reactions to changes in financial wealth on the one hand and changes in housing wealth on the other hand. In addition, the relative importance of these two wealth components for consumption can vary over time. The issue of households' responses to changes in real estate prices and housing wealth has been especially controversial. In the mid-2000s, discussions on the possible consequences of a fall in real estate prices in the US, particularly for households, showed that there are several reasons, pro and contra, for a housing wealth effect being larger or smaller than the financial wealth effect. An article in *The Economist*[1], e.g., highlighted that although rising real estate prices do not necessarily create large gains, a much larger fraction of households owns housing wealth than owns financial wealth in the U.S. Thus, aggregate housing effects could still become as important as financial wealth effects. The article further stated that until 1980, housing wealth effects were found to hardly exist according to the literature. Since then, studies have estimated that the housing wealth effect has increased over time, so that the MPC out of housing wealth in the U.S. now lies at approximately 9 cents on the dollar, compared to 4 cents on the dollar for financial wealth.[2] However, these findings of housing wealth effects being greater than financial wealth effects apply primarily to the U.S. and the U.K. because, as the article argued, "Anglo-saxon economies have more sophisticated instruments through which people can take cash out of their homes, through the ability to refinance mortgages, for example".

Motivated by a log-linearization of the intertemporal budget constraint of house-

[1] "Home truths: economic focus", The Economist, 14 October 2006.

[2] This means that consumption is increased by 9 cents when housing wealth increases by one dollar and that consumption is increased by 4 cents when financial wealth increases by one dollar.

holds, the estimation of long-run MPCs out of wealth in most of the existing studies is usually based on a cointegrating relationship among consumption, wealth and income. However, several studies have recently shown that this cointegrating relationship is quite fragile. A possible non-existence of such a relationship would indicate the need for another method to estimate wealth effects on consumption. Carroll, Otsuka, and Slacalek (2011) presented such an alternative method. It relies on the assumption of sticky consumption growth motivated by habit formation and sticky expectations through which short-run wealth effects can become long-lasting.

For Switzerland, the question of the extent to which changes in wealth can affect expenditures of households has become of special interest. Uptrends in stock market prices and the parallel increase in real estate prices have led to a strong increase in Swiss household wealth over the past few years. From 2004 to 2014, per capita wealth rose by nearly 40%. Consumption expenditures, however, rose by only 6.5% per capita over the same period.

Despite the potential importance of wealth effects for Switzerland, hardly any studies have investigated the effects of wealth changes on consumption for the Swiss case. To my knowledge, the only study that did so was Schmid (2013). He estimated the MPC out of wealth to be approximately 2 Swiss centime on average, which means consumption increases by 2 Swiss centime when wealth increases by one Swiss franc. In elasticity terms, a 1% increase in asset wealth would then imply a 0.17% higher consumption in the long-run. Given the latest wealth developments, these estimates would suggest that a large gap between consumption and the other two cointegrated variables, wealth and income, has opened in recent years. However, as the analysis in this paper will reveal, the link among consumption, income and wealth has become very unstable since 2000. This makes restoration of the equilibrium less likely.

Furthermore, the Schmid (2013) study only looked at aggregate wealth effects, and did not distinguish between financial and housing wealth effects. For Switzerland, knowledge of the housing wealth effect is especially important because real estate asking prices grew by approximately 35% from 2004 to 2014. The study did also not include robustness checks to test the influence of the underlying method or the stability of the estimates and the cointegrating relationship over time. As mentioned before, the results in this paper reveal that this relationship turns out to be quite unstable over time and over different methods for estimating the cointegrating vector. In addition to this fragility issue, Schmid's results could have been affected by the 2014 revision of the national accounts in Switzerland.

Overall, according to both empirical evidence and economic theory, higher wealth can lead to higher consumption. This paper analyzes whether these wealth effects on consumption are also present for Switzerland and explores how the links among consumption, wealth and income evolved over time. By distinguishing between financial and non-financial wealth, it also tries to shed light on how the recent strong increase in real estate prices and housing wealth could affect personal consumption expenditures. By using different econometric approaches to estimate cointegrating relationships, the aim is also to ascertain whether the results are robust over different estimation methods.

The remainder of this paper is organized as follows: Section 2 provides an overview of the existing literature on wealth effects. Section 3 describes the data and presents some stylized facts, before section 4 provides an overview of the cointegration-based approach to estimating wealth effects and presents some first baseline results. In section 5, robustness checks using different methods and time spans are conducted. Section 6 then discusses the findings of the robustness checks by highlighting several fragility issues related to the cointegration approach. Section 7 provides a short summary of the findings and concludes.

2 Literature review

The economic literature on wealth effects in general and on the relationship among consumption, wealth and income in particular is very broad. Possible effects of changes in household wealth on private consumption expenditures were first discussed in Friedman (1957), Brumberg and Modigliani (1954) and Ando and Modigliani (1963). In general, there are several approaches to empirically estimating such wealth effects. The most popular, from a macro perspective, is the cointegration approach, where a cointegrating relationship among consumption, wealth and income is motivated by linearizing and rewriting the intertemporal budget constraint of households. This yields an approximation of the consumption-to-wealth ratio, the so-called cay residual (c stands for consumption, a for asset wealth and y for income, the proxy for human capital wealth). This residual has been shown to be a function of the present value of expected future net returns on aggregate wealth and expected future consumption growth. If these two variables are assumed to be stationary, the cay residual will be stationary, and consumption, wealth and income will be cointegrated. The MPC out of wealth is then given by a transformation of the coefficient on wealth in the cointegrating vector of these three variables. Internationally, this MPC out of wealth seems to lie between 0.03 and 0.07. In terms of separate financial and housing wealth effects, the housing wealth effect is usually estimated to be larger in countries where it is possible to obtain consumer credit against housing collateral (US, UK) than in countries where this is not as common (Continental Europe). A good and broad survey on the literature on empirical evidence for wealth effects on consumption can be found in Cooper and Dynan (2014) for studies using micro data and those using macro data. In the remainder of this section, I only discuss selected studies that are particularly related to the use of a cointegration approach to estimating wealth effects.

Ludvigson and Steindel (1999) were among the first to investigate wealth effects in quite a broad manner. They estimated wealth effects for the U.S. by the use of different models, and they divided wealth into stock market and non-stock market wealth to estimate separate wealth effects. Over the full sample (1953–1997), their estimated MPC out of asset wealth was approximately 4 cents, with the same value for both wealth components. However, the authors documented that the effect of wealth changes on consumption is rather unstable over time and difficult to pin down. The same applied to the general relationship among consumption, wealth and income.

Lettau and Ludvigson (2001) and Lettau and Ludvigson (2004) estimated the cointegrating vector of the cointegrating relationship among U.S. consumption, wealth and income with quarterly data. The MPC out of wealth in their study is approximately 4.6 cents. They also showed that, when the cointegrating relationship is in disequilibrium, it is solely wealth that has error-correction properties and drives the cay residual back to equilibrium. Consumption and income do not react to the cay residual. This finding also means that the cay residual can predict future returns on the market portfolio and thus has forecasting power for the stock market. Lettau and Ludvigson (2011) updated the estimates with new, revised data. Interestingly, based on the reestimated cointegrating vector, the MPC out of wealth decreased by nearly 40% to 2.8 cents.

Benjamin, Chinloy, and Jud (2004) tried to estimate separate housing and financial wealth effects for the US. However, because they were unable to find a cointegrating relationship among consumption, wealth and income, they estimated their equations in first differences. Their resulting MPC out of housing wealth was approximately 8 cents, and that out of financial wealth was only 2 cents.

What Lettau and Ludvigson (2001, 2004, 2011) did for the U.S. was replicated for Germany by Hamburg, Hoffmann, and Keller (2008). Their estimated cointegrating vector suggests an MPC out of wealth of approximately 4-5 euro cents. Interestingly, in their study, it is income that has error-correction properties and drives the cay residual back to the equilibrium level, which means the cay residual has predictive power for future income growth. The authors concluded from this that the German cay residual is more related to economic business cycles than to stock market cycles. As a possible reason for this, the authors highlighted that in Germany, compared to Anglo-Saxon countries, "private stock ownership is much less widespread (...) and households generally hold large shares of their wealth in form of relatively illiquid assets" (p. 453).[3]

Sousa (2010) extended Hamburg, Hoffmann, and Keller (2008)'s exercise to the whole euro area, additionally trying to distinguish among financial and housing wealth effects. The results suggest that the MPC out of asset wealth is only 0.4 cents for the euro area. For financial wealth and housing wealth, it is 1.4 cents and 0.2 cents, respectively.

Fisher and Voss (2004) estimated the cay residual for Australia. They were unable to find an empirical cointegrating relationship between consumption, wealth and income, but they argued that this was due to problems with separating permanent and transitory components of wealth in finite samples. For this reason, they simply assumed stationarity and continued the standard calculations. In their work, the cay residual has predictive power for the Australian stock market, which is similar to what Lettau and Ludvigson (2004) found for the U.S.

Finally, Schmid (2013) performed the cointegration analysis for Switzerland, finding a significant cointegrating relationship among consumption, wealth and income. However, the cointegrating vector turned out to be fairly unstable over time. Depending on the sample period, the resulting MPC out of asset wealth was 2 Swiss centime (1990–2009) or 5.7 Swiss centime (1980–2009). In terms of short-run adjustment, it was mainly wealth that reacted to the cay residual. However, for Switzerland, consumption seemed to also drive the residual back into equilibrium to some extent, although the related adjustment coefficient was quite small.

The studies described here and in Cooper and Dynan (2014) show a wide and sometimes contradictory variety of findings on wealth effects. The same applies to the relative importance of housing wealth effects compared to financial wealth effects. Related

[3]By illiquid, assets Hamburg, Hoffmann, and Keller (2008) meant pension and housing wealth.

to housing wealth effects, a good review of estimates for transitory and permanent effects of changes in house prices on consumer spending for the U.S. can be found in a background paper of the Congressional Budget Office (2007).

A critique of the general approach to estimating aggregate wealth effects, but particularly housing wealth effects, was expressed by Muellbauer (2007) and Aron, Muellbauer, and Murphy (2008). When estimating housing (and aggregate) wealth effects, controls for common drivers of house prices and consumption are often omitted, including income growth expectations, interest rates, credit supply conditions, other assets, indicators of income uncertainty and even income itself. In Aron, Muellbauer, and Murphy (2008), the authors argued that, when not controlling for the direct effect of credit liberalization, housing wealth effects can be over-estimated because "a major part of the rise of the consumption-to-income ratio (...) is explained by easing of credit availability" (p. 28). Both Muellbauer (2007) and Aron, Muellbauer, and Murphy (2008) also showed that when controlling for credit market liberalization, the estimate on the MPC out of income increases. The authors also explained how the interest rate channel can sustain consumption expenditures and growth through the responsiveness of the housing market to low interest rates. In addition, "a rise in short-term interest rates has negative direct effects on consumer spending, but there appear to be even larger indirect effects via asset prices and income expectations" (Aron, Muellbauer, and Murphy, 2008, p.29).

Another critique, aiming at the estimation of wealth effects through cointegration methods, was brought up by Carroll, Otsuka, and Slacalek (2011). They argued that changes in fundamentals such as the long-run growth rate, the long-run interest rate, the tax scheme, social security generosity or demographics affect the equilibrium among consumption, wealth and income and thus the cointegrating vector. The existence of labor frictions and income uncertainty may also be problematic. The authors also argued that, due to these changes in factors that affect the economy, one would need very long data series to obtain reliable estimates of the cointegrating vector. Another critique was that estimating separate wealth effects is not straightforward within the cointegration approach.

To overcome these issues, the studies of Slacalek (2009) and Carroll, Otsuka, and Slacalek (2011) proposed a new approach that is not cointegration-based to estimate long-run wealth effects, where the calculation of the eventual (long-run) wealth effect, i.e., the long-run MPC out of wealth, is based on the assumption of consumption stickiness (friction by incomplete information), so that short-run effects of wealth changes on consumption become long lasting. Consumption stickiness is motivated by two theories: habit formation and sticky expectations. International evidence of sticky consumption growth can be found in Carroll, Slacalek, and Sommer (2011). Compared to the cointegration approach, their method, as the authors argue, has the advantage that it is much more robust to changes in the underlying parameters including expected income growth and demographics. Furthermore, it easily allows one to estimate wealth effects out of financial wealth and housing wealth separately. Carroll, Otsuka, and Slacalek (2011) applied the method to U.S. data. The results suggest a sluggishness of quarterly consumption of 0.6 to 0.7. The one-quarter MPC out of asset wealth is estimated to be approximately 2 cents per dollar, while the eventual MPC is approximately 4 to 10 cents. Furthermore, some evidence was found that the MPC out of housing wealth could be higher than the MPC out of financial wealth.

Slacalek (2009) extended the application of the new approach to a broad set of 16 countries. The eventual MPC was usually between 0.01 and 0.05 per currency unit. Strong wealth effects can especially be found in countries with more developed mortgage markets (the U.K., the U.S. and non-euro countries). In euro area countries, there are hardly any wealth effects (1 cent per dollar). The effect of housing wealth is found to be somewhat smaller (3 cents) than that of financial wealth ($3-4$ cents), except for the U.S. and the U.K. However, the author argues that the MPC out of housing wealth in the euro area may be smaller, but because housing wealth relative to consumption is larger in the EU than in the US, housing wealth effects can still be important. As already found by other studies, Slacalek (2009) showed that the housing wealth effect has risen substantially over the last few decades for industrial countries, probably because it has become easier to borrow against housing wealth.

In Galli (2016), I apply the new approach to Swiss data, finding that, first, there seems to be a remarkably high degree of consumption stickiness in Switzerland. The estimation results show that, in sticky expectation terms, only approximately half of the households update their expectations and optimize their consumption behavior in a given year. Therefore, consumption growth is quite persistent on an annual basis. Second, the short-run (one-year) MPC out of assets is estimated to be approximately 1.4 Swiss centime, which is small compared to other countries. However, given the high degree of consumption stickiness in Switzerland, part of this short-run effect also remains effective in the subsequent quarters, so that the long-run effect accumulates over time to approximately 6-7 Swiss centime, which is somewhere in the middle of international results. In terms of elasticities, this means that when asset wealth increases by 1% in a given year, consumption is expected to increase by approximately 0.13% in the next year and by approximately 0.6% in the long-run. Third, when splitting up wealth, the mean MPCs out of housing wealth is somewhat smaller than that out of housing wealth. Furthermore, there is a much higher degree of uncertainty surrounding the estimated housing wealth effect. This supports the point that changes in housing wealth do not necessarily have an effect on aggregate consumption expenditures of households.

3 Data and stylized facts

Before presenting the cointegration approach to estimating long-run MPCs out of wealth and the results for Switzerland, this section briefly describes the data.

Consumption, wealth and income data are used in real per capita terms. Data on all measures of consumption (total, non-durable, non-housing) and on the consumption deflator are obtained from the official national accounts for Switzerland, published by the federal statistical office (annual figures) and the state secretariat of economic affairs (quarterly, calendar and seasonally adjusted figures).

For income, the measure of disposable income (which consists of compensation of employees, net operating surplus, property income and net-transfers) is used.[4] Annual data from 1990 onward are obtained from the official national accounts. For 1980–1990, annual figures reflect SNB internal retropolations using old national accounts data. Quarterly, seasonally adjusted figures are obtained using the Chow-Lin procedure with labor income as the relevant indicator. The other components of disposable income are unfortunately not available on a quarterly basis for Switzerland.

Regarding financial wealth, the asset side can be decomposed into money and deposit holdings, debt securities, shares, units in collective investment schemes, structured products, and claims against pension funds and insurances. On the liability side, financial wealth consists of loans (mortgages, consumer loans and other loans) and other accounts payable. Annual figures from 1999 onward come from the official Swiss financial accounts. For 1980–1998, the annual figures reflect SNB internal retropolations, which are based on

[4] A detailed discussion of the appropriate choice of income measure is presented in section 6.2.

the statistics on bank balance sheets, securities deposits statistics, banknote circulation data, postal account data and insurance statistics. Quarterly financial wealth figures are mostly based on bank statistics if available. For components where quarterly observations are missing, dynamics are approximated by relevant indicators such as the money stock, bond and stock market indices.

Housing wealth consists of houses, condominiums and rental apartments valued at market prices and held by private households. Annual figures are based on internal estimates using data on dwellings from the Federal Register of Buildings and Dwellings (RBD), published by the federal statistical office, and data on hedonic price indices (transaction prices), as follows: For each village in Switzerland, one representative standard property for each of the three property types (single-family homes, condominiums and apartment buildings with rental apartments) is evaluated by real estate consulting companies using hedonic pricing models. These valued standard properties are then multiplied by the number of properties per municipality. For the aggregated property stock over all municipalities, the share of the household sector is taken using a reference value from the Swiss Housing Census of 2000 (the RBD does not include this information). Before 2000, the RBD data are only available at a 10year frequency (1980 and 1990). Thus, annual figures on the real estate stock for the period 1980–1999 are obtained by applying the same method used in Schmid (2013), assuming that the change in the annual real estate stock is proportional to data on newly built housing units. Quarterly figures on housing wealth are obtained by interpolation using quarterly developments of the relevant hedonic price indices. More details on the calculation of financial and housing wealth can be obtained from Swiss National Bank (2012)

In what follows, total wealth is defined in net terms, i.e., financial wealth plus housing wealth minus all liabilities. When working with separate wealth components (financial wealth and housing wealth), netting is performed on the housing wealth side. The reason for doing so is that for Switzerland, 94% of households' liabilities consist of mortgage loans, which are usually directly linked to housing wealth.

The log levels of consumption, income and wealth from 1981Q1 to 2012Q4 are shown in Figure 1. At first sight, there is much comovement among consumption, wealth and income from 1981 to 2000. Apart from the general upward trend in the saving rate, indicating that income grew more strongly than consumption, increases (decreases) in wealth were usually followed by solid (subdued) consumption developments. From 2000

Figure 1: Log levels of consumption, income and wealth (real, per capita)

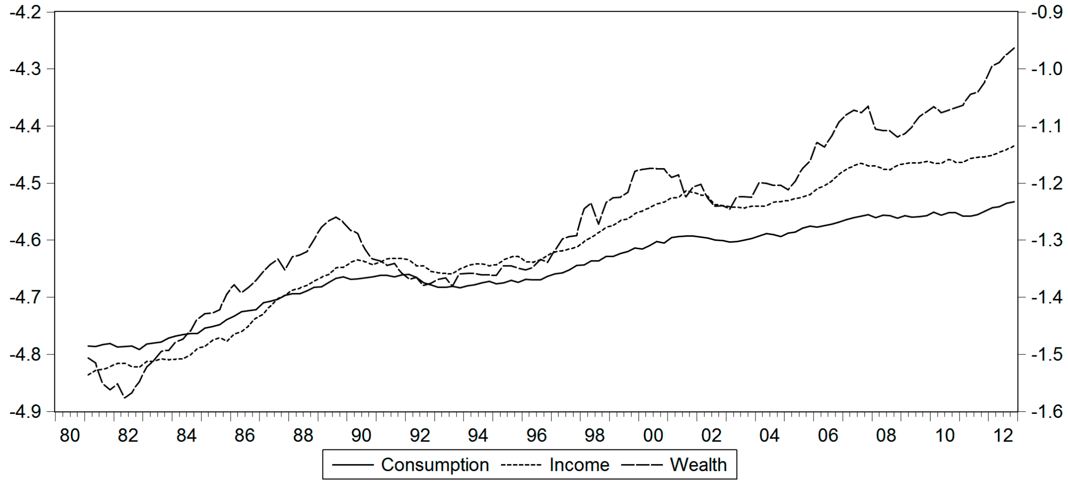
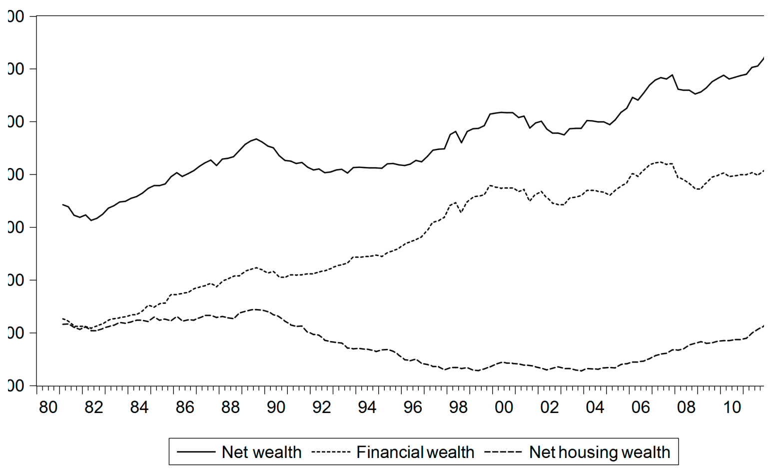


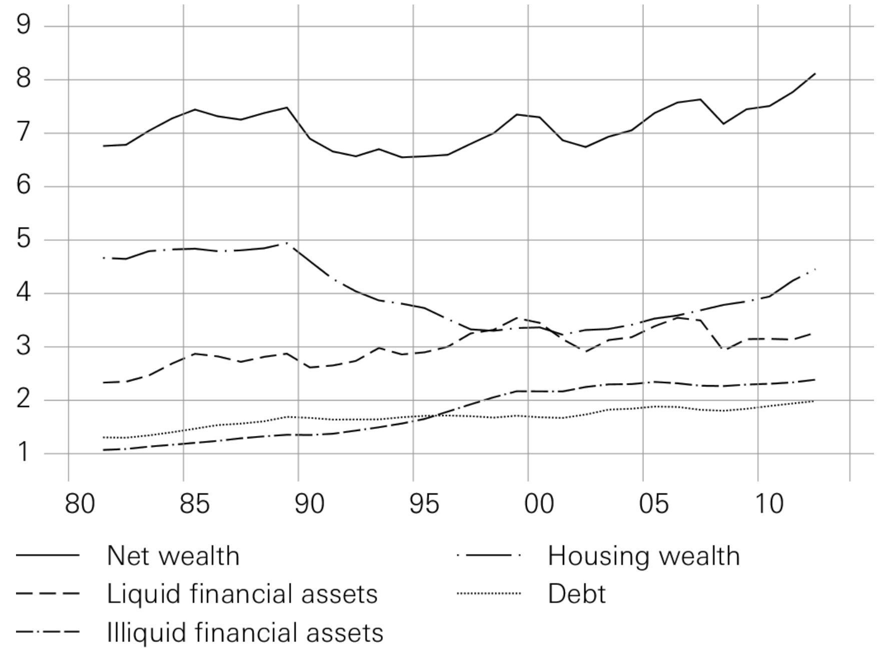
Figure 2: Total net wealth, financial wealth and net housing wealth (real, per capita, in 2010 Swiss francs)



onward, however, the links seem to have become less clear. Consumption expenditures hardly reacted to strong increases and drops in wealth during this period. On the other hand, the relationship between income and consumption seems to have become stronger. On average, consumption grew by 0.8%, asset wealth by 1.2%, and income by 1.2% per year in real per capita terms.

A decomposition of wealth into financial wealth and net housing wealth, shown in Figure 2, indicates that short-run dynamics in asset wealth are more driven by financial wealth while the long-run dynamics are more influenced by net housing wealth, which is somewhat smoother. Looking at financial wealth exclusively, the stock market is the main driver of short-run fluctuations in financial wealth. The main drivers in the long-run, however, are pension claims and deposits which are the two largest components and are

Figure 3: Components of Swiss household wealth relative to disposable income



Liquid assets are defined as the sum of deposits, bonds and stock market shares. Liquid assets equal pension wealth.

much smoother.

When looking at developments in wealth relative to disposable income, Figure 3 shows that the ratio of net wealth to disposable income remained roughly stable from 1980 to 2000, fluctuating between 6.5 and 7.5. Since the beginning of the new century, however, an upward trend seems to be present. This upward trend is mainly driven by increases in housing wealth. Liquid and illiquid financial assets, on the other hand, have roughly stagnated relative to disposable income since 2000, after having trended upward previously.

When looking at real estate prices, the main driver of housing wealth, relative to disposable income, Figure 4 shows that after being on a high but stable level from 1985 to 1990, price-to-income ratios decreased until 2000 against the backdrop of the housing crisis in Switzerland in the early 1990s. Since 2000, housing prices have started to increase again compared to disposable income. This especially applies to owner-occupied apartments, where the price-to-income ratio reached the pre-crisis levels of the late 1980s.

Figure 4: Swiss housing market: Price-to-income ratios

Shown are Swiss hedonic real estate transaction price indices of single-family homes and owner-occupied apartments relative to per capita disposable income of Swiss households.

4 The cointegration approach

The most common way to estimate MPCs out of wealth is based on the assumption of a cointegrating relationship among consumption, wealth and income. The respective cointegrating residual, denoted by cay (c stands for consumption, a for asset wealth and y for income), is also often found to have predictive power for stock market developments. Two of the most influential studies in this area were Lettau and Ludvigson (2001) and Lettau and Ludvigson (2004). This section first presents a quick review of the theoretical foundation and econometric framework related to the cointegration-based approach to estimating wealth effects. Next, possible ways to separate among financial and housing wealth are shown, before the first baseline estimation results for the Swiss case are presented. Section 5 then presents broad robustness checks.

4.1 Theoretical foundation and classical econometric framework

As mentioned before, the cointegration-based approach relies on the assumption that aggregate consumption C_t and aggregate wealth W_t (defined as the sum of asset wealth and human capital) follow a common long-run trend. Thus, the consumption-to-wealth ratio and its log representation

$$\log\left(\frac{C_t}{W_t}\right) \equiv c_t - w_t \tag{1}$$

should be stationary. Lowercase letters denote the natural logarithms of the corresponding variable.

The theoretical foundation for this concept of a stable consumption-to-wealth ratio comes from the intertemporal budget constraint of households, which is given by

$$W_{t+1} = R_{t+1}(W_t - C_t), \tag{2}$$

where R_{t+1} is the gross return on investment $W_t - C_t$. Rewriting (2) as

$$W_t = C_t + \frac{W_{t+1}}{R_{t+1}} \tag{3}$$

and solving forward, while imposing that the limit of discounted future wealth is zero, yields the following formula, which states that today's wealth equals the discounted value of future consumption:

$$W_t = C_t + \sum_{i=1}^{\infty} \frac{C_{t+i}}{\Pi_{j=1}^{i} R_{t+j}} \tag{4}$$

To obtain a linear relationship among wealth, consumption and the return on investment, we divide (2) by W_t and take logs, which results in

$$w_{t+1} - w_t = r_{t+1} + \log\left(1 - \frac{C_t}{W_t}\right) = r_{t+1} + \log(1 - e^{c_t - w_t}). \tag{5}$$

A first-order Taylor approximation of the last term around the steady state level of the consumption-to-wealth ratio $c_t - w_t$ yields

$$\log(1 - e^{c_t - w_t}) \approx \underbrace{\log(\rho) - \left(1 - \frac{1}{\rho}\right)\log(1-\rho)}_{k_1} + \left(1 - \frac{1}{\rho}\right)(c_t - w_t). \tag{6}$$

k_1 represents a linearization constant and $\rho = 1 - e^{c-w}$, where $c - w$ is the steady state level of the consumption-to-wealth ratio; see, e.g., Campbell and Mankiw (1989).

Using this approximation, we can rewrite equation (6) as

$$\Delta w_{t+1} \approx k_1 + r_{t+1} + \left(1 - \frac{1}{\rho}\right)(c_t - w_t). \tag{7}$$

In a final step, we can replace the growth rate of wealth with the growth rate of consumption, using the fact that $\Delta w_{t+1} = \Delta c_{t+1} + (w_{t+1} - w_t) - (c_{t+1} - c_t) = \Delta c_{t+1} - (c_{t+1} - w_{t+1}) + (c_t - w_t)$. Substituting this into (7) and rearranging yields the following approximate linear relationship:

$$c_t - w_t \approx \rho(r_{t+1} - \Delta c_{t+1}) + \rho(c_{t+1} - w_{t+1}) + \rho k_1. \tag{8}$$

Solving this forward results in a forward-looking approximation of the consumption-to-wealth ratio:

$$c_t - w_t \approx E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}) + \frac{k_1 \rho}{1-\rho}, \tag{9}$$

Thus, the approximate consumption-to-wealth ratio is a function of forecasts of returns on aggregate wealth and of consumption growth. If r_t and Δc_t both follow a stationary process (so that the forecasts are also stationary), the consumption-to-wealth ratio $c_t - w_t$ will also be stationary, and consumption and aggregate wealth follow a common long-run trend.

By combining the log-linearized budget constraint with a behavioral restriction on household behavior, given, e.g., by a log-linear Euler equation of the form

$$E_t \Delta c_{t+1} = \mu + \sigma E_t r_{t+1}, \tag{10}$$

we obtain the following consumption function:

$$c_t - w_t \approx (1-\sigma) E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} + \frac{(k_1 - \mu)\rho}{1-\rho}, \tag{11}$$

where $r_{t+1} \approx \log(1 + R_{t+1})$, σ is the intertemporal elasticity of substitution and μ is a constant term.

The Euler equation (10) is based on power utility, which means that households maximize a utility function of the form

$$\mathrm{U}(C_t) = \frac{C_t^{1-1/\sigma} - 1}{1 - 1/\sigma} \tag{12}$$

Standard optimization yields a non-logarithmized Euler equation of the form

$$C_t^{-\frac{1}{\sigma}} = E_t[\beta(1 + R_{t+1}) C_{t+1}^{-\frac{1}{\sigma}}]. \tag{13}$$

This is approximately equivalent to the log-linearized version (10).

From the rewritten approximate consumption-to-wealth ratio (11) we can see that if the income effect dominates the substitution effect ($\sigma < 1$), the consumption-to-wealth ratio falls if expected returns fall. On the other hand, if the substitution effect dominates the income effect (i.e., $\sigma > 1$), the consumption-to-wealth ratio increases if expected returns fall. In the special case of $\sigma = 1$, the income effect and the substitution effect offset each other, so that the consumption-to-wealth ratio is constant, independently of the expectations on returns. In the other special case, $\sigma = 0$, we end up with the permanent income hypothesis, where consumption follows a random walk.

So far, all derivations have been in terms of total wealth W_t, which includes human capital. However, to derive MPCs out of asset wealth only, total wealth needs to be substituted by its two components, asset wealth A_t (i.e., the sum of financial and housing wealth) and human capital wealth H_t. To obtain a log-linearized relationship between aggregate wealth and its two components, the wealth decomposition equation $W_t = A_t + H_t$ is first divided by A_t. Taking logs yields

$$w_t - a_t = \log\left(1 + \frac{H_t}{A_t}\right) = \log(1 + e^{h_t - a_t}). \tag{14}$$

Assuming that the ratios $A_t/W_t = \pi$ and $H_t/W_t = 1 - \pi$ are constant on the balanced growth path, a first-order Taylor approximation of the term on the right hand side around the long-run human capital wealth to asset wealth ratio $h - a$ yields

$$\begin{aligned} \log(1 + e^{h_t - a_t}) &\approx \underbrace{\log(1 + e^{h-a}) - \frac{e^{h-a}}{1 + e^{h-a}}(h - a)}_{k_2} + \frac{e^{h-a}}{1 + e^{h-a}}(h_t - a_t) \\ &\approx k_2 + \left(1 - \frac{A}{W}\right)(h_t - a_t) = k_2 + (1 - \pi)(h_t - a_t), \end{aligned} \tag{15}$$

where k_2 summarizes all constant terms. Plugging (15) into (14) yields the following approximate decomposition of total wealth:

$$w_t \approx k_2 + \pi a_t + (1 - \pi)h_t \tag{16}$$

Because human capital is not observable, I follow Lettau and Ludvigson (2001) and approximate it with income (y_t in log terms), which implies $h_t = b + y_t + z_t$, where b is a constant and z_t is a stationary random variable with mean zero. Combining (9) and (16), ignoring constants, yields the following relationship among consumption, asset wealth and income:

$$c_t - \pi a_t - (1-\pi)y_t \approx E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}) + \frac{k\rho}{1-\rho} + (1-\pi)z_t. \tag{17}$$

This is often referred to as the approximate consumption-to-wealth ratio. The left hand side can be interpreted as a cointegrating residual, known as *cay*:

$$c_t - w_t = c_t - \pi a_t - (1-\pi)h_t \approx c_t - const - \pi a_t - (1-\pi)y_t \tag{18}$$

$$\Leftrightarrow c_t = const + \pi a_t + (1-\pi)h_t + cay_t \tag{19}$$

Because the equation above is specified in log-terms, the coefficient π is an elasticity, $\frac{\Delta C_t/C_t}{\Delta A_t/A_t}$, and is not directly the MPC out of (asset) wealth. Wealth effects in terms of MPCs are obtained through the following transformation (see, e.g., Hamburg, Hoffmann, and Keller, 2008):

$$MPC = \frac{\Delta C_t}{\Delta A_t} = \pi \frac{C_t}{A_t}, \tag{20}$$

The econometric procedure to estimate wealth effects based on the theoretical derivation of the cointegration concept above can be outlined as follows:

1. Check whether the involved time series (consumption, wealth and income) do individually contain a unit root, i.e., whether they are I(1).

2. Check for a cointegrating relationship among consumption, wealth and income using residual-based (Engle-Granger, Phillips-Ouliaris) or likelihood-ratio-based (Johansen) cointegration tests. As highlighted in Ludvigson and Steindel (1999), cointegration is important because only then can OLS estimates of equation (19) result in parameters and, ultimately, in MPCs that are robust to the presence of regressor endogeneity which may be present in our case. The parameters on wealth and income could possibly reflect the effect of an increase in consumption on these two variables. The authors refer to this simultaneity problem as "reverse causality" (p. 35), or endogeneity bias. Thus, the cay residual is typically correlated with the regressors (W_t and Y_t).

3. Estimate the cointegrating vector, i.e., the long-run coefficients on wealth and income, by dynamic OLS (DOLS) or full information maximum likelihood (FIML, Johansen procedure).

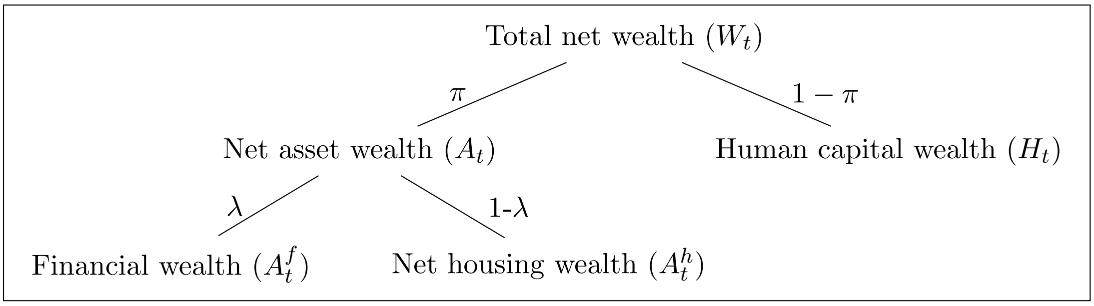
4. Calculate the long-run wealth effect $MPC = \hat{\pi}\frac{C_t}{A_t}$, where I use the average level of $\frac{C_t}{A_t}$ to obtain an average estimate for the MPC out of wealth as a transformation of the estimated elasticity $\hat{\pi}$.

5. Estimate a VAR in differences including the cay residual to investigate short-run responses of consumption, wealth and income to a disequilibrium in the cointegrating relationship, and check which of the three variables drives the cay residual back to equilibrium.

4.2 Separating financial and housing wealth effects

Thus far, the cointegration framework to estimate wealth effects has been derived in terms of total asset wealth, A_t, which only allows one to estimate an MPC out of total asset wealth. However, we are often not only interested in the effect of changes in aggregate asset wealth on consumption but also in the separate effects of changes in financial wealth and housing wealth. The decomposition of total wealth into its components is illustrated in Figure 5. π and $1-\pi$ represent the (steady state) shares of asset wealth A_t and human capital wealth H_t in total wealth W_t. λ and $1-\lambda$ represent the (steady state) shares of financial wealth A_t^f and housing wealth A_t^h in total asset wealth A_t.

Figure 5: Decomposition of total wealth



Generally, both forms of asset wealth can affect consumer spending. However, the channels are somewhat different, and the size of the effect can potentially differ quite a bit. Developments related to financial wealth can affect spending in several ways. A stock market rally, for example, directly results in higher equity wealth, but it can also have a positive effect on consumer confidence, which usually boosts consumption. Furthermore, most components of financial wealth (except for pension claims) are usually quite liquid and can be used for consumption more or less immediately.

The effect of housing wealth, on the other hand, is less straightforward. The main factor driving housing wealth is typically real estate prices. However, a higher value of the owned house does not necessarily have to lead to higher consumption, because rising house prices do not necessarily create aggregate gains: for households living in their owned house, a higher value of the latter cannot directly positively affect their consumption because they cannot sell their house, or if they do, they need to buy a new one (whose price has also risen). Households that own housing wealth as an investment can indeed sell their house (more or less) immediately to realize gains from a higher price of their property, which can boost the household's spending. However, on the other side of the deal is a buyer household that had or will have to restrict their consumption in order to buy the house. This ends up in a zero sum game, which makes the home-owners relatively richer and the non-home-owners relatively poorer. Based on a Yaari-Blanchard OLG model, Buiter (2008) summarized this fact as follows: "A fall in house prices due to a change in fundamental value redistributes wealth from those long housing (for whom the fundamental value of the house they own exceeds the presented discounted value of their planned future consumption of housing services) to those short housing" (p. 2).

From this perspective, direct aggregate housing wealth effects seem to be limited. The only way aggregate consumption coul be directly supported by higher housing prices is when a household gains by selling their real estate assets to a non-household buyer, e.g., a company. An exception, also brought up by Buiter (2008), is when the increase in house prices reflects a change in the speculative bubble prices component and not a change in fundamental value. In that case, there can be direct effects of changes in house prices and housing wealth on consumption.

Generally, one could also think of housing wealth affecting consumption expenditures negatively. When increases in (aggregate) housing wealth are not due to higher house prices but to an increase in the home owner rate, more people face amortization requirements, which may force them to restrict their consumption expenditures, so that the debt service to income ratio rises. This would become visible in a higher aggregate saving rate. In Switzerland, this pattern was indeed visible in the last few years. Drehmann and Juselius (2012) showed that "high debt service ratios prevent borrowers from smoothing consumption (...)" (p. 26).

In addition to these direct channels, there are other, indirect ways house prices and housing wealth influence spending. One is an implicit easing in credit constraints for households. Households may benefit from rising house prices through taking out new loans against the increased value of their home. This way of borrowing is especially important for households that were credit-constrained before (usually households with a low level of financial wealth), but no longer are. This type of credit-based consumption, also known as home equity withdrawal (HEW), allows the household to smooth their consumption over time more easily and perhaps even to increase their life-time consumption because borrowing became cheaper. The aggregate effect on consumer spending usually depends strongly on credit market regulations and the home owner rate of the respective country. While it may be larger for countries with a market-based financial system (e.g., in the U.K. and the U.S.) it can be assumed to be less important for Switzerland (and other European economies).

Another indirect effect could come from the redistribution effect from sellers to buyers or vice versa, in case of differences in their MPCs out of housing wealth.

Different channels through which changes in housing wealth, housing prices and related credit conditions can affect consumption expenditures were also extensively discussed in Muellbauer (2007) and Aron, Muellbauer, and Murphy (2008).

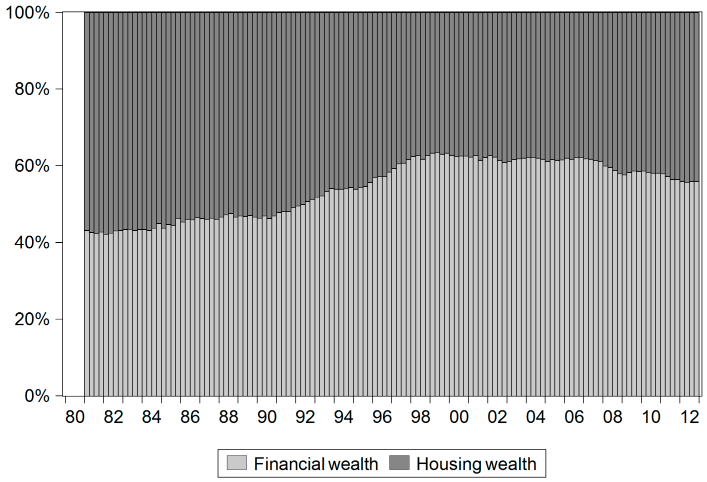
Within the discussed standard cointegration framework, splitting up wealth effects while (a) continuing along the lines of the theoretical foundation from the intertemporal budget constraint and (b) being simultaneously able to estimate separate MPCs is quite difficult to achieve. To split up wealth in a way that is consistent with the theory, one could proceed similarly to the decomposition of total wealth into asset wealth and human capital wealth in section 4.1. A loglinear approximation of asset wealth A_t around the ratio of housing wealth A_t^h to financial wealth A_t^f (a_t^f and a_t^h in log terms) yields

$$a_t \approx k_3 \lambda a_t^f + (1-\lambda) a_t^h, \tag{21}$$

where k_3 is a constant term and λ is the share of financial wealth out of asset wealth A_t. I then proceed similarly to Nitschka (2010)'s decomposition of financial assets into domestic and foreign stock and let λ (an observed value) be time-varying. By substituting (21) into (17) and rearranging terms, we obtain the following relationship among consumption, financial wealth, housing wealth and income.

$$c_t - \pi a_t^h - \pi \lambda_t (a_t^f - a_t^h) - (1-\pi) y_t = E_t \sum_{j=1}^{\infty} (r_{t+j} - \Delta c_{t+j}) + \frac{k\rho}{1-\rho} + a + (1-\pi) z_t. \tag{22}$$

Figure 6: Decomposition of household wealth: Fractions of financial and housing wealth



However, in this approach, the coefficient on housing and on financial wealth, i.e., the elasticities π^f and π^h, must be the same, by definition. Thus, while it may conceptually be correct, it is not useful for our purpose.

Another – more empirical and ad hoc – way to estimate separate asset wealth effects is to simply replace asset wealth a_t in the cointegrating vector with its two components, financial wealth a_t^f and housing wealth a_t^h. Equation (17) would then change to

$$c_t - \pi^h a_t^h - \pi^f a_t^f - (1 - \pi^h - \pi^f) y_t = E_t \sum_{j=1}^{\infty} (r_{t+j} - \Delta c_{t+j}) + \frac{k\rho}{1-\rho} + a + (1-\pi) z_t, \quad (23)$$

allowing for separate coefficients on financial wealth (π^f) and housing wealth (π^h). However, this approach assumes that the shares of housing wealth and financial wealth in asset wealth are constant over time. Only if this is true will the coefficients lead to the correct MPCs out of financial wealth and housing wealth. As we see in Figure 6, this is not the case for Switzerland. While households held 43% of their asset wealth in financial assets in 1981, this fraction increased to 63% in 2000. In 2012, it stood at 56%.

4.3 A baseline estimation for the Swiss case

Depending on the sample period, the results of Schmid (2013) for wealth effects in Switzerland suggested an estimate of π of 0.422 (sample period 1981Q1–2009Q4) or 0.153 (sample period 1990Q1–2009Q4).[5] Given a consumption-to-asset wealth ratio of approximately

[5] The results are obtained by estimating a dynamic OLS equation of the form $c_t = \pi^a a_t + \pi^y y_t + \Delta a_{t-1:t-6} + \Delta y_{t-1:t-6} + \Delta a_{t+1:t+6} + \Delta y_{t+1:t+6}$.

Table 1: Cointegration tests for 1981Q1–2012Q4

	p-value
Engle-Granger (t-stat)	0.0047
Engle-Granger (z-stat)	0.0033
Phillips-Ouliaris (t-stat)	0.0060
Phillips-Ouliaris (z-stat)	0.0050
Johansen (2 lags, trace)	0.3063
Johansen (2 lags,L-max)	0.4514
Automatic SIC lag length selection for Engle-Granger	
Automatic SIC lag length selection for Phillips-Ouliaris	

0.13, the resulting MPC out of asset wealth would then be 5.9 Swiss centime (using the 1981–2009 estimate for π) or 2.1 Swiss centime (using the 1990–2009 estimate for π). Focusing on the short-run responses of consumption, wealth and income to a disequilibrium in the cointegrating relationship, Schmid found that it is mainly wealth that drives the cay residual back to equilibrium. However, consumption also has error-correction properties, though small.

The remainder of this section and section 5 present updated and more extensive estimation results on wealth effects for Switzerland based on the cointegration approach. First, a baseline estimation is set up where the calculations are performed for the entire sample, 1981Q1 to 2012Q4, using one particular estimation technique. In section 5, I go beyond this and check for robustness of the results over different methods and time periods. In both sections, individual unit root tests on the relevant time series and cointegration tests are performed first. Then, the cointegrating vector and long-run MPCs are calculated before the short-run dynamics are investigated.

For the entire sample, standard unit root tests cannot reject the null hypothesis of consumption, wealth and income all individually having a unit root. Because they are thus all at least integrated of order 1, there can be at least one cointegrating relationship, i.e., the variables can share a common trend.

To test for cointegration among the three variables, cointegration tests using different approaches are performed. The results, shown in Table 1, are mixed. While residual-based tests reject the hypothesis of no cointegration, the results from the Johansen tests suggest that no cointegrating relationship is present. For baseline estimation purposes, I continue assuming that a cointegrating relationship among consumption, wealth and income exists.

Estimating the cointegrating vector

Several methods can be used to estimate a cointegrating vector. For the baseline estimation, I will focus on dynamic OLS (DOLS), as presented in Stock and Watson (1993). To obtain an estimate on the cointegrating vector by DOLS, I estimate the following equation by ordinary least squares

$$c_t = \alpha + \pi^a a_t + \pi^y y_t + \sum_{k=-K}^{K} [\beta^{ka} \Delta a_{t+k} + \beta^{ky} \Delta y_{t+k}] + v_t^{DOLS}, \tag{24}$$

where the long-run equation is augmented by K leads, K lags and the contemporaneous element of the changes in wealth and income in order to soak up short-run dynamics.

For baseline estimation purposes, I estimate the cointegrating vector using $K = 4$. The sensitivity of the results to this choice will be discussed in section 5. The baseline estimation results in the following cointegrating relationship:

$$c = \underset{(0.16)}{-1.98} + \underset{(0.03)}{0.06}\,a + \underset{(0.04)}{0.56}\,y \tag{25}$$

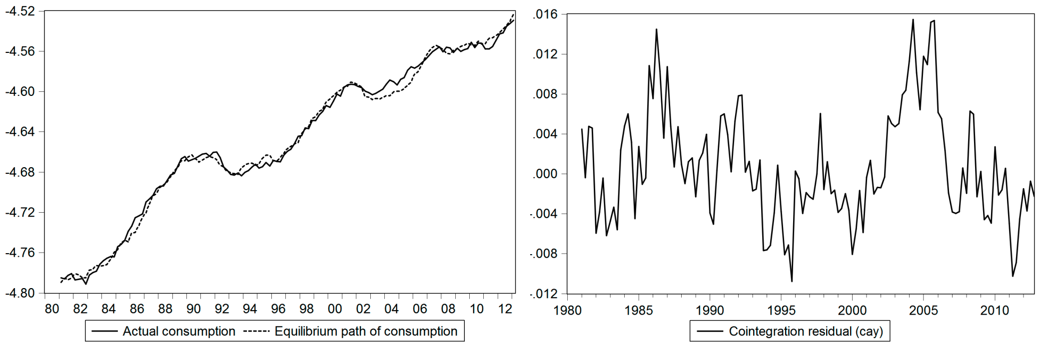
HAC standard errors are shown in parentheses. With a p-value of 0.067, the coefficient on wealth is significant at the 10%, but not the 5% level.

Regarding the MPC out of asset wealth, the baseline coefficient on wealth implies an estimate of only approximately 0.8 Swiss centime through applying transformation (20) based on an average consumption-to-asset wealth ratio of 0.1369 for the full sample period. This would mean that increases in wealth hardly have a long-run effect on consumption.

It is notable that the sum of the coefficients on wealth and income are quite far from summing up to unity as should roughly be the case conventionally. A possible reason for this could be that certain consumption expenditures are not captured in the national accounts data. Another possible reason is that people leave wealth to their descendants, and thus, their lifetime consumption does not equal the sum of income and wealth.

Given the baseline cointegrating vector, the estimated long-run equilibrium path of consumption compared to actual consumption and the related cointegrating residual cay are shown in Figure 7. It is obvious that most of the time, consumption fluctuated only temporarily around the equilibrium implied by the cointegrating relationship. The only period where deviations where somewhat more long lasting and larger was in the first part of 2000. From 2000 to 2002, wealth decreased significantly due to the dot-com stock

Figure 7: Equilibrium consumption and cay residual from the baseline estimation



The left panel shows the actual level of consumption (solid line) and the cointegration-implied equilibrium level of consumption (dashed line) implied by the baseline cointegrating vector, both in real per capita terms. The right panel shows the corresponsive cointegrating residual, cay.

market crash. Disposable income also dropped. Consumption, however, reacted only modestly and overshot relative to its equilibrium level. Driven by the looser monetary policy in the US, the stock markets and wealth started to pick up again, and disposable income grew very robustly, while consumption more or less continued growing at around average rates. Eventually, consumption was back at its equilibrium level in 2006.

However, because the cointegrating coefficient on wealth is fairly low in the baseline case, indicating that consumption hardly reacted to wealth changes over the estimation period, the cay residual mainly reflects developments in income and consumption, but not wealth.

This outcome of wealth effects on consumption being hardly present could be due to the developments in the 2000s, where Swiss private consumption hardly reacted to major changes in wealth. One reason for this lack of response in consumption could be that in this period, developments in the stock markets and wealth were mainly caused by external and not domestic events. In contrast, the wealth decrease in the early 1990s, to which consumption showed some response, was driven by the domestic housing crash. The influence of the 2000s on the results and the stability of the estimation to different methods and time spans will be discussed later, in section 5.

Estimating short-run responses

In a next step, short-run dynamics are estimated to answer the question of which variables respond to a deviation of the cay residual from its equilibrium. For this purpose, a VAR(2)

Table 2: Short-run responses to cay residual from VAR(2)

	Δc_t	Δa_t	Δy_t
Δc_{t-1}	-0.054	0.543	0.078
	(0.099)	(0.437)	(0.128)
Δc_{t-2}	0.036	0.279	0.328
	(0.088)	(0.390)	(0.114)
Δa_{t-1}	0.025	0.032	0.070
	(0.021)	(0.094)	(0.027)
Δa_{t-2}	0.061	0.018	0.042
	(0.022)	(0.095)	(0.028)
Δy_{t-1}	0.222	0.261	0.188
	(0.067)	(0.298)	(0.087)
Δy_{t-2}	0.052	-0.214	0.120
	(0.069)	(0.305)	(0.089)
cay_{t-1}	-0.096	0.088	0.218
	(0.062)	(0.272)	(0.080)
constant	0.001	0.003	0.001
	(0.000)	(0.002)	(0.000)
R^2	0.30	0.05	0.37

of the form

$$\begin{bmatrix}\Delta c_t\\ \Delta a_t\\ \Delta y_t\end{bmatrix} = \begin{bmatrix}\mu^c\\ \mu^a\\ \mu^y\end{bmatrix} + \mathbf{B}(L)\begin{bmatrix}\Delta c_t\\ \Delta a_t\\ \Delta y_t\end{bmatrix} + \begin{bmatrix}\gamma^c\\ \gamma^a\\ \gamma^y\end{bmatrix} cay_{t-1} + v_t, . \tag{26}$$

is run. $B(L)$ is a matrix polynomial that represents short-run comovement of the variables (common cycles). $[\mu^c\ \mu^a\ \mu^y]'$ are constant terms. The responses of consumption, wealth and income to the cay residual are then given by the coefficient vector $[\gamma^c\ \gamma^a\ \gamma^y]'$. The cay residual is computed according to the baseline cointegrating vector.

To select the order of the VAR, I estimate VARs of different lag lengths and then select the model with the smallest AIC. In this case, the best model is that with a lag length of 1. However, because the residuals of this model still show patterns of autocorrelation, I decide to add a second lag and work with a VAR(2).

For the baseline case, the results in Table 2 suggest that it is solely income that drives the cay residual back to its equilibrium. In forecasting terms, this would mean that the cay residual potentially has predictive power for future income growth.

Separating wealth effects

In a next step, I split wealth into financial wealth, a^f, and net housing wealth, a^h, to investigate a possible difference in the effects from the two wealth components on consumption. Thus, motivated by equation (23), the DOLS estimation equation changes to

$$c_t = \alpha + \pi^{a^f} a_t^f + \pi^{a^h} a_t^h + \pi^y y_t + \sum_{k=-K}^{K} [\beta^{ka^f} \Delta a_{t+k}^f + \beta^{ka^h} \Delta a_{t+k}^h + \beta^{ky} \Delta y_{t+k}] + v_t^{DOLS}, \quad (27)$$

where the long-run equation is augmented by K leads, K lags and the contemporaneous element of the changes in financial wealth, housing wealth and income in order to soak up short-run dynamics.

For the baseline case, this results in the following estimates:

$$c = \underset{(0.03)}{-2.11} - \underset{(0.07)}{0.03} a^f + \underset{(0.02)}{0.00} a^h + \underset{(0.15)}{0.70} y \quad (28)$$

Compared to the results for aggregate wealth, wealth effects have now disappeared completely at all common significance levels.

Looking at the short-run responses, only income responds to a disequilibrium in the cointegrating relationship, as was already the case in the estimations based on aggregated wealth.[6]

Given the result of hardly any wealth effects in the baseline case is not very intuitive, I dig deeper, and in section 5, I conduct several robustness checks to see if these results are robust across different estimation techniques and if they are driven by the more recent period where major changes in wealth did not cause reactions in consumer spending.

5 Robustness checks using different methods and time spans

To check for robustness of the results across different estimation methods, I introduce two alternative approaches that allow estimation of the cointegrating vectors: Full information Maximum Likelihood (FIML) from Johansen (1988) and the Phillips-Loretan method (PL) from Phillips and Loretan (1991).

With Johansen's FIML method, I estimate a vector error-correction model (VECM)

[6] Detailed results are not shown but are available upon request.

of the form

$$\begin{bmatrix}\Delta c_t\\ \Delta a_t\\ \Delta y_t\end{bmatrix} = \underbrace{\begin{bmatrix}\mu^c\\ \mu^a\\ \mu^y\end{bmatrix}}_{\mu} + \mathbf{B}(L)\begin{bmatrix}\Delta c_t\\ \Delta a_t\\ \Delta y_t\end{bmatrix} + \underbrace{\begin{bmatrix}\gamma^c\\ \gamma^a\\ \gamma^y\end{bmatrix}}_{\gamma}\begin{bmatrix}c_{t-1}\\ a_{t-1}\\ y_{t-1}\\ 1\end{bmatrix}'\begin{bmatrix}1\\ -\pi^a\\ -\pi^y\\ -\alpha\end{bmatrix} + v_t^{FIML}, \tag{29}$$

by maximum likelihood to obtain an estimate on the cointegrating vector $\Pi = [-\pi^a, -\pi^y, -\alpha]'$ and the corresponding long-run MPC out of asset wealth. $B(L)$ is a matrix polynomial that represents short-run comovement of the variables (common cycles), μ and α are constant terms, γ are the adjustment coefficients and v is an error term. To select the order of the VECM, L, I first follow Vahid and Engle (1993) and estimate level VARs of different lag lengths and then select the model with the smallest AIC. In my case, this best model is related to a lag length of 2. This would imply an order of $L = 1$ for the VECM, because the VECM is run in first-difference form. However, to account for the fact that in the case of $L = 1$ the errors are still autocorrelated, I decide on working with $L = 2$.

The second alternative, PL, estimates the following equation by non-linear least squares:

$$\begin{aligned} c_t =& \alpha + \pi^a a_t + \pi^y y_t + \sum_{i=1}^{S}\gamma^s(c_{t-s} - \alpha - \pi^a a_{t-s} - \pi^y y_{t-s}) \\ &+ \sum_{k=-K}^{K}[\beta^{ka}\Delta a_{t+k} + \beta^{ky}\Delta y_{t+k}]\beta^{yk}\Delta y_{t+k}] + v_t^{PL} \end{aligned} \tag{30}$$

Compared to dynamic OLS, the estimation equation is augmented by S lags of the cointegrating residual. As shown in Phillips and Loretan (1991), this results in more-precise coefficient estimates and better t-ratios in small samples. In what follows, the cointegrating vector is re-estimated using alternative specifications and cointegration methods. As a first method, I use (a) FIML with two lags. Furthermore, to test the robustness of the DOLS results to the choice of the number of leads and lags, K, I apply DOLS with (b) one and (c) eight leads and lags instead of four in the baseline case. Finally, I also use (d) the PL method with four leads and lags plus one lag of the cointegrating residual (i.e., I augment the baseline DOLS estimation by the lagged cointegrating residual).[7]

[7] More than one lag of the cointegrating residual could be included in the PL method. However, higher orders of lags turn out to be insignificant at all common significance levels.

Table 3: Estimation of the cointegrating vector: Different methods

		FIML	DOLS(1)	DOLS(4)	DOLS(8)	PL
1981Q1–2012Q4	Wealth	−0.07	0.08	0.06	0.09	0.07
		(0.06)	(0.03)	(0.03)	(0.05)	(0.04)
	Income	0.73	0.54	0.56	0.53	0.55
		(0.08)	(0.04)	(0.04)	(0.06)	(0.06)
	Intercept	−1.34	−2.05	−1.98	−2.08	−2.04
			(0.13)	(0.16)	(0.20)	(0.20)

Standard errors in parentheses
HAC standard errors used for DOLS

The estimation results using the different estimation techniques for the entire sample, 1981Q1 to 2012Q4, are shown in Table 3. While all least squares based-estimates roughly result in similar cointegrating vectors for the full sample, FIML shifts the coefficients slightly from wealth toward income. However, all results have in common that wealth effects hardly seem to be present because the coefficients on wealth are either comparatively small or not significant.

As mentioned in section 4.3, apart from the econometric technique, the estimation sample can also have a potentially large impact on the estimation results. In our case, e.g., as seen in section 3, the link among consumption and wealth seems to be much looser from 2000 on than in the period before. This could make the estimation results of the cointegrating vector very unstable. To test the influence of the more recent period on the overall results, I formally specify the potential break point first. Following Kurozumi (2002) and Bai (1994), this is done by computing sequences of the sum of squared residuals from dynamic OLS regressions with alternative break dates k . The estimated break point T_b then results from the minimization problem

$$T_b = \arg\min_k \left(\sum_{t=1}^{k} \tilde{e}_t^2 + \sum_{t=k+1}^{T} \hat{e}_t^2 \right) = \arg\min_k \sum_{t=1}^{T} [SSR(k)], \tag{31}$$

where $\tilde{e}_t$ are the DOLS residuals when estimating the cointegrating vector using the sample from 1981Q1 to k, and $\hat{e}_t$ the DOLS residuals using the sample from $k+1$ to 2012Q4. Depending on the number of leads and lags in the DOLS specification, the break point test indicates that the potential break point in the cointegrating vector lies around 2002/3. It has to be noted that by applying this break point estimation setup, I explicitly assume the existence of only one break point. However, there could be even more break points, causing the estimation of the cointegrating vector to be even more difficult. To test for the

Table 4: Cointegration tests, p-values

	1981Q1–2001Q4	2002Q1–2012Q4
Engle-Granger (t-stat)	0.0011	0.1270
Engle-Granger (z-stat)	0.0007	0.1502
Phillips-Ouliaris (t-stat)	0.0009	0.1047
Phillips-Ouliaris (z-stat)	0.0005	0.1192
Johansen (2 lags, trace)	0.0323	0.1304
Johansen (2 lags,L-max)	0.1927	0.1110

Automatic SIC lag length selection for Engle-Granger
Automatic SIC lag length selection for Oullips-Ouliaris

existence of multiple break points, one could apply the dynamic optimization algorithm in Bai and Perron (1998, 2003).

A specific test for the existence of a cointegrating relationship in the presence of a structural break can be found in Carrion-I-Silvestre and Sanso (2006). It was applied, e.g., in Haug, Beyer, and Dewald (2011) to the Fisher effect. However, given the limited number of observations for the time span after our estimated break point, applying this test makes no sense in our case.

Robustness results for cointegration tests and the cointegrating vector

To account for the potential break around 2002/3, the sample is split into two parts, and all cointegration tests and calculations are redone separately for 1981Q1 to 2001Q4 and for 2002Q1 to 2012Q4.[8] The cointegration tests for these two separate time spans, shown in columns 2 and 3 of Table 4, suggest that the cointegrating relationship among consumption, wealth and income was quite stable over the first part of the sample. Only the L-max test of the Johansen procedure is found not to reject the null hypothesis of no cointegration, but this could also be due to a small sample problem, as Zhou (2000) showed that the Johansen cointegration test rejects the null hypothesis of no cointegration too often in small samples. Things change for the second part of the sample, where no cointegration tests are able to reject the null of no cointegration at any common significance levels.

The results for the estimated cointegrating vector across the different time periods and across different estimation methods (under the assumption that cointegration is

[8]Given the limited number of observations in the second sample, an alternative to test the influence of the more recent period on the overall results would be to split the sample in exactly two halves (1981Q1 to 1996Q4, 1997Q1 to 2012Q4). However, because the general results, shown in the remainder of this section, hold for both alternatives, I continue along the lines of the break point test.

Table 5: Estimation of the cointegrating vector: Different time spans

		FIML	DOLS(1)	DOLS(4)	DOLS(8)	PL
1981Q1–2012Q4	Wealth	−0.07	0.08	0.06	0.09	0.07
		(0.06)	(0.03)	(0.03)	(0.05)	(0.04)
	Income	0.73	0.54	0.56	0.53	0.55
		(0.08)	(0.04)	(0.04)	(0.06)	(0.06)
	Intercept	−1.34	−2.05	−1.98	−2.08	−2.04
			(0.13)	(0.16)	(0.20)	(0.20)
1981Q1–2001Q4	Wealth	0.26	0.14	0.17	0.34	0.14
		(0.05)	(0.02)	(0.04)	(0.04)	(0.06)
	Income	0.34	0.47	0.44	0.27	0.46
		(0.05)	(0.02)	(0.04)	(0.04)	(0.06)
	Intercept	−2.74	−2.32	−2.41	−2.94	−2.33
			(0.09)	(0.14)	(0.14)	(0.19)
2002Q1–2012Q4	Wealth	−0.04	0.13	0.03	0.04	0.08
		(0.06)	(0.03)	(0.07)	(0.27)	(0.12)
	Income	0.63	0.27	0.50	0.48	0.39
		(0.13)	(0.06)	(0.15)	(0.50)	(0.25)
	Intercept	−1.78	−3.19	−2.30	−2.40	−2.71
			(0.26)	(0.58)	(1.94)	(0.99)

Standard errors in parentheses
HAC standard errors used for DOLS

present over all time spans) are shown in Table 5. For the first part of the sample, 1981–2001, the estimates are comparatively stable, although some differences across methods are already visible. The results are also in line with those for other countries: wealth effects are present, and the coefficient on wealth is between 0.14 and 0.34, while that on income is between 0.27 and 0.47, depending on the method.

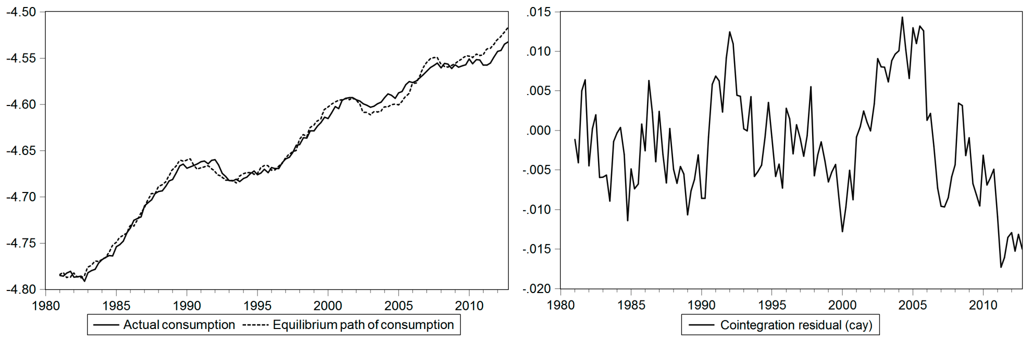
However, when estimating over the entire sample, i.e., including the 2002–2012 period (baseline case), all estimation methods indicate either very small or non-significant wealth effects. The coefficient on income, on the other hand, becomes larger.

When considering only the second part of the sample, 2002–2012, the differences between the two parts of the sample become obvious. The estimates are quite different from those for the first part of the sample and the results diverge more substantially across the different estimation methods. Except for DOLS(1), the coefficient on wealth is not significantly different from zero for any of the common significance levels for any method. The coefficient on income has increased for FIML, DOLS(4) and DOLS(8) but has decreased for DOLS(1) and PL. For DOLS(8) and the PL method, neither the coefficient on wealth nor the coefficient on income is significant, which may be related to small sample issues. Overall, because the cointegration tests indicate that for the second part of the sample the cointegrating relationship among consumption, wealth and income has vanished, these results may not be surprising, and they indicate that the results for the entire sample are largely driven by the second part of the sample.

Applying the stable pre-2002 results to the more recent period

In the results for the more recent period, no cointegrating relationship and no wealth effects seem to be present. Nevertheless, one could hypothetically argue that both the failure of the cointegration approaches to find a stable cointegrating relationship in the second part of the sample and the non-response of consumption to changes in wealth in the 2000s are merely due to longer-lasting deviations of the cointegration residual from its equilibrium, so that the stable estimates for 1981–2001 would still apply to the time after. Under this assumption, the equilibrium level of consumption compared to its actual level and the related cay residual would look as shown in Figure 8.

Figure 8: The cay residual based on the 1981–2001 cointegrating vector



Shown is the cointegration residual based on the cointegrating vector resulting from a DOLS(4) estimation over the time span 1981Q1 to 2001Q4.

These charts illustrate the differences between the 1981–2000 period and the remaining part nicely. In the first 20 years of the sample, consumption deviated only temporarily from its equilibrium level, so that the cay residual usually reverted quite quickly to zero. This was even the case when a major shock hit the Swiss economy. At the beginning of the 1990s, the collapse of the Swiss housing bubble led to a decrease in wealth and income. However, because consumption reacted almost immediately to these developments, the residual remained more or less around zero. The same behavior was present when the economy recovered, so that wealth and income caught up again: consumption accelerated as well, and the cay residual remained roughly in equilibrium.

After 2000, however, deviations in the cay residual from its equilibrium level would have become much more persistent and much larger. For the first time, this was the case

Table 6: MPC out of asset wealth

	Cointegration coefficient on asset wealth			
	0.10	0.20	0.30	0.40
1981Q1–2012Q4 c-a ratio: 0.137	0.014	0.027	0.041	0.055
1981Q1–2001Q4 c-a ratio: 0.143	0.014	0.029	0.043	0.057
2002Q1–2012Q4 c-a ratio: 0.126	0.013	0.025	0.038	0.050

at the beginning of the 2000s, as already mentioned in section 4.3: wealth decreased significantly due to the dot-com crash, and disposable income dropped. Consumption, however, reacted only modestly and would have overshot relative to its equilibrium level. Driven by the looser monetary policy in the US, stock markets and wealth then started to pick up again in the mid 2000s. Disposable income grew more robustly, while consumption more or less continued growing only at around average rates. Accordingly, the equilibrium would have been restored in 2005, before consumption would have even undershot somewhat, given that wealth increased further. In 2008/2009, the financial crises led to a relapse in financial wealth so that consumption would have been back at the fundamental level implied by the cointegrating relationship.

However, a new persistent disequilibrium would have opened in the more recent past, driven by the strong increase in wealth due to both uptrends in stock markets and rising housing prices in Switzerland, which were not accompanied by a reaction in consumption. During the most recent period, the cay residual would have fallen to a record low, indicating that the level of consumption is much too low relative to the level of wealth and income. Thus, to restore equilibrium, a huge drop of approximately 10% in per capita wealth or many years of very strong per capita consumption growth would be necessary. However, all of this only applies if wealth effects are still present in the same way as they were until 2001.

Implications for marginal propensities to consume

To gain a sense of the general implications of the resulting cointegration coefficient estimates on the MPC out of asset wealth, Table 6 presents some sensitivity results, applying transformation (20).

Table 7: Short-run dynamics: Response to disequilibrium from VAR(2)

		FIML	DOLS(1)	DOLS(4)	DOLS(8)	PL
1981Q1–2012Q4	Consumption	0.008	−0.110	−0.096	−0.096	−0.108
		(0.046)	(0.062)	(0.062)	(0.059)	(0.062)
	Wealth	0.028	0.088	0.088	0.116	0.085
		(0.200)	(0.273)	(0.272)	(0.260)	(0.273)
	Income	0.203	0.198	0.218	0.187	0.201
		(0.057)	(0.080)	(0.080)	(0.077)	(0.080)
1981Q1–2001Q4	Consumption	−0.273	−0.339	−0.350	−0.158	−0.343
		(0.074)	(0.108)	(0.102)	(0.052)	(0.107)
	Wealth	0.294	−0.015	0.174	0.347	0.005
		(0.357)	(0.509)	(0.484)	(0.242)	(0.507)
	Income	−0.031	0.236	0.154	−0.061	0.227
		(0.109)	(0.152)	(0.146)	(0.074)	(0.152)
2002Q1–2012Q4	Consumption	−0.102	−0.295	−0.178	−0.189	−0.239
		(0.137)	(0.156)	(0.151)	(0.152)	(0.156)
	Wealth	0.010	0.130	0.070	0.084	0.112
		(0.573)	(0.681)	(0.641)	(0.644)	(0.671)
	Income	0.590	0.519	0.627	0.614	0.598
		(0.145)	(0.190)	(0.166)	(0.169)	(0.180)

Reported are the VAR coefficients on the lagged cointegration residual
Standard errors in parentheses

Given a coefficient on wealth of approximately 0.2-0.3 for the stable sample of 1981–2001, the corresponding MPC out of asset wealth is between 2.5 and 4.3 Swiss centime, depending on the underlying consumption-to-asset wealth ratio (which became smaller over time). This is a reasonable estimate for the first part of the sample. For the more recent period, things are much less clear because most of the cointegrating vector estimates suggest that consumption no longer reacts to wealth in the long-run.

Robustness results for short-run responses

As a next step, we look at the short-run responses across the different estimation methods and time spans. The results in Table 7 suggest that in the first part of the sample, 1981 to 2001, it was solely consumption that drove the cay residual back to its equilibrium. Thus, if the level of consumption was too low given the level of wealth and income, one could usually have expected consumption to catch up. Therefore, the cay residual had predictive power for future consumption growth. This is in contrast to the results from for other countries, were it was usually wealth, or sometimes income, that responded to deviations in the cay residual. Furthermore, this also contradicts the existing results for Switzerland in Schmid (2013), where it was mainly wealth that showed responsiveness.

For the more recent period, however, all estimation methods suggest that it is solely income that responds to deviations from equilibrium. This is also the case when estimating over the entire sample. In forecasting terms, this would mean that the cay residual potentially has predictive power for future income growth.[9]

Robustness results for separate wealth effects

In a next step, I also check for robustness of the results in the case of splitting up wealth into financial wealth and net housing wealth. As Table 8 shows, the results are very mixed and sometimes difficult to interpret. For the more stable first part of the sample, 1981–2001, DOLS(1) and DOLS(4) indicate cointegration coefficients on financial wealth that are roughly double the size as that on housing wealth. However, because the consumption-to-financial wealth ratio is only approximately half of the consumption-to-housing wealth ratio over that time period, the resulting MPCs out of the two wealth components would be roughly the same: approximately 2 Swiss centime each. Looking at other methods, DOLS(8) sees much higher wealth effects, which mostly come from the financial wealth side. The same finding was already present for aggregate asset wealth. However, given that this method attributes a negative MPC to income, the results are dubious. The caveat in terms of reliability of the result applies to FIML (very negative wealth effects) and the PL method (no significant results at all).

When extending the period to 1981–2012, wealth effects disappear (DOLS(1), DOLS(4)) or become negative (FIML and DOLS(8)). PL, again, results in non-significant results.

For the more recent half of the sample, the results have to be treated with caution given the limited number of observations and the increased number of coefficients to be estimated, but they generally confirm the findings for the aggregate case: wealth effects no longer seem to be present. However, because the cointegration tests indicated that for the second part of the sample the cointegrating relationship among consumption, wealth and income has vanished, these results are not surprising.

One reason for the lowering in goodness of the results when splitting wealth into its two components could be that we need a constant ratio of financial wealth to housing wealth over time to adequately estimate separate wealth effects within this setup. However, as discussed in section 4.2, this is not the case for Switzerland. While households held 43% of their asset side in financial assets in 1981, this fraction increased to 63% in 2000.

[9] However, because for this period the cointegration coefficient on wealth is very close to zero, it is basically only the bivariate relationship between consumption and income alone that is responsible for this predictive power for future income growth.

Table 8: Estimation of the cointegrating vector: Separate wealth

		FIML	DOLS(1)	DOLS(4)	DOLS(8)	PL
1981Q1–2012Q4	Financial wealth	−0.87	0.05	−0.03	−0.18	0.07
		(0.17)	(0.03)	(0.07)	(0.07)	(0.13)
	Housing wealth	−0.22	0.02	0.00	−0.05	0.02
		(0.05)	(0.01)	(0.02)	(0.02)	(0.04)
	Income	2.57	0.52	0.70	0.99	0.47
		(0.36)	(0.07)	(0.15)	(0.14)	(0.29)
	Intercept	5.23	−2.11	−1.49	−0.54	−2.31
			(0.26)	(0.51)	(0.49)	(1.04)
1981Q1–2001Q4	Financial wealth	−2.13	0.09	0.14	0.43	0.09
		(0.46)	(0.03)	(0.05)	(0.18)	(0.12)
	Housing wealth	−0.52	0.05	0.06	0.14	0.04
		(0.16)	(0.01)	(0.02)	(0.06)	(0.04)
	Income	5.47	0.44	0.35	−0.34	0.43
		(1.01)	(0.06)	(0.12)	(0.38)	(0.27)
	Intercept	15.76	−2.33	−2.69	−5.15	−2.44
			(0.23)	(0.42)	(1.33)	(0.97)
2002Q1–2012Q4	Financial wealth	−1.34	0.11	−0.01		0.02
		(0.34)	(0.04)	(0.10)		(0.15)
	Housing wealth	0.08	0.04	0.05		0.05
		(0.13)	(0.01)	(0.03)		(0.03)
	Income	1.09	0.24	0.36		0.34
		(0.85)	(0.08)	(0.13)		(0.21)
	Intercept	−1.35	−3.23	−2.84		−2.89
			(0.30)	(0.53)		(0.78)

Standard errors in parentheses
HAC standard errors used for DOLS

In 2012, it stood at 56%.

As a last step, I also look at the short-run responses when using separate wealth measures, although I take into account the limited information content of the results due to the problems related to the estimation of the cointegrating vector when splitting up wealth. Overall, however, the results, shown in Table 9, are very similar to the aggregate wealth case. For the period 1981–2001, all methods except FIML indicate that consumption alone reacted to deviations in the cay residual from its equilibrium and showed error-correction properties. For the more recent period, most of the methods see income as the variable that responds to deviations in the cay residual.

For the full sample, all methods attribute error-correction properties to income. Furthermore, DOLS(8) suggests that housing wealth also drives the cay residual back into equilibrium. FIML, on the other hand, indicates that consumption also responds to disequilibria, although with an incorrect, i.e., negative, sign. This would mean that a negative residual (where consumption is too low given the level of the other relevant

Table 9: Short-run dynamics with separate wealth: Response to disequilibrium from VAR(2)

		FIML	DOLS(1)	DOLS(4)	DOLS(8)	PL
1981Q1–2012Q4	Consumption	0.037	−0.110	−0.027	0.031	−0.128
		(0.012)	(0.059)	(0.057)	(0.038)	(0.056)
	Financial wealth	0.023	−0.004	−0.042	−0.165	−0.116
		(0.066)	(0.323)	(0.308)	(0.203)	(0.308)
	Housing wealth	0.076	0.311	0.490	0.492	0.346
		(0.082)	(0.400)	(0.380)	(0.248)	(0.382)
	Income	0.069	0.153	0.245	0.164	0.095
		(0.015)	(0.078)	(0.072)	(0.047)	(0.075)
1981Q1–2001Q4	Consumption	0.017	−0.323	−0.365	−0.124	−0.291
		(0.006)	(0.112)	(0.098)	(0.034)	(0.103)
	Financial wealth	0.050	−0.119	−0.463	−0.311	−0.710
		(0.034)	(0.647)	(0.584)	(0.196)	(0.588)
	Housing wealth	0.041	0.354	−0.035	−0.226	−0.211
		(0.041)	(0.761)	(0.691)	(0.234)	(0.699)
	Income	0.029	0.266	0.070	−0.116	0.216
		(0.008)	(0.154)	(0.143)	(0.047)	(0.142)
2002Q1–2012Q4	Consumption	−0.018	−0.293	−0.255		−0.256
		(0.019)	(0.161)	(0.130)		(0.134)
	Financial wealth	−0.247	0.646	−0.426		−0.202
		(0.072)	(0.736)	(0.600)		(0.621)
	Housing wealth	0.154	−0.667	−0.691		−0.868
		(0.104)	(0.952)	(0.770)		(0.787)
	Income	0.010	0.466	0.425		0.441
		(0.023)	(0.191)	(0.152)		(0.156)

Reported are the VAR coefficients on the lagged cointegration residual
Standard errors in parentheses

cointegration variables) would lead to a deceleration in consumption growth, so that the residual becomes even more negative.

6 Fragility issues of the classical cointegration approach

The results of the robustness checks in the previous section confirm that while the cointegrating relationship among consumption, wealth and income was quite stable in the first part of the sample, 1981–2001, it became quite weak and unstable in the 2000s. This could be due to either a breakdown in the cointegrating relationship or to changes in the cointegrating vector. Overall, this makes a potential cointegrating vector and the responses to a disequilibrium much more difficult to estimate.

What can cause such instabilities in the theory-based cointegrating relationship among consumption, wealth and income? To find (theoretical, empirical and econometrical) answers to this question, we should revisit the motivation of the cointegrating relationship among consumption, wealth and income. As emphasized before, the theoretical foundation of the existence of a stable cointegrating relationship – which is key for the econometric framework used so far – largely depends on the variables of equation (9) and their time-series properties.

Generally, there are already reasons to question the existence of a theoretically stable consumption-to-wealth ratio. This point will be discussed in section 6.1. The remaining sections demonstrate that even if this theoretical assumption is maintained, there are circumstances that can lead to a (approximate) consumption-to-wealth ratio that is empirically unstable over time. Furthermore, there are problems that can arise in estimation.

6.1 Stationarity assumptions and heterogeneity aspects

A first fragility issue in terms of theoretical stability concerns the *stationarity assumptions.* A theoretically stable relationship between consumption and wealth relies strongly on the stationarity assumptions on the two variables of the right hand side of equation (9), the return on aggregate wealth and consumption growth, and, in particular, the expectations regarding them. Expectations on returns are especially key in the theoretical framework. As seen in equation (11), under a standard behavioral restriction on household behavior, the stationarity of the cay residual solely depends on the stationarity of expectations on future returns on aggregate wealth.

Returns on aggregate wealth can be decomposed into its two components, returns on asset wealth and returns on human capital wealth, as follows:

$$(1+R_t) = \frac{A_t}{W_t}(1+R_{A,T}) + \frac{H}{W}(1+R_{H,T}) = \pi(1+R_{A,T}) + (1-\pi)(1+R_{H,T}), \qquad (32)$$

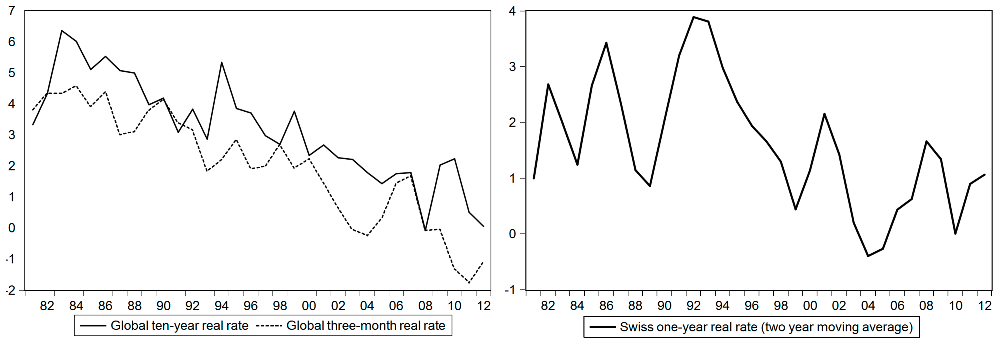
where R_A is the aggregate return on assets and R_H is the return on human capital. As shown in Campbell (1996) this can be rewritten in terms of log returns by noting that $r_{a,t} \approx R_{A,t} - 1$ and $r_{h,t} \approx R_{H,t} - 1$ and linearizing around the steady state ratio π, so that

$$r_t \approx \pi r_{a,t} + (1-\pi) r_{h,t}, \qquad (33)$$

ignoring the linearization constant.

As discussed earlier, for the whole framework to hold, r_t must be stationary, and the shares of asset wealth and of human capital wealth out of total wealth, i.e., π and

Figure 9: Global and Swiss real interest rates, 1981–2012



Left panel: Shown are the average global, GDP-weighted ten-year (solid line) and three-month (dashed line) interest rates, adjusted for inflation. Source: IMF World Economic Outlook, April 2014. Right panel: Ex post CPI-adjusted 12-month Eurofranken Libor.

$(1-\pi)$, are assumed to be constant. This automatically implies that the return on both asset wealth and human capital wealth (and thus, the expectations on both of them) must also be stationary for the cay residual to be stationary and the framework to hold.

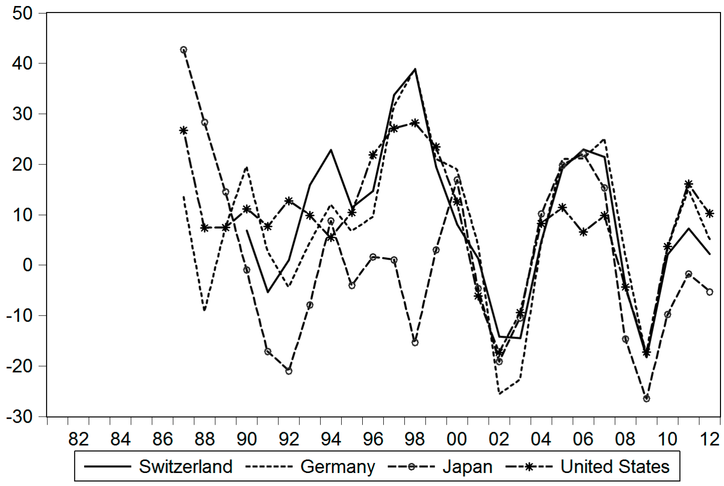
Because the question on the stationarity of returns on human capital is more difficult to address, I focus on returns on asset wealth. These consist of many different types of returns, such as interest rates, capital gains, pension return schemes or returns from housing investment. The question of a permanent lowering in returns of some investment types is currently a much-debated issue.

The phenomenon of a downward trend in inflation-adjusted interest rates was recently discussed in the IMF's World Economic Outlook (April 2014). Furthermore, even for countries or bond types where real returns remained more stable in the (very) long-run than globally, the recent period of low interest rates has shown that deviations from the long-run equilibrium can become very persistent and long-lasting. As an illustrated example, the left panel of Figure 9 shows the average global (GDP-weighted) ten-year and three-month interest rates in real terms (adjusted for inflation), which both have a clear downward trend since 1980.

In terms of real interest rates, the Swiss case shows similarities to the global decline in real rates. However, as shown in the right panel of Figure 9, Swiss real interest rates seem to have experienced a level shift in the late 1990s rather than a gradual downward trend.

A second return component, real stock market returns, is shown for selected countries in Figure 10. The stationarity properties of this return category are more difficult to assess due to the number of shocks in the 2000s. Although looking quite stationary over-

Figure 10: International and Swiss real stock returns



Shown are two-year moving averages of CPI-adjusted stock market returns, based on return indices for the SPI (Switzerland), S&P500 (US), DAX30 (Germany) and TOPIX (Japan).

all, real returns were somewhat lower on average after 2000 than in the period before for all countries except Japan. Furthermore, in an environment where a permanent lowering in growth expectations is discussed, expectations on stock market returns could also be expected to be permanently lower.

A third asset component affecting aggregate returns is pension schemes. These are affected by both stock market returns and real interest rates as well as by demographics. In the presence of a lowering in the latter and, at best, stabilized stock market returns, profits of pension schemes are expected to have fallen as well, especially in light of diversification restrictions.

On the non-financial asset side, returns on real estate assets are the main element that affect aggregate returns on asset wealth. On the one hand, gross initial rates of return on real estate investments have fallen since 2000 in Switzerland, roughly parallel to long-term interest rates. On the other hand, the increase in housing prices since the mid-2000s has led to increased performance of real estate funds and real estate property that is held for speculation reasons. Therefore, due to these opposing effects and the lack of availability of relevant data, the overall development in returns on real estate assets remains unclear.[10]

[10] A possibility would be to look at the user cost of capital (UCC) related to investing in housing. However, the link between the UCC, which is mostly driven by developments in interest rates and house prices) and the actual returns seems to be rather weak in Switzerland. In theory, one would expect returns, i.e., rents, to decrease (increase) in periods where UCC is low (high) due to arbitrage pressure coming from cheaper homeownership. Empirically, however, opposite patterns are present in Switzerland. Browne, Conefrey, and Kennedy (2013) found similar results for Ireland.

To conclude, even after looking at the major return components, it remains an open question how all the developments in returns on different asset types have affected the aggregate return on asset wealth and, in particular, their related expectations. Depending on the evolution of returns of different assets types, households usually try to shift their portfolio away from (toward) wealth components on which returns expectations go down (up). Therefore, even in the case where returns on some wealth components may not be stationary and may diverge, expected returns on asset wealth may remain stationary as long as households optimize their portfolio in an adequate way. This asset portfolio reallocation could, however, lead to changes in the aggregate MPC out of asset wealth, which results in an unstable cointegrating vector. This will be discussed in section 6.3.

Overall, given that some return components have lowered over time (and none of them seem to have risen), we cannot rule out that expectations on returns on asset wealth have deceased, independently of how households have adjusted their portfolios. Ultimately, such a lowering in return expectations would also reflect generally lower growth expectations. In that case, the stationary implication for the cay residual no longer holds[11]. Furthermore, even if assuming that a lowering in return expectations has only arisen regarding financial assets, an expected portfolio readjustment of households toward housing assets would probably not fully compensate for this, given the credit constraints that some households face.

Apart from stationarity, a second fragility issue in terms of theoretical stability concerns *possible heterogeneity across households*, i.e., the question of the aggregate versus the individual perspective. The intertemporal budget constraint, the main relationship on which the motivation of a stable consumption-to-wealth ratio is based, may hold for each individual household, so that a stable consumption-to-wealth ratio per household may arise cross-sectionally (for Switzerland, see Galli and Rosenblatt-Wisch, 2016) and maybe even over time. Changes in the distribution of households, however, may lead to an aggregate consumption-to-wealth ratio that is unstable over time. The fact that individual and aggregate measures can evolve differently is also found in saving rate dynamics (although in the opposite way). Romer (2005) showed empirically that across households at a given point in time, the higher the level of income, the higher the saving rate. Within a country over time, however, aggregate consumption is more or less a stable fraction of aggregate

[11]To investigate the effect of developments in interest rates on the cointegrating vector, I tried to include interest rates as a control variable in the cointegrating vector. However, even in this case there appears to be no stable cointegration among consumption, wealth and income for the post-2002 period.

income. Hahn and Lee (2006) pointed out that changes in the degree of heterogeneity of households over time can lead to a deterministic trend in the aggregate consumption-to-wealth ratio and, thus, in the cay residual. The fact that a representative agent may behave differently than the median household was also brought up in Carroll (2000).

6.2 Empirical problems

Even when maintaining the theoretical concept of a stable consumption-wealth ratio over time, issues arise when it comes to empirics. For consumption, asset wealth and income, it is important to use an "accurate", i.e., intertemporal budget constraint-relevant, measure of the respective variables.

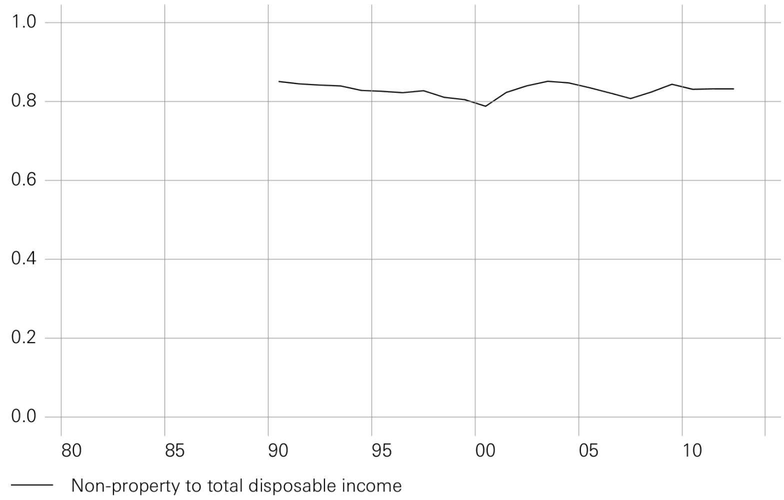
In terms of consumption, many possible measures have been used in the literature so far, such as total consumption, non-durable consumption and services or consumption excluding housing. Depending on the choice of consumption measure, the conclusions regarding a stable consumption-wealth ratio can be rather different. Rudd and Whelan (2006), e.g., criticized Ludvigson and Lettau for working with non-durable consumption instead of total consumption, and they showed that when using total consumption, no cointegrating relationship among consumption, labor income and wealth is present in U.S. data.

Regarding wealth, the main questions are the following: Must human-capital wealth, i.e., its proxy income, be included? Is the return on housing wealth irrelevant, and if so, should housing wealth be excluded? What about the stock of non-durable consumption goods such as cars and other investment goods, which are usually very difficult to measure?

Finding a correct definition of income, the proxy of human-capital wealth, is even more difficult. There are several possible measures, such as disposable income, disposable non-property income, (after-tax) labor income, or the sum of after-tax labor and proprietors' income[12]. There are also constructed measures, which do not directly appear in the official national accounts, such as the Blinder-Deaton measure presented in Blinder and Deaton (1985). An important point regarding the choice of income measure is whether it should or should not include proprietors' income, as the latter may also proxy part of human-capital wealth (except for countries where proprietors' income is included in the asset wealth of households). This would imply that labor income alone is a too-

[12] After-tax labor income is mainly an alternative for the U.S., where property income is not included in disposable income of households.

Figure 11: Non-property to total disposable income



narrow approximation of human capital wealth, so that disposable income would be a more preferable income measure. However, disposable income also includes rental income and distributed income (often also called property income), which both actually represent returns to asset wealth, so that they are unrelated to human-capital wealth.

In this sense, the preferred income measure for Switzerland, where proprietors' wealth is not included in household wealth, would be labor income plus proprietors' income minus rental income, after transfers and taxes. Conceptually, this should be roughly equal to disposable income minus rental income and distributed income. Unfortunately, necessary components of this most preferable measure are not available at all (non-rental income), or at least not for a sufficiently large time span (disposable non-property income). Therefore, the only remaining measure is disposable income. Looking at the ratio of non-property to total disposable income for the available time span, Figure 11 implies that this ratio is quite stable over time. Therefore, in trend terms, it should not matter whether one works with total disposable income or with disposable non-property income.

Overall, working with an inappropriate measure for only one of the variables can lead to a consumption-to-wealth ratio that is empirically unstable and thus makes the econometric framework no longer feasible.

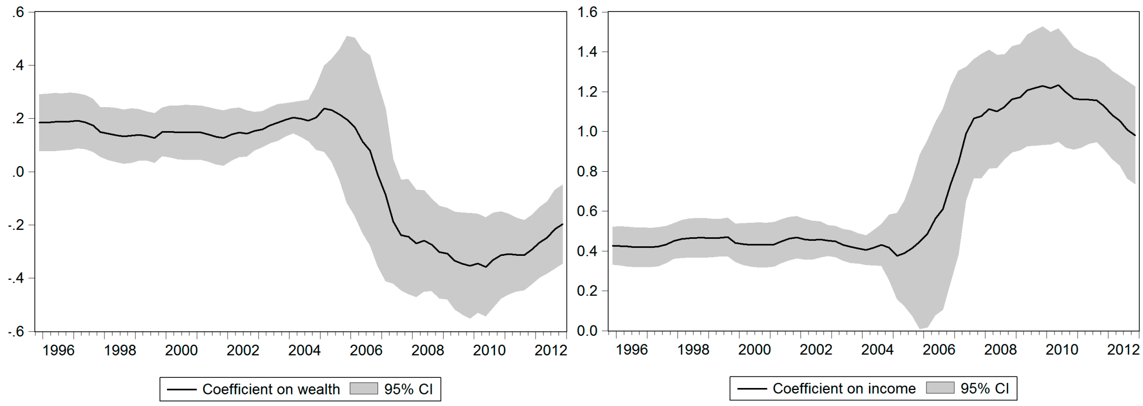
6.3 Estimation issues – Changes in the aggregate MPCs over time

Even when consumption, wealth and income indeed follow a common underlying trend, and even when using the theoretically appropriate measures of variables to estimate the cointegrating vector, estimation issues may arise. First, as is usually the case when estimating cointegrating relationships, sample length limitations play a role because a large sample span is needed to consistently estimate the cointegrating vector. This especially applies if there are long-lasting deviations from the long-run trend, as present in our case in the 2000s. However, the sources of our variables (usually national accounts) often limit the estimation sample to a time window that may not be long enough to estimate such a long-run relationship.

A much more specific estimation issue that arises when trying to pin down cointegration-based wealth effects is related to potential changes in the (aggregate) marginal propensities to consume over time. A cointegrating relationship among consumption, wealth and income may exist, but the cointegrating vector, i.e., the MPCs, can change over time. Within the context of wealth effects, Hahn and Lee (2001), e.g., found substantial changes in the cointegrating vector over time when estimating the relationship among consumption, wealth and income for the case of the U.S. Performing a similar exercise for Switzerland, using DOLS(4) estimates, we obtain the rolling and recursive estimates of the cointegration coefficients on wealth (left panel) and income (right panel) shown in figures 12 and 13, respectively. We can see that after being very stable for a long time, the coefficient on wealth started to decrease around 2005, where one-third of the window consisted of observations of the 2000s. The decrease continued until 2010, before the coefficient slightly increased again in the very recent past. However, it is currently still in negative territory, which, economically, does not really make sense. The coefficient on income, on the other hand, underwent the opposite development. In addition to these changes in the point estimates over time, the rolling estimations also reveal significantly higher standard errors related to the coefficients on both wealth and income in the second part of the sample. This could be due to collinearity problems caused by a non-negligible extent of comovement between wealth and income over the 2000s, as is visible in Figure 1.

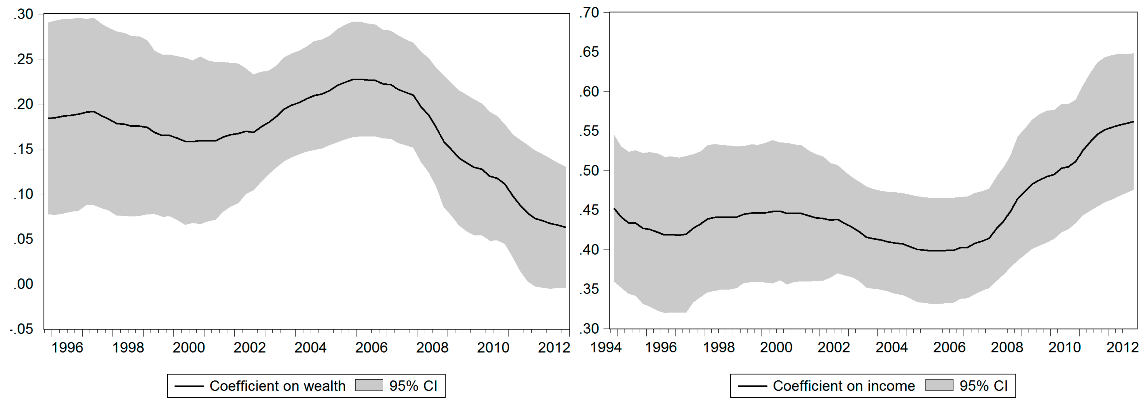
There may be several reasons for changes in the MPCs over time. One could be *institutional changes* (tax policy, pension system, demographics, composition of stock holders, new financial products), which may affect households optimizing behavior. This was also noted in Poterba (2000). An example for Switzerland would be the extension of unemployment insurance over time. Thus, the impact on the personal financial situation when falling out of work was reduced, and the possibility of consuming out of wealth in periods of being unemployed probably became less important. Another example would be

Figure 12: Rolling estimation results for the cointegration coefficients



Shown are DOLS(4) estimates for the cointegration coefficients on asset wealth (left panel) and income (right panel) over a rolling 15-year window from 1981Q1–1995Q4 to 1998Q1–2012Q4 (69 windows). The date axis refers to the end point of the respective estimation window.

Figure 13: Recursive estimation results for the cointegration coefficients

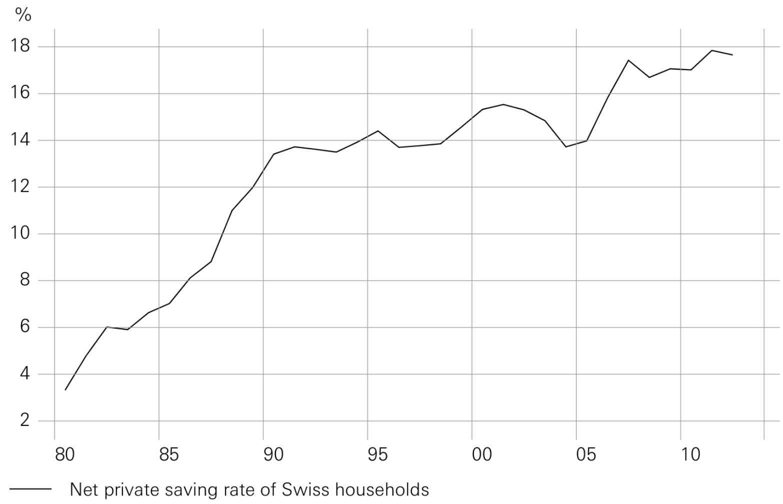


Shown are DOLS(4) estimates for the cointegration coefficients on asset wealth (left panel) and income (right panel) over an expanding window from 1981Q1–1995Q4 to 1981Q1–2012Q4 (69 windows). The date axis refers to the end point of the respective estimation window.

worries about the pension system such that households generally consume more cautiously and save more. Such an increase in savings is visible in Swiss saving statistics, shown in Figure 14. The net saving rate of Swiss household's increased over the 2000s from approximately 14% in the 1990s to 18% in 2012.

Among other things, such changes in the net saving rate could also be caused by changes in the pension system. In Switzerland, this system consists of three so-called pillars: state pensions (pillar 1), occupational benefits insurance (pillar 2) and private pensions (pillar 3). All three pillars are based on different laws that may be adjusted over time. In the mid-1980s, e.g., the institutionalization of pension funds (pillar 2) led to a substantial increase in the private saving rate. Other examples of changes in the pension system that could have affected households' saving behavior were the increase in

Figure 14: Net saving rate of Swiss households



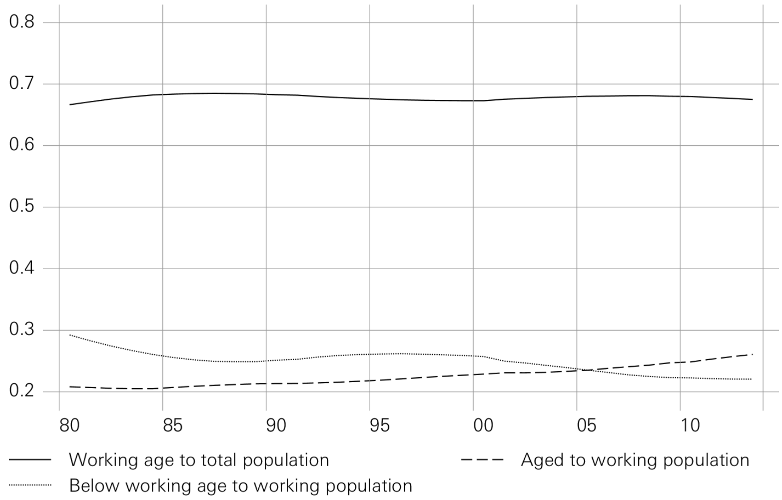
Shown are net savings of Swiss households relative to the sum of net disposable income plus pension fund contributions. Net savings are defined as net disposable income plus pension fund contributions minus consumption expenditures.

the retirement age of women from 62 to 64 in the first half of the 2000s and the lowering of the monthly withdrawal rate related to the pay-as-you-go occupational pension fund system (pillar 2).

Changes in the net saving rate may also be driven by the housing market. For example, in an environment of an increasing house price-to-income ratio (as has been the case in Switzerland since the beginning of the 21st century, see Figure 4), households need to save more to be able to buy a house. Furthermore, monthly mortgage repayment rates have become higher relative to income in the aggregate. Both may force households to restrict their consumption expenditures.

When changes in the aggregate MPC out of wealth appear to be mainly driven by housing wealth, this could actually be the result of *changes in credit market regulations*, particularly the mortgage market. Although there have been no explicit regulatory changes in Switzerland since 1980, several developments that were related to the housing and mortgage market may have led to changes in mortgage market conditions. In the early 1980s, a spatial planning act reduced the supply of housing. Shortly after, in the mid-1980s, the institutionalization of pension funds led to a substantial increase in demand for housing assets. Driven by these two events, the vast majority of housing market participants expected ongoing increases in house prices. This led to an implicit easing of mortgage market conditions. This trend was broken in the early 1990s. Losses from the housing crises forced banks to implement self-regulation measures, which led to

Figure 15: Population trends in Switzerland



stricter rules for obtaining a mortgage loan, resulting in a tightening of mortgage market conditions. It was not before 2000 that housing market conditions and, in turn, mortgage market conditions normalized again. Generally, the mortgage market in Switzerland is characterized by high down-payment requirements and little equity finance. In such countries, the MPC out of housing wealth is likely to be negative, as shown by Aron, Duca, Muellbauer, Murata, and Murphy (2011).

Also, *demographic changes* can affect the aggregate MPCs, especially changes in the ratios of working age to total population and of aged and below working age to working population. These changes are shown in Figure 15. Although the ratio of working age to total population has remained roughly constant over the sample, the composition of the non-working-age population has changed from below working age to aged persons.

Another possible reason for changes in the aggregate MPC out of asset wealth over time could be *changes in the composition of Swiss household wealth over time.* Table 10 shows two major transition periods since 1981. From 1990 to 2000, shares and pension claims as a fraction of total wealth increased from 6% of to 21% and from 21% to 32%, respectively. On the one hand, the fraction of housing wealth decreased from 66% to 45% and the fraction of debt securities from 11% to 7%. Although all fractions remained roughly constant in the first part of the 2000s, the composition of assets underwent further changes in the most recent past. Until 2012, the fraction of shares and debt securities decreased to 14% and 4%, respectively. On the other hand, the fraction of housing wealth increased to 55% in 2012. All other fractions remained roughly constant in the most recent past. Given that the MPCs out of different asset components can potentially differ, these changes in the composition of aggregate wealth can also lead to an MPC out of asset wealth that changes over time.

Changes in the aggregate MPC out of total wealth could also be caused by changes in the *distribution of wealth across Swiss households*. Rich households typically tend to spend less out of an additional amount of wealth than less-wealthy households and thus have a lower MPC out of wealth. Therefore, if the distribution of wealth grows more uneven, this may lead to a decrease in the aggregate wealth effect. However, as Table 11 shows, the distribution of wealth across Swiss tax payers has hardly changed since 1981.[13] The Gini coefficient increased only marginally, from 0.81 in 1981 to 0.83 in 2010. As shown in Jann and Fluder (2014), this was mainly due to gains among the wealthiest 5% compared to the rest of tax payers.

Another possible reason for changes in the aggregate MPC could be *changes in inflation expectations*. As shown in Rosenblatt-Wisch and Scheufele (2015), households' inflation expectations have turned significantly and permanently lower in Switzerland, from approximately 3% in the 1980s and 1990s to slightly below 1% since 2000. Doepke and Schneider (2006) showed empirically that in terms of wealth gains, debtors benefit and creditors suffer from higher inflation expectations. Bachmann, Berg, and Sims (2015) pointed out, therefore, that "to the extent that debtors have on average higher propensities to spend out of wealth than creditors, increased inflation expectations might lead to higher current aggregate spending" (p. 2). However, as the authors argue further, there may be other channels, such as signaling aspects, that make the direction of the relationship between inflation expectations and aggregate spending less clear. The authors provide evidence that outside the zero lower bound, the impact of higher inflation expectations on spending is usually not significant. During the zero lower bound period, however, "a one percentage point increase in expected inflation (...) reduces households probability of having a positive attitude towards spending by about 0.5 percentage points" (p. 1). Therefore, this would at least partly imply a lower MPC out of asset wealth in Switzerland

[13]The figures indicate that the taxable net worth of a large share of tax payers is zero (or even negative). However, there are three factors related to housing wealth and pension claims that bias this fraction upward. First, the taxable value of housing wealth is typically smaller than its market value and sometimes even smaller than the outstanding mortgage amount, which, in turn, results in a negative taxable housing wealth. Second, wealth in the form of claims against pension funds is not included in taxable net worth. Third, in cases where the amortization is performed via the so-called third pillar (a form of voluntary pension savings), the tax-relevant outstanding mortgage amount does not decrease over the years. Thus, even in cases where most of the mortgage is (technically) already paid back, the tax relevant net real estate worth remains at the same (negative) level as in the beginning until the outstanding mortgage amount is eventually zero. A more reasonable estimate from the Swiss household panel (2012) shows that approximately 10% of tax payers do not possess any type of wealth.

Table 10: Composition of Swiss household wealth

	1981		1990		2000		2006		2012	
Currency and deposits	179.64	(22%)	293.41	(21%)	384.53	(18%)	506.93	(20%)	666.11	(22%)
Debt securities	59.29	(7%)	148.88	(11%)	150.57	(7%)	113.00	(5%)	105.42	(4%)
Shares	38.18	(5%)	84.67	(6%)	437.22	(21%)	514.83	(21%)	429.32	(14%)
Claims against pension funds	137.60	(17%)	295.59	(21%)	668.64	(32%)	792.74	(32%)	886.84	(30%)
Real estate	560.93	(69%)	942.27	(66%)	956.93	(45%)	1156.25	(47%)	1652.94	(55%)
Liabilities	159.24	(20%)	347.03	(24%)	485.42	(23%)	610.66	(25%)	735.92	(24%)
Net worth	816.39		1417.79		2112.48		2473.08		3004.70	

in Billion Swiss francs, shares of total net worth in parenthesis
*including units in collective investment schemes
Source: Swiss National Bank, own calculations

Table 11: Distribution of wealth across Swiss tax payers

Net financial wealth* per capita	1981 % of tax payers	1981 % of net wealth	1991 % of tax payers	1991 % of net wealth	2003 % of tax payers	2003 % of net wealth	2006 % of tax payers	2006 % of net wealth	2010 % of tax payers	2010 % of net wealth
0	35.5%	-	32.7%	-	28.4%	-	25.7%	-	25.5%	-
0–50,000	32.8%	6.6%	30.0%	4.2%	29.6%	2.3%	30.1%	2.0%	30.7%	1.8%
50,000–100,000	12.3%	9.4%	11.3%	5.8%	10.3%	3.3%	10.4%	2.8%	9.7%	2.5%
100,000–200,000	10.1%	15.0%	11.0%	11.1%	10.5%	6.7%	10.9%	5.9%	10.3%	5.2%
200,000–500,000	6.4%	20.4%	10.0%	21.8%	12.0%	16.9%	12.6%	15.1%	12.6%	14.0%
500,000–1,000,000	1.8%	12.9%	3.2%	15.2%	5.5%	16.6%	6.0%	15.5%	6.3%	15.2%
1,000,000 and more	1.2%	35.7%	1.9%	42.0%	3.7%	54.2%	4.2%	58.7%	4.8%	61.4%
Gini Coefficient**	0.81		0.81		0.82		0.82		0.83	

*Tax relevant net wealth. Not included are all mandatory and voluntary pension claims (roughly 75% of tax relevant wealth.)
**Because the missing components of tax relevant net wealth are distributed more evenly, the effective Gini coefficient is lower. As a comparison, the Gini coefficient of primary income is approximately 0.4.
Source: Swiss Federal Tax Administration

in the more recent past than in the 1980s and 1990s.

Eventually, most of these concerns regarding the cointegration approach to estimating wealth effects on consumption result in an omitted variable problem, meaning that the three variables of consumption, income and wealth are unable to capture changes in fundamental variables of the economy, such as changes in income expectations, interest rates or the unemployment rate. However, it has to be mentioned that even when controlling for any these variables, the results do not become more stable for the case of Switzerland.

6.4 The cay residual as a result of two separate cointegrating relationships

Changes in the MPCs out of wealth and income would result in one or more breaks in the ratio of consumption-to-aggregate wealth. This issue can also be related to a point that was brought up by Hoffmann (2006) and that also illustrates the fragility of the cay residual as a proxy of the aggregate consumption-to-wealth ratio and its estimation. The author shows that the cay residual can be rewritten as linear combinations of approximations of the so-called "great ratios", namely, ca (consumption-to-asset wealth ratio), cy (consumption-to-income ratio) and ay (assets-to-income ratio) by the following simple substitution:

$$cay = c - \pi a_t - (1-\pi)y = c - a + (1-\pi)(a-y) \qquad = ca + (1-\pi)ay \tag{34}$$

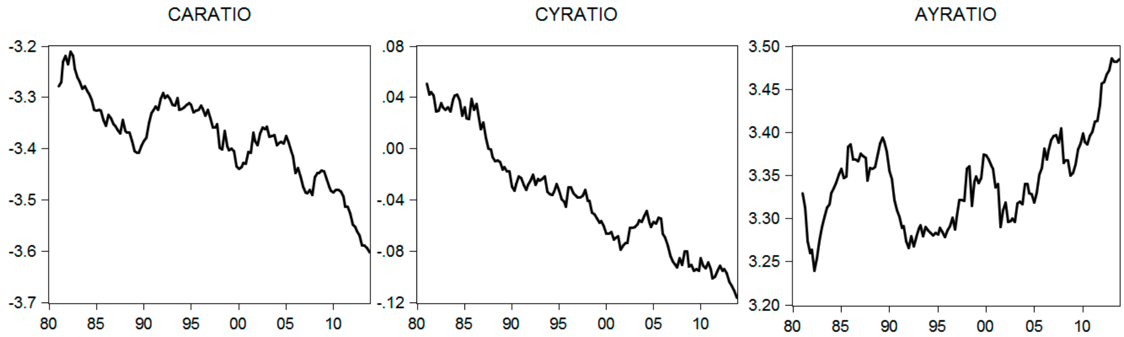
$$= \pi(c-a) + (1-\pi)(c-y) \qquad = \pi ca + (1-\pi)cy \tag{35}$$

$$= c - y - \pi(a-y) \qquad = cy - \pi ay \tag{36}$$

Therefore, the cay residual as an approximation of the consumption-to-wealth ratio is conceptually the product of two separate cointegrating relationships. As before, π and $1-\pi$ are the fractions of asset wealth in total wealth and human capital wealth in total wealth, respectively. Because the framework of Ludvigson and Lettau assumes that these shares are stable, it directly follows that the great ratios need to be individually stationary for the whole framework to hold. However, Hoffmann (2006) showed that for the U.S., a linear trend, and even a break in the trend, needs to be included to have the cointegration tests reject the hypothesis of non-stationarity for all ratios. Otherwise, only one cointegrating relationship is found among the three variables.

Similar findings regarding breaks in the great ratios and the cointegrating relationship of the involved variables come from Attfield and Temple (2010), who examine the

Figure 16: The great ratios for Switzerland (in logs)



Shown are the consumption-to-asset wealth ratio (CARATIO, left panel), the consumption-to-income ratio (CYRATIO, center panel) and the asset wealth-to-income ratio (AYRATIO, right panel) for Switzerland over the 1981Q1 to 2012Q4 period.

stationarity of the consumption-to-output and investment-to-output ratios for the U.S. and the U.K. They argue that the reasons for these breaks are changes in the underlying "deep" parameters that determine the long-run means of the ratios.

For Switzerland, the great ratios are shown in Figure 16. We can see that all of them are trending downward. For the consumption-to-asset wealth ratio (left panel) and the consumption-to-income ratio (center panel), a downward trend seems to already be present since 1980. Regressions of the ratios on a constant and a linear time trend confirm these stylized facts. The trend is found to be highly significant in all cases. However, while stationarity tests indicate that the consumption-to-income ratio is trend stationary, the consumption-to-asset ratio is not.[14] This suggests, as already noted earlier, that a potential break in the cay framework or the breakdown of this framework is related to developments in wealth, and not income. This view is also supported by looking at the assets-to-income ratio (right panel). While it was more or less stable until the early 2000s, it has been trending since then. In general, Hoffmann's is another example that shows how sensitive the results are to time series properties and specifications.

To sum up all these issues related to the cointegration approach, it is difficult, especially given the limited amount of data points, to judge whether the latest developments in the cointegration behavior among consumption, wealth and income for Switzerland reflect only a (perhaps temporary) change in the cointegrating vector or a complete breakdown of the relationship among consumption, wealth and income. However, given all the problematic issues related to the cointegration approach stated above, it seems reasonable to

[14]The results are not shown here but are available upon request.

search for an alternative method to estimate wealth effects for Switzerland and not merely rely on the estimates coming from cointegration approaches. Such an alternative approach was set up by Carroll, Otsuka, and Slacalek (2011) and is applied for Switzerland in Galli (2016).

7 Conclusions

For Switzerland, the question of the extent to which changes in wealth influence expenditures of households has become of special interest. Uptrends in stock market prices and the parallel increase in real estate prices have led to a strong increase in Swiss household wealth over the past few years. Consumption, however, did not grow very robustly. In the presence of a stable cointegrating relationship, this would have opened a large gap among consumption, wealth and income. Therefore, a significant drop in wealth or many years of very strong consumption growth or very low income growth would currently be necessary to restore equilibrium. However, as the analysis in this paper has revealed, while the link among consumption, wealth and income was quite strong from 1981 to 2000, it has become very unstable since 2000. This makes restoration of the equilibrium less likely.

Using the cointegration approach to estimating wealth effects, this study showed that when estimating over the whole sample period of 1981–2012, wealth effects seem to be hardly present in Switzerland. However, this result is largely driven by the most recent past, during which consumption did not respond to several major changes in wealth. Estimates over the more stable time span of 1981–2001 indicate that the marginal propensity to consume out of asset wealth was approximately 2.5 to 4.3 Swiss centime for this period. Regarding short-run dynamics, it was solely consumption that showed responsiveness to disequilibria. However, for the more recent past, 2002–2012, these regularities and the relationship among consumption, wealth and income in general have become much weaker and more difficult to pin down. Most estimation methods suggest that wealth effects have completely disappeared. Furthermore, the results show that it is now income, not consumption, that responds to disequilibria. This finding that the most recent past has had a strong impact on the overall results (hardly any wealth effects present in Switzerland) makes these results much less reliable.

This study also showed that separating aggregate wealth effects into effects coming from (a) changes in financial wealth and (b) changes in housing wealth is difficult within the cointegration approach and that the results depend on the estimation method (at least in the case of Switzerland). Dynamic OLS estimates indicate that the MPC out of financial wealth and out of housing wealth were approximately the same over the stable sample period, 1981–2001.

As outlined in this paper, the separability problem and the mentioned general estimation problems for the recent past can both potentially be attributed to several fragility issues related to the use of a cointegration approach to estimating wealth effects. A first fragility issue concerns the assumption on which the motivation of a theoretically stable consumption-to-wealth ratio is based. I have shown that there is reason to believe that the assumption of stationary returns on aggregate wealth may be violated.

A second fragility issue is related to the empiric implementation. For the whole framework to work, it is very important to use an "accurate", i.e., intertemporal budget constraint-relevant, measure for all variables. In practice this can be difficult due to the lack of data availability. Working with an inappropriate measure for only one of the variables can lead to a consumption-to-wealth ratio that is empirically unstable over time, which makes the econometric framework infeasible.

A third fragility issue related to the cointegration approach concerns changes in the cointegrating vector, i.e., the MPCs out of wealth and out of income, over time. Rolling regression estimates suggest that such changes are present in the Swiss case. As outlined in the paper, these changes can have several causes, such as institutional or demographic changes as well as changes in the composition of Swiss household wealth over time, the distribution of wealth across Swiss households and inflation expectations.

Despite all these fragility issues, it cannot be ruled out that we are simply undergoing an extraordinary and temporary, but still long-lasting period of, e.g., higher economic uncertainty, lower growth expectations and lower interest rates, so that the consumption-to-wealth ratio deviates strongly and long-lastingly from its equilibrium. Therefore, it would take an extremely long time to finally reach equilibrium again. Especially given the limited amount of data points, it is difficult to judge whether the latest developments in the cointegration behavior among consumption, wealth and income for Switzerland only reflect a change in the cointegrating vector or whether they point to a complete breakdown of the relationship among consumption, wealth and income.

Nevertheless, given my results, it seems reasonable to search for an alternative way to estimate wealth effects and not solely rely on the estimates coming from cointegration approaches. Such an alternative was presented in Carroll, Otsuka, and Slacalek (2011). It is based on the assumption of consumption stickiness, motivated by both habit formation and sticky information (friction as a result of incomplete information), so that short-run effects of wealth changes on consumption become long lasting. In Galli (2016), I apply this alternative method to the case of Switzerland. As mentioned in the introduction, the main findings are that there seems to be a remarkably high degree of consumption stickiness in Switzerland and that the long-run wealth effect lies somewhere in the middle of international results. The short-run effect, however, turns out to be quite small. In contrast to the results obtained with the cointegration approach, this implies that Swiss consumers do actually react to changes in wealth, but this reaction takes place over a rather long period. The low pace of adjustment may partly explain why the cointegration approach fails to uncover the presence of wealth effects in the most recent past, where several major events led to rather volatile developments in Swiss household wealth.

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