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The Decay of *cay*

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Overview

1) **Motivation:**
   Investigate changes in the impact of the consumption-wealth ratio (*cay*) on asset returns since its inception in Lettau and Ludvigson (2001)
2) **Extension:**
   The obvious decay of the “classcial” *cay* motivates the construction of alternative versions of *cay*
3) **Explanation:**
   A structural shift in the underlying cointegration relation explains the poor performance over the last two decades

The key equation

Campbell and Mankiw (1989) derive an equation for the consumption-wealth ratio as a function of expected future returns on total wealth of the form

$$c_t - w_t = E_t \sum_{i=1}^{\infty} \rho^i (r_{w,t+i} - \Delta c_{t+i}),$$

where $c_t - w_t$ denotes the log consumption-wealth ratio, Δ is the difference operator and ρ is the steady-state value of invested wealth to total wealth, i.e., $(W - C)/W$.

The definition of *cay*

Since the consumption-wealth ratio is **not** directly observable, we need a **proxy**.

This is where *cay* enters the stage.

Lettau and Ludvigson (2001) define

$$cay_t := c_t - \alpha_a a_t - (1 - \alpha_a) y_t$$

where c_t, a_t and y_t are log consumption, log asset wealth and log labor income, respectively.

α_a represents the average share of asset wealth in total wealth.

The estimation of *cay*

Lettau and Ludvigson (2001) exploit the cointegrating relationship between consumption, asset wealth and labor income to estimate a single cointegrating vector of parameters via a DLS specification including eight leads and lags, i.e.,

$$c_t = \alpha + \beta_a a_t + \beta_y y_t + \sum_{i=-8}^{8} b_{a,i} \Delta a_{t-i} + \sum_{i=-8}^{8} b_{y,i} \Delta y_{t-i} + \varepsilon_t.$$

Then,

$$\widehat{cay}_t := c_t - \widehat{\beta}_a a_t - \widehat{\beta}_y y_t$$

is the estimated version of *cay* and by that a proxy for the consumption-wealth ratio, $c_t - w_t$.

Comparison with benchmark papers

Panel A: Cointegrating parameters				
		LL2001	HL2006	DC2010
$\widehat{\beta}_a$	0.035	0.310***	0.275***	0.274***
	(0.987)	(11.700)	(27.500)	(11.417)
$\widehat{\beta}_y$	0.906***	0.590***	0.616***	0.684***
	(23.950)	(23.920)	(61.600)	(28.500)
Sample	1952:1-2019:4	1952:4-1998:3	1952:4-2002:4	1946-2006
Note:			*p<0.1; **p<0.05; ***p<0.01	

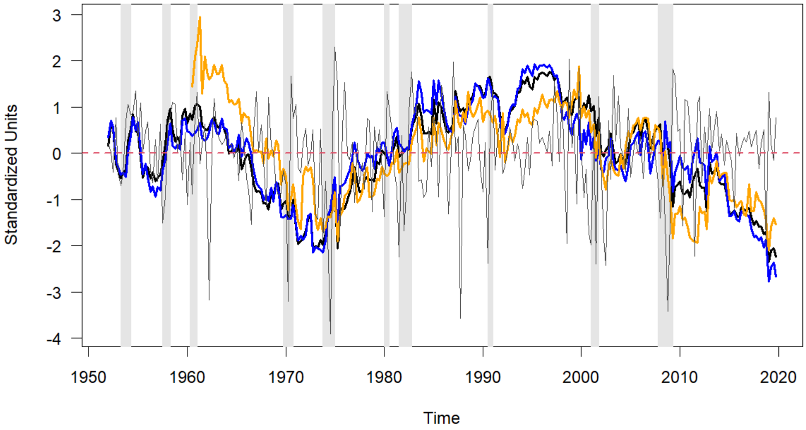
Table: The table reports the cointegrating parameters from different papers using various sample periods. Newey and West (1987) corrected *t*-statistics appear in parentheses. Hereby LL2001 denotes Lettau and Ludvigson (2001), HL2006 denotes Hahn and Lee (2006) and DC2010 represents Della Corte et al. (2010).

Alternative specifications

Additionally, we consider two alternative versions of *cay*:

- $\widehat{cay}_t^{\text{top10}}$: Accounting only for the consumption, asset wealth and labor income of the wealthiest 10% of households in order to capture the marginal investor in stock markets more accurately. Employs a method from Lettau et al. (2019)
- $\widehat{cay}_t^{\text{unfil}}$: Using unfiltered NIPA consumption according to the method of Kroencke (2017) applying the uncertainty measure of Jurado et al. (2015)

cay over time



Forecast regression

We regress H-quarter ahead returns of the "market portfolio", i.e., the CRSP NYSE/NYSE MKT/NASDAQ/Arca Value-Weighted Market Index, in excess of the "risk-free rate", i.e., the 3-Month Treasury Bill Secondary Market Rate, on the one-quarter lagged value of $\widehat{cay}_t$.

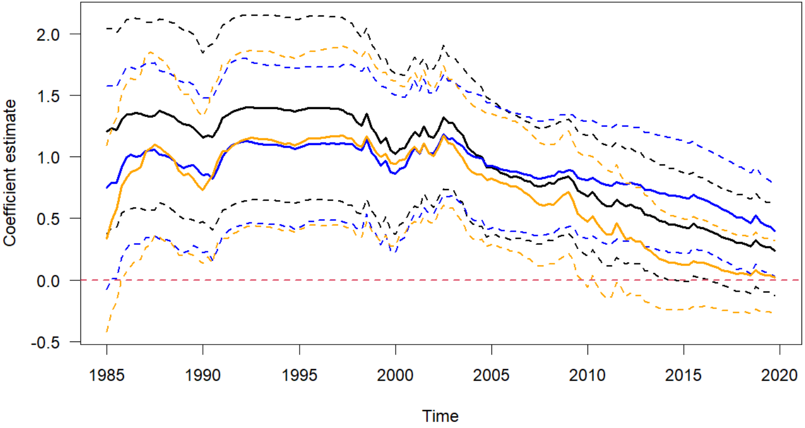
Thus, our regression equation is given by

$$r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H} = \alpha + \beta \cdot \widehat{cay}_t + \varepsilon_t$$

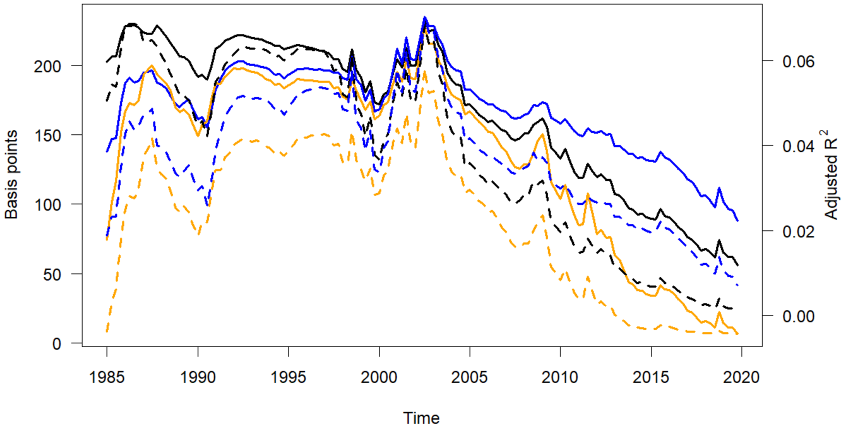
Forecasting results

	Dependent variable: $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$						
	$H = 1$	$H = 2$	$H = 4$	$H = 8$	$H = 12$	$H = 16$	$H = 20$
$\widehat{cay}_t$	0.240	0.467	0.813	1.537	2.152	2.970	3.520
	(1.079)	(1.060)	(0.692)	(0.703)	(0.662)	(0.965)	(0.991)
	[0.001]	[0.004]	[0.008]	[0.019]	[0.030]	[0.050]	[0.055]
$\widehat{cay}_t^{top10}$	0.398*	0.777*	1.482	2.889	3.817	4.968**	5.592*
	(1.762)	(1.744)	(1.290)	(1.517)	(1.629)	(2.286)	(1.914)
	[0.007]	[0.015]	[0.031]	[0.066]	[0.086]	[0.123]	[0.121]
$\widehat{cay}_t^{unfil}$	0.023	-0.012	-0.245	-0.594	-0.599	-0.550	-0.875
	(0.127)	(-0.036)	(-0.304)	(-0.459)	(.0.307)	(-0.258)	(.0.394)
	[−0.004]	[−0.004]	[−0.002]	[0.002]	[0.000]	[−0.001]	[0.002]

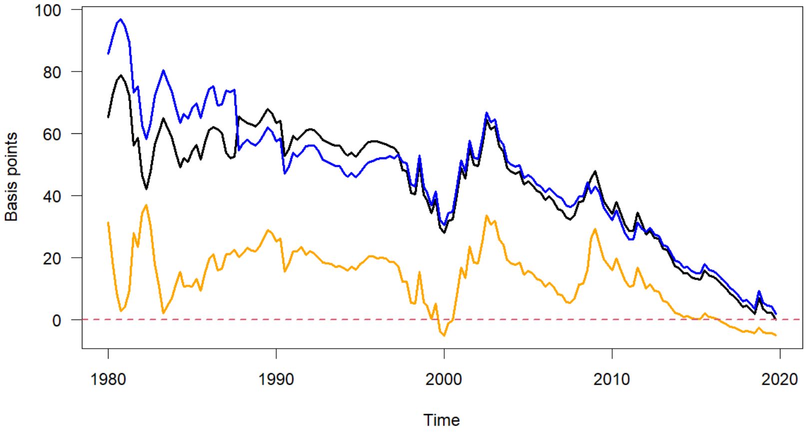
The decay of *cay* - in sample



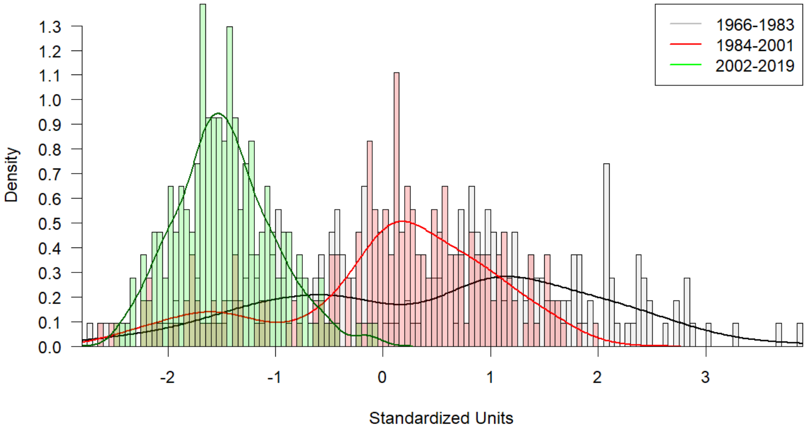
The decay of *cay* - in sample



The decay of *cay* - out of sample



The structural shift visualized



A structural shift

It appears that the negative development of *cay* at the end of our sample is not just an artefact but a development that has been going on over roughly the last two decades!

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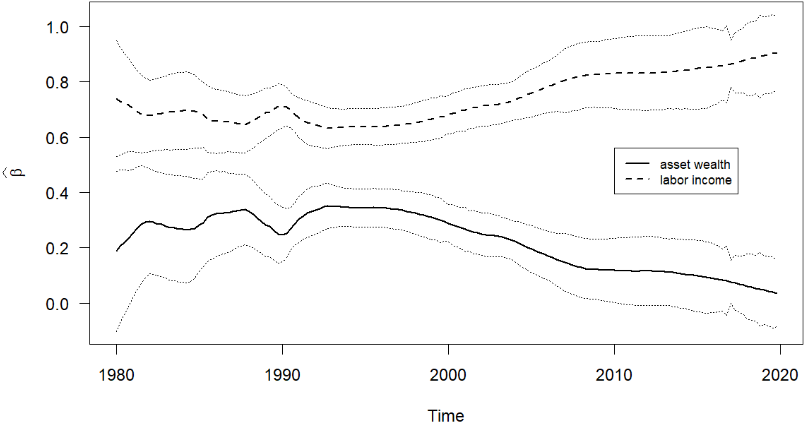
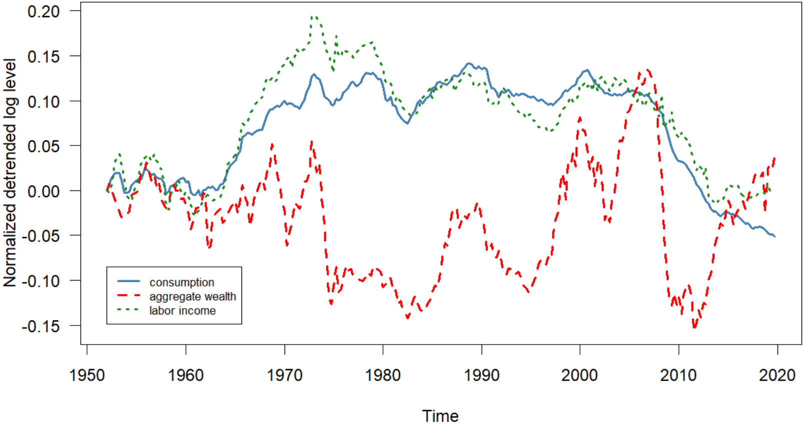
Main finding

The decay of *cay* is the result of an ongoing structural shift in the underlying cointegrating relationship between consumption, aggregate wealth and labor income.

Drifting apart...



The reason for the shift



Robustness checks

- Various other cointegrating techniques
  - Johansen (1988, 1991) procedure
  - Park's (1992) Canonical Cointegrating Regression (CCR)
  - Phillips and Hansen's (1990) Fully Modified Estimator (FME)
- Regressing excess returns directly on consumption, aggregate wealth and labor income as in Lettau and Ludvigson (2005)
- Using PCE consumption instead of NDS consumption
- Specifically account for financial wealth by considering *cday* from Sousa (2010)
- Adding volatility to the forecast regression as in Guo (2006)

Thank you for your attention!

Moritz Dauber & Jochen Lawrenz

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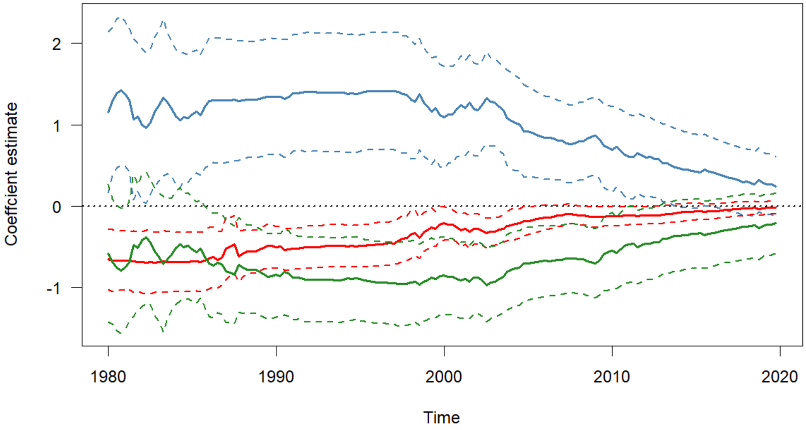
Appendix - Robustness I

	Dependent variable: $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$						
	$H = 1$	$H = 2$	$H = 4$	$H = 8$	$H = 12$	$H = 16$	$H = 20$
c_t	0.238	0.468	0.848	1.689	2.455	3.446	4.320
	(1.060)	(1.024)	(0.708)	(0.741)	(0.696)	(0.735)	(1.009)
a_t	-0.015	-0.054	-0.158	-0.315	-0.426	-0.544	-0.765
	(-0.323)	(-0.597)	(-0.570)	(-0.469)	(-0.483)	(-0.398)	(-0.850)
y_t	-0.211	-0.388	-0.637	-1.277	-1.887	-2.696	-3.275
	(-0.926)	(-0.870)	(-0.538)	(-0.596)	(-0.604)	(-0.756)	(-0.930)
$\bar{R}^2$	-0.006	-0.002	0.007	0.027	0.041	0.064	0.077
Note:	*p$<$0.1; **p$<$0.05; ***p$<$0.01						

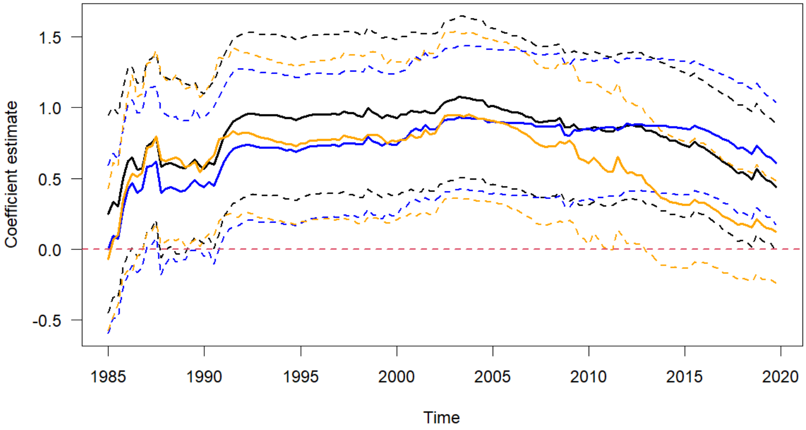
Appendix - Robustness I



Appendix - Robustness II

	Dependent variable: $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$						
	$H = 1$	$H = 2$	$H = 4$	$H = 8$	$H = 12$	$H = 16$	$H = 20$
$\widehat{cay}_t^{\text{PCE}}$	0.438	0.937^{*}	2.017	4.202^{*}	5.710^{**}	6.935^{***}	7.759^{***}
	(1.617)	(1.855)	(1.480)	(1.830)	(2.116)	(3.462)	(3.303)
	[0.007]	[0.019]	[0.047]	[0.114]	[0.156]	[0.193]	[0.188]
Note:	*p$<$0.1; **p$<$0.05; ***p$<$0.01						

Appendix - Robustness II



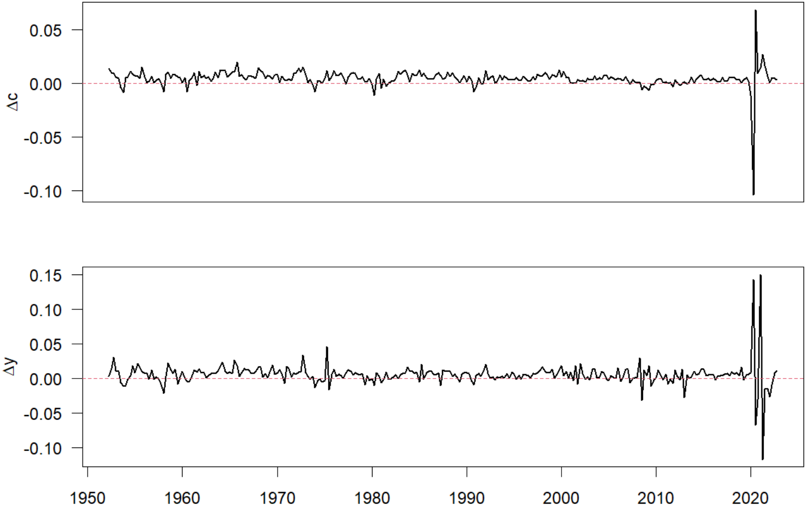
Appendix - Robustness III

	Dependent variable: $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$						
	$H = 1$	$H = 2$	$H = 4$	$H = 8$	$H = 12$	$H = 16$	$H = 20$
$\widehat{cday}_t^{NDS}$	0.285	0.560	0.994	1.883	2.477	3.102	2.996
	(1.225)	(1.138)	(0.805)	(0.732)	(0.571)	(0.605)	(0.586)
	[0.001]	[0.005]	[0.010]	[0.022]	[0.030]	[0.041]	[0.030]
$\widehat{cday}_t^{PCE}$	0.471	1.023*	2.244*	4.728**	6.318**	7.464**	7.682**
	(1.630)	(1.751)	(1.686)	(2.137)	(2.381)	(2.513)	(2.293)
	[0.008]	[0.021]	[0.053]	[0.127]	[0.166]	[0.194]	[0.162]
Note:	*p<0.1; **p<0.05; ***p<0.01						

Appendix - Robustness IV

	Dependent variable: $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$						
	$H = 1$	$H = 2$	$H = 4$	$H = 8$	$H = 12$	$H = 16$	$H = 20$
$\widehat{cay}_t$	0.238	0.453	0.794	1.502	2.137	2.949	3.481
	(1.072)	(1.009)	(0.670)	(0.654)	(0.654)	(0.945)	(0.973)
$\sigma^2_{m,t}$	0.178	1.216	1.886	2.978	1.875	2.866	5.249**
	(0.215)	(1.478)	(1.529)	(1.557)	(0.854)	(1.368)	(2.518)
$\bar{R}^2$	-0.003	0.009	0.015	0.031	0.031	0.056	0.077
Note:					*p<0.1; **p<0.05; ***p<0.01		

Appendix - Covid-19



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