

Online Appendix to Asset holders' Consumption Risk and Tests of Conditional CCAPM

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OA.1 Proof of the equation (1)

Consider a representative-agent endowment economy. The Euler equation in continuous time is

$$0 = \Lambda_t D_t dt + E_t[d(\Lambda_t S_t)], \quad (\text{OA.1})$$

where Λ_t is the state price density and S_t is the stock price. By applying Itô's product and dividing terms by $\Lambda_t S_t$,

$$\begin{aligned} 0 &= \frac{\Lambda_t D_t}{\Lambda_t S_t} dt + E_t\left[\frac{S_t d\Lambda_t + \Lambda_t dS_t + dS_t d\Lambda_t}{\Lambda_t S_t}\right] \\ &= \frac{D_t}{S_t} dt + E_t\left[\frac{dS_t}{S_t}\right] + E_t\left[\frac{d\Lambda_t}{\Lambda_t}\right] + E_t\left[\frac{dS_t d\Lambda_t}{S_t \Lambda_t}\right] \end{aligned} \quad (\text{OA.2})$$

Given that instantaneous total return is $dR_t = \frac{dS_t + D_t dt}{S_t}$ and the first moment of the state price density dynamics is $E_t\left[\frac{d\Lambda_t}{\Lambda_t}\right] = -r_f dt$,

$$E_t[dR_t] - r_f dt = -E_t\left[dR_t \frac{d\Lambda_t}{\Lambda_t}\right] \quad (\text{OA.3})$$

The state price density is defined as

$$\Lambda_t = e^{-\delta t} u'(C_t), \quad (\text{OA.4})$$

where C_t is the consumption stream and δ is the subjective discount rate. By applying Itô's lemma, the dynamics of the state price density is

$$\frac{d\Lambda_t}{\Lambda_t} = -\delta dt + \frac{C_t u''(C_t)}{u'(C_t)} \frac{dC_t}{C_t} + \frac{1}{2} \frac{u'''(C_t)}{u'(C_t)} dC_t dC_t \quad (\text{OA.5})$$

Plugging this equation into equation (OA.3) gives

$$E_t[dR_t] - r_f dt = -E_t\left[dR_t \frac{C_t u''(C_t)}{u'(C_t)} \frac{dC_t}{C_t}\right] = \gamma_t E_t\left[dR_t \frac{dC_t}{C_t}\right] \quad (\text{OA.6})$$

where $\gamma_t \equiv -\frac{C_t u''(C_t)}{u'(C_t)}$. This can be re-written as

$$E_t[dR_t^e] = \gamma_t \text{Cov}_t\left(dR_t^e, \frac{dC_t}{C_t}\right) \quad (\text{OA.7})$$

where $dR_t^e \equiv dR_t - r_f dt$

OA.2 Consumption measures from surveys

In this subsection, we describe consumption measures from CEX and NielsenIQ CPD data in detail. We use CEX and NielsenIQ data to measure asset holders' consumption as well as aggregate consumption within each data set.

OA.2.1 Consumer Expenditure Survey

The Consumer Expenditure Survey (CEX) is a nationwide household survey that is collected by the Census Bureau by the US Bureau of Labor Statistics (BLS) to provide data on expenditures, income, and demographic characteristics of consumers in the United States. Surveys are collected in two surveys – the Interview Survey for major and/or recurring items and the Diary Survey, or record-keeping survey. The Diary sample interviews households for two consecutive weeks, and it is designed to obtain detailed expenditure data on small and frequently purchased items, such as food, personal care, and household supplies. CEX data are used to revise the weight of goods and services in the market basket of the Consumer Price Index. The survey has been conducted continuously since 1980. The survey consists of around 5,000 households in most waves. The CEX is the only Federal household survey to provide information on the complete range of consumers' expenditures and incomes. For this reason, this survey data set is widely used in studies of economics and finance.¹

A selected family is interviewed about their expenditures every 3 months over five times.

¹See Deaton and Paxson (1994), Attanasio and Jappelli (2001), Attanasio et al. (2002); Brav et al. (2002); Vissing-Jørgensen (2002); Krueger and Perri (2006); Malloy et al. (2009); Primiceri and Van Rens (2009); Wachter and Yogo (2010); Aguiar and Hurst (2013); Aguiar and Bils (2015); Baker (2018); Parker and Souleles (2019); Cloyne et al. (2020); Cole et al. (2020); Coibion et al. (2021); Gaudio et al. (2021); Zhang (2021), for example.

Households report past 3-month expenditures on detailed categories ending in the month prior to the interview month. For example, if a household was interviewed in January 1984, the CEX reports its consumption from November to December 1983. The BLS conducts the survey on a monthly basis by introducing new households and dropping old households who finish the last interview each month. Therefore, the composition of interviewed households in a month is different from the next month, and thus, we can calculate the quarterly consumption growth at a monthly frequency. The final interview records information on earnings, income, and taxes from the preceding 12 months as well as financial asset-holding information. Following most past studies, our analyses only work with the Interview survey sample.

We follow the literature to measure consumption and filter out noisy or erroneous consumption observations. The consumption measure is nondurables plus services, and thus we exclude housing expenses (but not costs of household operations). We also exclude transportation costs which include vehicles and related costs (but not gasoline, oil, and public transportation) to match the definition of nondurables and services in NIPA. We compute the quarterly consumption growth ratio (C_{t+1}^h/C_t^h) for each household and drop extreme outliers where the consumption growth ratio is less than the bottom 1% and above 99%. Financial information is collected in the fifth interview. Therefore, we also exclude households for which any of the interviews two to five are missing. Moreover, non-urban households and households residing in student housing are excluded. We further exclude negative income, negative consumption, and zero food consumption. Our main definition of asset holders is a positive holding of "stocks, bonds, mutual funds, and other such securities", as in Vissing-Jørgensen (2002). There was a change in household identification numbers in the first

quarter interview of 1986. While Malloy et al. (2009) dropped households samples that did not finish the fifth interview before the change, we match two different identification numbers by exploiting two sets² of 1986Q1 interview files where one has the old identification numbers and the other has the new. To be specific, if two households from two different sets of interviews have the exact same answers for all 17 questions³ in the same month, we identify them as the same households. As a result, we match the identification numbers of 1,267 households out of 1,609 households who did not finish the interview before ID changes. To check the validity of this matching strategy, we apply the same rule to interview files of different years where there are no ID number changes, we confirm that once we find two households from two sets of interviews that have the same answers in the same month, it turns out that they are indeed hundred percent the same households.

OA.2.2 NielsenIQ CPD data

In this subsection, we provide detailed information on the NielsenIQ CPD data, based on the description on the website, documentation, and the data.⁴

The CPD data set is provided by the Kilts-Nielsen Data Center at the University of Chicago Booth School of Business, available for the years from 2004 to 2019. Different from the CEX data where a household is interviewed five times, the CPD data set is a lon-

²CEX adds an "X" to the names of quarterly Interview Survey files that appear twice, once as the fifth and final quarter of the previous year and once as the first quarter of the new year. This "X" file indicates that this file differs from the same quarterly file of the previous calendar year release, because it uses the methodology for the new year.

³We choose the following questions which can possibly have various numeric or categorical answers and also all households fully answered: composition of earners, region, income class, building type, number of males age 16 and over, number of females age 16 and over, number of males age 2 through 15, number of females age 2 through 15, number of members under age 2, ethnic origin, family type, marital status, housing tenure, age, education, race, and interview number.

⁴Please see <https://www.chicagobooth.edu/research/kilts/datasets/nielsenIQ-nielsen> for details of the data.

gitudinal panel data that keep track of the same household for a long time (approximately 9 years on average during our sample period) as long as the panel households continue to meet NielsenIQ's criteria. Moreover, while the CEX data set consists of around 5,000 households in most waves, the CPD data keep track of approximately 38,000-70,000 representative U.S. households. These households are geographically dispersed and demographically balanced.⁵

The data provide detailed demographic information of households' male/female heads that include households income range, size, type of residence, household composition, presence and age of children, age range, hours employed, education, occupation, birth year, marital status, race, and Hispanic origin. For other family members, other than family heads, birth year, employment status, and relationship/sex are collected.

For geographic information, the data provide information on households' 5-digit zip code, FIPS state, and county codes as well as region code, scantrack market code, and Designated Market Area (DM) code.

The unique feature of the CPD data set is that the data set provides detailed information on households' purchases at a daily frequency with a 12-digit Universal Product Code (UPC), which is the most granular level of product identification. They have about 1.4 million UPC codes. NielsenIQ estimates that approximately 30 percent of household consumption is accounted for by consumer panel data categories. Products include items for all retail channels – grocery, drug, mass merchandise, superstores, club stores, convenience, health, and others. All household members in the panel continually provide information to

⁵U.S. NielsenIQ samples all states (except Alaska and Hawaii) and 52 Nielsen-Defined Scantrack areas plotted in Online Appendix Figure OA.2.

NielsenIQ about products, time, and location of purchases that they make. To do so, their panel members use in-home scanners or mobile apps to record all of their purchases, from any outlet, intended for personal, in-home use. A panelist also can use an online grocery ordering service.

There are some requirements that NielsenIQ have to keep households in their sample. First, a household must be considered "active" by NielsenIQ. Second, the household must spend the minimum required amount of dollars per four-week period, depending on the household size, to be considered eligible. Past 12-month consumption of households who do not meet requirements is not reported in the data. Each year, NielsenIQ retains about 80% of its active panel.

To ensure data quality, NielsenIQ has multiple validation checks. Every quarter, they compare projected Consumer Panel data to store-based scanning data of retailers. In addition, they form a weekly sample report that tracks historical static or usable sample counts on a weekly, monthly, quarterly, and annual basis. Moreover, they assess sample representativeness of demographic characteristics and county size dispersion for each major market and the remaining U.S. sample segment on a weekly basis. They rebalance or re-weight the panel to better represent national estimates of demographic composition.

We focus on total consumption (e.g., Pukthuanthong et al., 2021) as durable types of consumption in this data account for only a small portion of the data, and the data set does not include standard durable goods such as furniture and mobile homes. To reduce noise in the data, we remove households whose total interview duration is less than 12 months. This is because households who dropped from the survey only after one year are not likely to provide precise consumption information. For consumption, we subtract the coupon value

from the total price paid. For both CEX and NielsenIQ CPD data, we regress consumption growth on family size growth and monthly dummies at the household level to account for changes in consumption due to changes in family size and seasonality.

Table OA.1 reports demographic characteristics of the CEX data from 1985 to 2019 (Panel A) together with Survey of Consumer Finances from survey years of 1989, 1992, 1995, 1998, 2001, 2004, 2007, 2010, 2013, 2016, and 2019 (Panel B) and NielsenIQ data from 2004 to 2019 (Panel C). Panel A shows that from the CEX data, asset holders are more likely to be better educated (less high school degrees but more college degrees), older, higher income, more white, male, and married than non-asset holders. The same patterns are observed in the SCF data, where asset holders are accurately measured, although the data span a different time period. This supports the validity of the CEX data. In NielsenIQ data, we do not directly observe the identification of asset holders. Instead, we use the consumption of households who live in a county that is in the top 10% highest dividend income to aggregate income ratio. Panel C shows that consistent with the CEX and SCF data sets, assumed asset holders in NielsenIQ data are better educated, older, and have higher incomes than non-asset holders. However, households in the top 10% county are not more white, male, and married, different from CEX and SCF data sets.

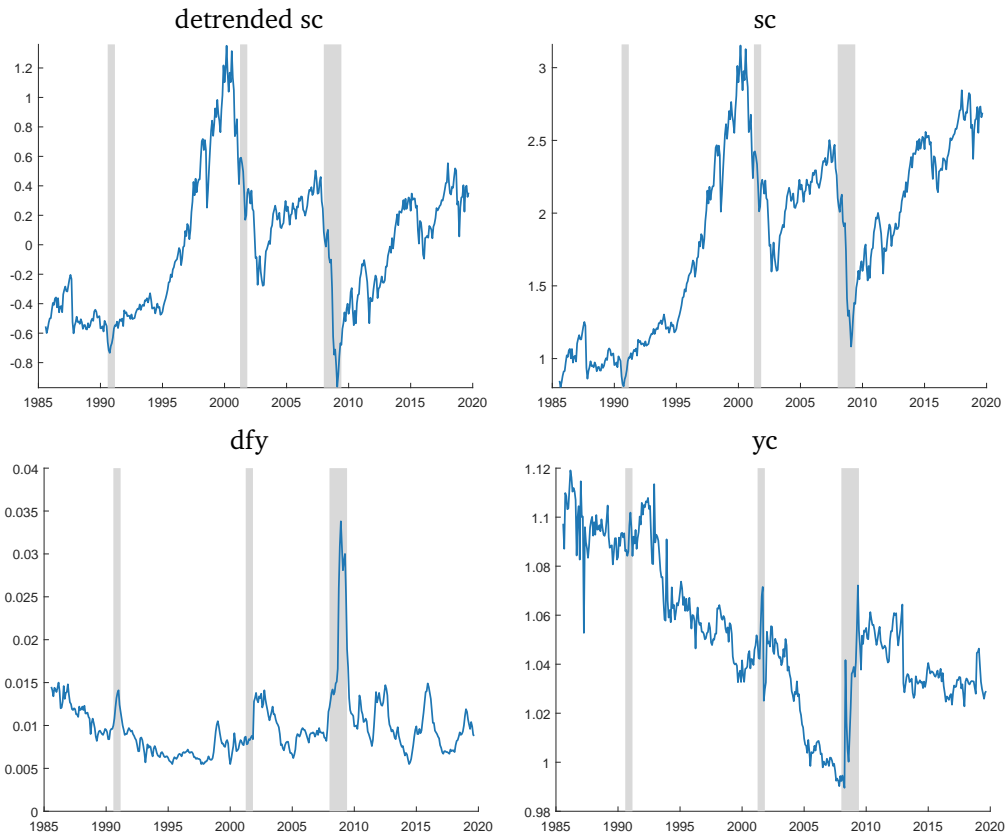


Figure OA.1. State variables

This figure plots state variables: *sc* (Stock market wealth-to-aggregate consumption ratio), *detrended sc*, *dfy* (default yield spread, the difference between BAA and AAA-rated corporate bond yields), and *yc* (labor income-to-aggregate consumption ratio). Shaded areas denote the NBER recessions.

NIELSEN TOTAL U.S. 52 SCANTRACK® MARKETS

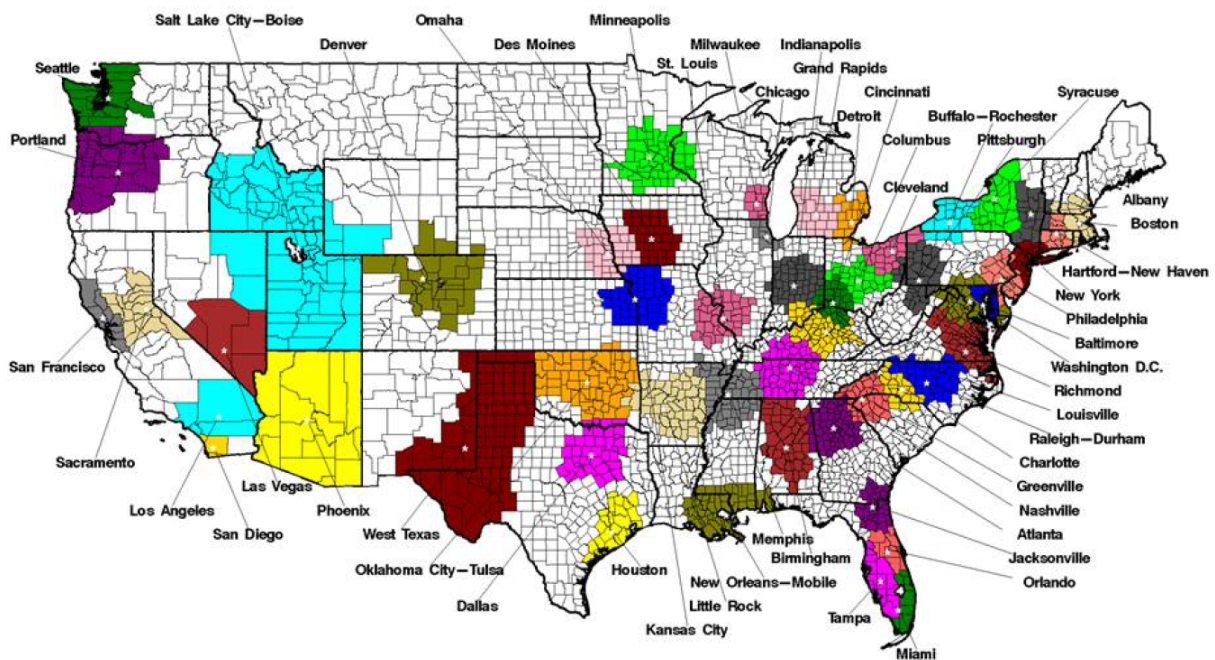


Figure OA.2. 52 Nielsen Scantrack markets

This figure presents 52 Nielsen Scantrack markets that Nielsen panelists are located in.

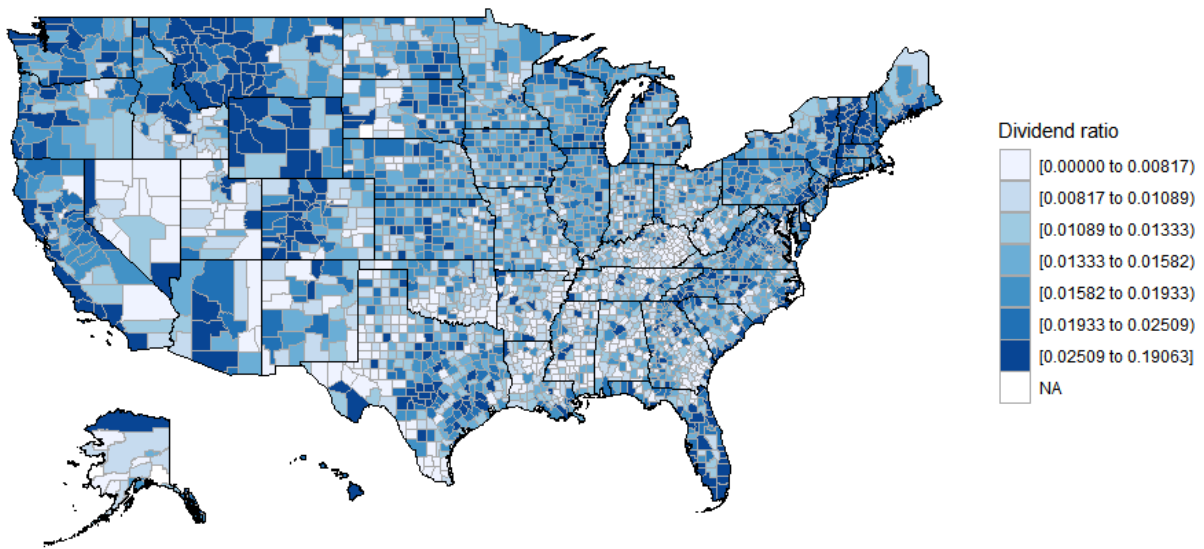


Figure OA.3. Stock market participation using IRS data

This figure shows the ratio of aggregate dividend income over aggregate taxable income for U.S. counties in 2019 using the data of IRS Statistics of Income.

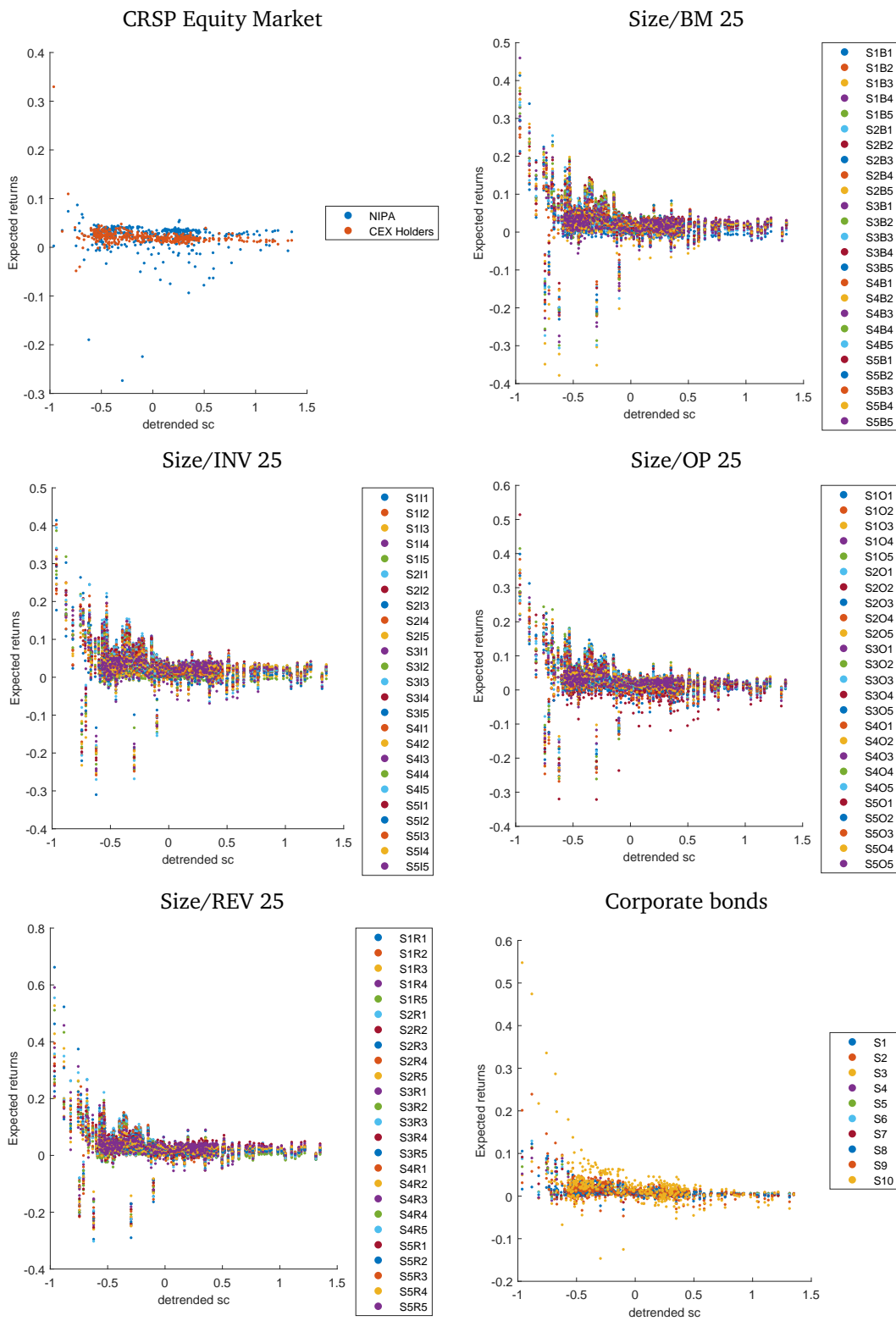


Figure OA.4. Expected Excess Returns for Each Asset and Detrended sc

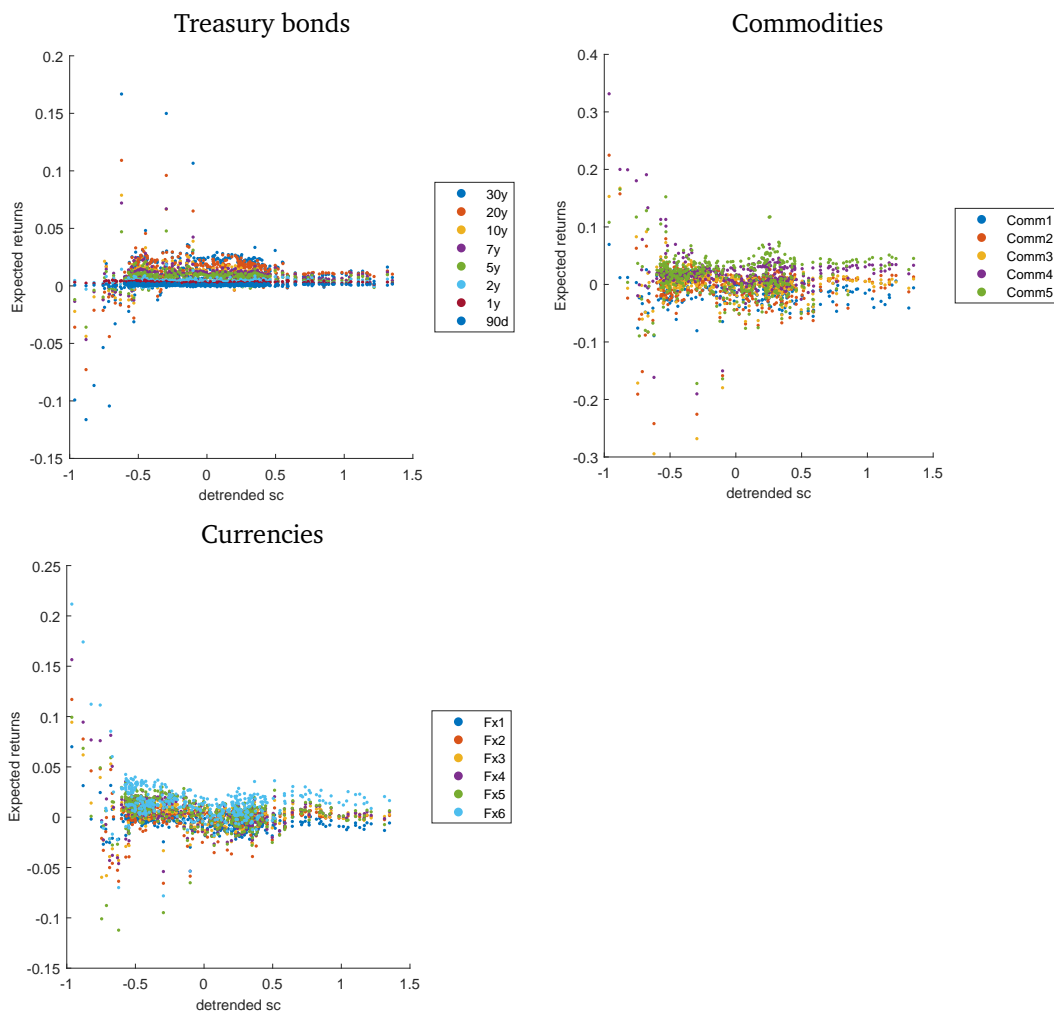


Figure OA.4. Expected Excess Returns for Each Asset and Detrended sc (Cont'd).

This figure plots the expected excess returns with respect to the detrended stock market wealth-to-aggregate consumption (sc) ratio (x-axis). “NIPA Aggregate” is NIPA aggregate consumption by the Bureau of Economic Analysis. “CEX Asset holders” is the consumption of households who have a positive financial asset from the data of the Consumer Expenditure Survey by the Bureau of Labor Statistics. “Size/BM” is 25 size/book-to-market sorted portfolios. “Size/INV” is 25 size/investment sorted portfolios. “Size/OP” is 25 size/operating profitability sorted portfolios. “Size/REV” is 25 size/long-term reversal sorted portfolios. “Corporate bonds” is 10 credit spread-sorted corporate bond portfolios Nozawa (2017). “Treasury bonds” is 8 Treasury bonds. “Commodities” is 5 basis-sorted commodity portfolios Yang (2013). “Currencies” is 6 portfolios sorted on forward discounts Lustig et al. (2011). For the aggregate equity market (CRSP Equity Market), we use $\hat{\alpha} + (\hat{\gamma}_0 + \hat{\gamma}'_1 z_t) \widehat{Cov}_t(R_{m,t+1}^e, \Delta C_{t+1}/C_t)$ using NIPA aggregate consumption or CEX asset holders’ consumption, where $R_{m,t+1}^e$ denotes market excess returns; C_t denotes consumption; and z_t is the first three principal components of 162 variables. For all other test assets, we use $\hat{E}_t[R_{i,t+1}^e]$ for each asset, which is obtained from a local linear regression of realized excess returns on z_t . For equity portfolios, size, value, investment, operating profitability, and reversal portfolios are labeled by S, B, I, O, and R from 1 to 5 where 1 denotes the lowest characteristics portfolios (e.g., S1B1 = small and growth).

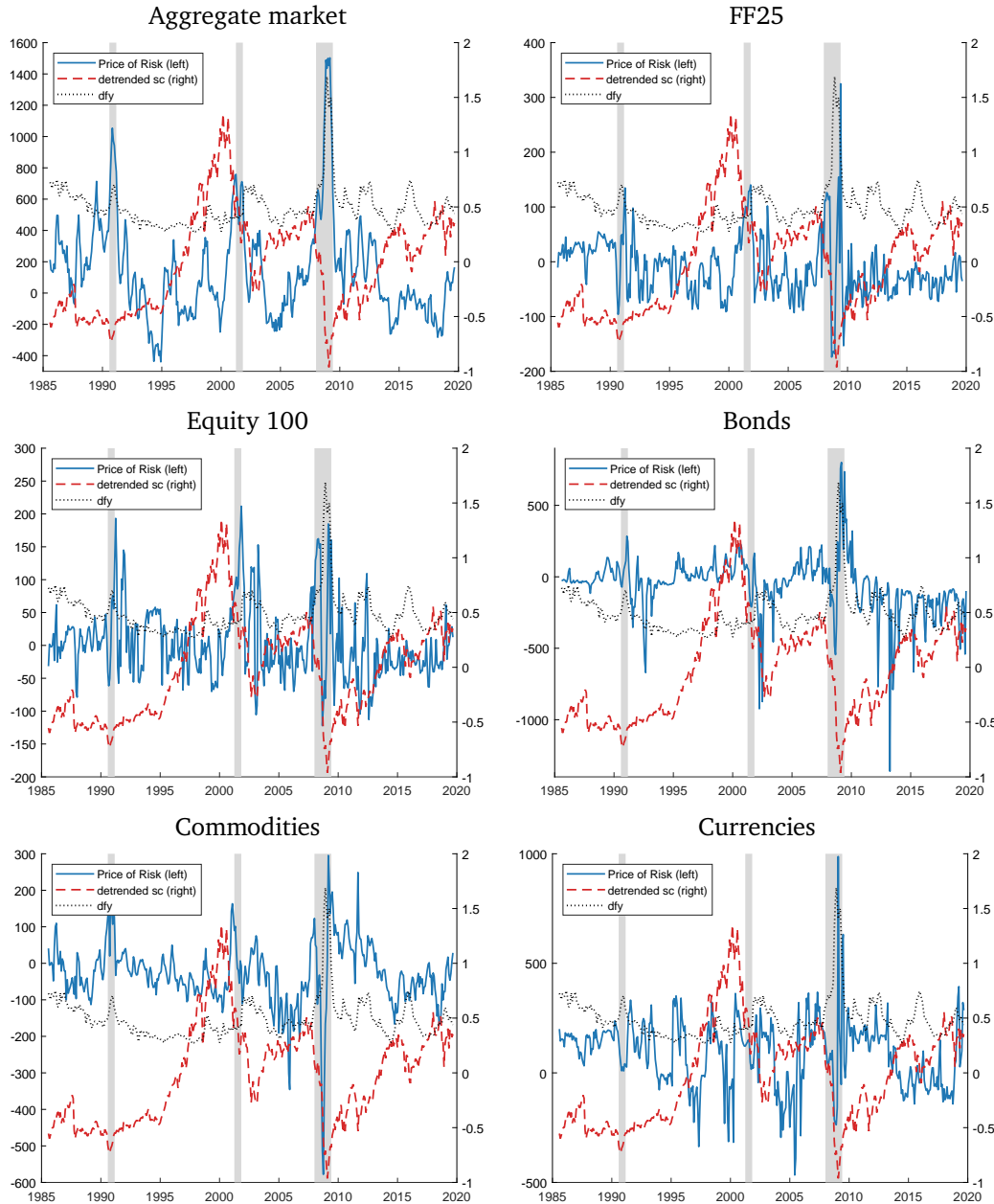


Figure OA.5. **Conditional Price of Consumption risk for Each Asset Class using CEX Aggregate consumption**

This figure plots the conditional price of consumption risk estimated using each asset class and the cross-sectional nonparametric estimation by Roussanov (2014): $\hat{\gamma}_t = (\hat{\mathbf{c}}_t' W \hat{\mathbf{c}}_t)^{-1} \hat{\mathbf{c}}_t' W \hat{\mathbf{m}}_t$ where $\hat{\mathbf{c}}_t$ is $N \times 2$ vector of ones and nonparametrically estimated conditional covariances, W is the weighting matrix, and $\hat{\mathbf{m}}_t$ is $N \times 1$ vector of the nonparametrically estimated conditional expectation of excess returns. For nonparametric estimations, the Epanechnikov kernel function is used. For the selection of bandwidth, the bias-corrected Akaike Information Criterion is used. For the conditioning information set, the first three principal components of 162 variables are used. The blue-solid line is the price of consumption risk (denoted by “Price of Risk”). The red dashed line is the detrended stock market wealth-to-aggregate consumption ratio (denoted by “detrended sc”). The black-dotted line is the rescaled default yield spread (denoted by “dfy”), the difference between BAA and AAA-rated corporate bond yields. Shaded areas denote the NBER recessions.

Table OA.1. Demographic Characteristics of Asset holders

This table presents demographic characteristics of asset holders versus non-asset holders in the CEX, SCF (Survey of Consumer Finances), and NielsenIQ CPD data. Reported are average values of demographic variables.

	High	College	Age	Income	Nonwhite	Male	Married
Panel A: CEX data							
Non-holders	0.25	0.47	44.46	26,426	0.19	0.54	0.59
Asset holders	0.10	0.54	46.32	46,903	0.08	0.67	0.71
Total	0.22	0.48	44.73	29,328	0.18	0.56	0.61
<i>t</i> -stat	-99.22	30.85	35.40	115.287	-81.71	54.53	52.43
Panel B: SCF data							
Non-holders	0.50	0.39	49.71	41,324	0.36	0.64	0.47
Asset holders	0.28	0.70	50.05	128,668	0.18	0.80	0.69
Total	0.39	0.55	49.88	84,807	0.27	0.72	0.58
<i>t</i> -stat	-42.68	62.42	1.82	77.13	-41.55	34.39	42.17
Panel C: NielsenIQ data							
Non-holders	0.31	0.68	50.38	25,716	0.22	0.71	0.51
Asset holders	0.25	0.74	51.14	27,277	0.26	0.69	0.48
Total	0.30	0.70	50.54	26,047	0.23	0.71	0.51
<i>t</i> -stat	-105.17	104.99	46.93	70.00	68.78	-39.24	-58.65

Table OA.2. State Variables

Table presents the list of conditioning variables. The column tcode denotes the following data transformation for a series z before estimating factors: (1) no transformation; (2) Δz_t ; (3) $\Delta^2 z_t$; (4) $\log(z_t)$; (5) $\Delta \log(z_t)$; (6) $\Delta^2 \log(z_t)$; (7) $\Delta(z_t/z_{t-1} - 1)$.

Number	Name	Description	Group	tcode
1	RPI	Real Personal Income	Group 1: Output and Income	5
2	W875RX1	Real personal income ex transfer receipts	Group 1: Output and Income	5
3	INDPRO	IP Index	Group 1: Output and Income	5
4	IPFPNSS	IP: Final Products and Nonindustrial Supplies	Group 1: Output and Income	5
5	IPFINAL	IP: Final Products (Market Group)	Group 1: Output and Income	5
6	IPCONGD	IP: Consumer Goods	Group 1: Output and Income	5
7	IPDCONGD	IP: Durable Consumer Goods	Group 1: Output and Income	5
8	IPNCONGD	IP: Nondurable Consumer Goods	Group 1: Output and Income	5
9	IPBUSEQ	IP: Business Equipment	Group 1: Output and Income	5
10	IPMAT	IP: Materials	Group 1: Output and Income	5
11	IPDMAT	IP: Durable Materials	Group 1: Output and Income	5
12	IPNMAT	IP: Nondurable Materials	Group 1: Output and Income	5
13	IPMANSICS	IP: Manufacturing (SIC)	Group 1: Output and Income	5
14	IPB51222S	IP: Residential Utilities	Group 1: Output and Income	5
15	IPFUELS	IP: Fuels	Group 1: Output and Income	5
16	CUMFNS	Capacity Utilization: Manufacturing	Group 1: Output and Income	2
17	COS	Consumer Opinion Surveys: Confidence Indicators	Group 1: Output and Income	4
18	RECPROUSM156N	Smoothed U.S. Recession Probabilities	Group 1: Output and Income	1
19	SAHMCURRENT	Sahm Rule Recession Indicator	Group 1: Output and Income	1
20	HWI	Help-Wanted Index for United States	Group 2: Labor Market	2
21	HWIURATIO	Ratio of Help Wanted/No. Unemployed	Group 2: Labor Market	2
22	CLF16OV	Civilian Labor Force	Group 2: Labor Market	5
23	CE16OV	Civilian Employment	Group 2: Labor Market	5
24	UNRATE	Civilian Unemployment Rate	Group 2: Labor Market	2
25	UEMPMEAN	Average Duration of Unemployment (Weeks)	Group 2: Labor Market	2
26	UEMPLT5	Civilians Unemployed - Less Than 5 Weeks	Group 2: Labor Market	5
27	UEMP5TO14	Civilians Unemployed for 5-14 Weeks	Group 2: Labor Market	5
28	UEMP15OV	Civilians Unemployed - 15 Weeks & Over	Group 2: Labor Market	5
29	UEMP15T26	Civilians Unemployed for 15-26 Weeks	Group 2: Labor Market	5
30	UEMP27OV	Civilians Unemployed for 27 Weeks and Over	Group 2: Labor Market	5
31	CLAIMSx	Initial Claims	Group 2: Labor Market	5
32	PAYEMS	All Employees: Total nonfarm	Group 2: Labor Market	5
33	USGOOD	All Employees: Goods-Producing Industries	Group 2: Labor Market	5
34	CES1021000001	All Employees: Mining and Logging: Mining	Group 2: Labor Market	5
35	USCONS	All Employees: Construction	Group 2: Labor Market	5
36	MANEMP	All Employees: Manufacturing	Group 2: Labor Market	5
37	DMANEMP	All Employees: Durable goods	Group 2: Labor Market	5
38	NDMANEMP	All Employees: Nondurable goods	Group 2: Labor Market	5
39	SRVPRD	All Employees: Service-Providing Industries	Group 2: Labor Market	5
40	USTPU	All Employees: Trade, Transportation & Utilities	Group 2: Labor Market	5
41	USWTRADE	All Employees: Wholesale Trade	Group 2: Labor Market	5
42	USTRADE	All Employees: Retail Trade	Group 2: Labor Market	5
43	USFIRE	All Employees: Financial Activities	Group 2: Labor Market	5
44	USGOVT	All Employees: Government	Group 2: Labor Market	5
45	CES0600000007	Avg Weekly Hours : Goods-Producing	Group 2: Labor Market	1
46	AWOTMAN	Avg Weekly Overtime Hours : Manufacturing	Group 2: Labor Market	2
47	AWHMAN	Avg Weekly Hours : Manufacturing	Group 2: Labor Market	1
48	CES0600000008	Avg Hourly Earnings : Goods-Producing	Group 2: Labor Market	6
49	CES2000000008	Avg Hourly Earnings : Construction	Group 2: Labor Market	6
50	CES3000000008	Avg Hourly Earnings : Manufacturing	Group 2: Labor Market	6
51	HOUST	Housing Starts: Total New Privately Owned	Group 3: Consumption and Orders	4
52	HOUSTNE	Housing Starts, Northeast	Group 3: Consumption and Orders	4
53	HOUSTMW	Housing Starts, Midwest	Group 3: Consumption and Orders	4
54	HOUSTS	Housing Starts, South	Group 3: Consumption and Orders	4
55	HOUSTW	Housing Starts, West	Group 3: Consumption and Orders	4

Table OA.2 – continued from previous page

Number	Name	Description	Group	tcode
56	PERMIT	New Private Housing Permits (SAAR)	Group 3: Consumption and Orders	4
57	PERMITNE	New Private Housing Permits, Northeast (SAAR)	Group 3: Consumption and Orders	4
58	PERMITMW	New Private Housing Permits, Midwest (SAAR)	Group 3: Consumption and Orders	4
59	PERMITS	New Private Housing Permits, South (SAAR)	Group 3: Consumption and Orders	4
60	PERMITW	New Private Housing Permits, West (SAAR)	Group 3: Consumption and Orders	4
61	ACOGNO	New Orders for Consumer Goods	Group 4: Orders and Inventories	5
62	AMDMNOx	New Orders for Durable Goods	Group 4: Orders and Inventories	5
63	ANDENOx	New Orders for Nondefense Capital Goods	Group 4: Orders and Inventories	5
64	AMDMUOx	Unfilled Orders for Durable Goods	Group 4: Orders and Inventories	5
65	BUSINVx	Total Business Inventories	Group 4: Orders and Inventories	5
66	ISRATIOx	Total Business: Inventories to Sales Ratio	Group 4: Orders and Inventories	2
67	DPCERA3M086SBEA	Real personal consumption expenditures	Group 4: Orders and Inventories	5
68	CMRMTSPLx	Real Manu. and Trade Industries Sales	Group 4: Orders and Inventories	5
69	RETAILx	Retail and Food Services Sales	Group 4: Orders and Inventories	5
70	UMCSENTx	Consumer Sentiment Index	Group 4: Orders and Inventories	2
71	M1SL	M1 Money Stock	Group 5: Money and Credit	6
72	M2SL	M2 Money Stock	Group 5: Money and Credit	6
73	M2REAL	Real M2 Money Stock	Group 5: Money and Credit	5
74	BOGMBASE	Monetary Base; Total	Group 5: Money and Credit	6
75	TOTRESNS	Total Reserves of Depository Institutions	Group 5: Money and Credit	6
76	NONBORRES	Reserves Of Depository Institutions	Group 5: Money and Credit	7
77	BUSLOANS	Commercial and Industrial Loans	Group 5: Money and Credit	6
78	REALLN	Real Estate Loans at All Commercial Banks	Group 5: Money and Credit	6
79	NONREVSL	Total Nonrevolving Credit	Group 5: Money and Credit	6
80	CONSPI	Nonrevolving consumer credit to Personal Income	Group 5: Money and Credit	2
81	MZMSL	MZM Money Stock	Group 5: Money and Credit	6
82	DTCOLNVHFNM	Consumer Motor Vehicle Loans Outstanding	Group 5: Money and Credit	6
83	DTCTHFNM	Total Consumer Loans and Leases Outstanding	Group 5: Money and Credit	6
84	INVEST	Securities in Bank Credit at All Commercial Banks	Group 5: Money and Credit	6
85	WPSFD49207	PPI by Commodity:Final Demand: Finished Goods	Group 6: Prices	6
86	WPSFD49502	PPI by Commodity: Final Demand: Personal Consumption Goods	Group 6: Prices	6
87	WPSID61	PPI by Commodity: Intermediate Demand, Processed Goods	Group 6: Prices	6
88	WPSID62	PPI by Commodity: Intermediate Demand, Unprocessed Goods	Group 6: Prices	6
89	OILPRICEx	Crude Oil, spliced WTI and Cushing	Group 6: Prices	6
90	PPICMM	PPI: Metals and metal products	Group 6: Prices	6
91	CPIAUCSL	CPI : All Items	Group 6: Prices	6
92	CPIAPPSL	CPI : Apparel	Group 6: Prices	6
93	CPITRNSL	CPI : Transportation	Group 6: Prices	6
94	CPIMEDSL	CPI : Medical Care	Group 6: Prices	6
95	CUSR0000SAC	CPI : Commodities	Group 6: Prices	6
96	CUSR0000SAD	CPI : Durables	Group 6: Prices	6
97	CUSR0000SAS	CPI : Services	Group 6: Prices	6
98	CPIULFSL	CPI : All Items Less Food	Group 6: Prices	6
99	CUSR0000SA0L2	CPI : All items less shelter	Group 6: Prices	6
100	CUSR0000SA0L5	CPI : All items less medical care	Group 6: Prices	6
101	PCEPI	Personal Cons. Expend.: Chain Index	Group 6: Prices	6
102	DDURRG3M086SBEA	Personal Cons. Exp: Durable goods	Group 6: Prices	6
103	DNDGRG3M086SBEA	Personal Cons. Exp: Nondurable goods	Group 6: Prices	6
104	DSERRG3M086SBEA	Personal Cons. Exp: Services	Group 6: Prices	6
105	FEDFUNDS	Effective Federal Funds Rate	Group 7: Interest rate and Exchange Rates	2
106	CP3Mx	3-Month AA Financial Commercial Paper Rate	Group 7: Interest rate and Exchange Rates	2
107	TB3MS	3-Month Treasury Bill	Group 7: Interest rate and Exchange Rates	2
108	TB6MS	6-Month Treasury Bill	Group 7: Interest rate and Exchange Rates	2
109	GS1	1-Year Treasury Rate	Group 7: Interest rate and Exchange Rates	2
110	GS5	5-Year Treasury Rate	Group 7: Interest rate and Exchange Rates	2

Table OA.2 – continued from previous page

Number	Name	Description	Group	tcode
111	GS10	10-Year Treasury Rate	Group 7: Interest rate and Exchange Rates	2
112	AAA	Moody's Seasoned Aaa Corporate Bond Yield	Group 7: Interest rate and Exchange Rates	2
113	BAA	Moody's Seasoned Baa Corporate Bond Yield	Group 7: Interest rate and Exchange Rates	2
114	COMPAPFFx	3-Month Commercial Paper Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
115	TB3SMFFM	3-Month Treasury C Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
116	TB6SMFFM	6-Month Treasury C Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
117	T1YFFM	1-Year Treasury C Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
118	T5YFFM	5-Year Treasury C Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
119	T10YFFM	10-Year Treasury C Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
120	AAAFFM	Moody's Aaa Corporate Bond Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
121	BAAFFM	Moody's Baa Corporate Bond Minus FEDFUNDS	Group 7: Interest rate and Exchange Rates	1
122	TWEXAFEGSMTHx	Trade Weighted U.S. Dollar Index: Major Currencies	Group 7: Interest rate and Exchange Rates	5
123	EXSZUSx	Switzerland / U.S. Foreign Exchange Rate	Group 7: Interest rate and Exchange Rates	5
124	EXJPUSx	Japan / U.S. Foreign Exchange Rate	Group 7: Interest rate and Exchange Rates	5
125	EXUSUKx	U.S. / U.K. Foreign Exchange Rate	Group 7: Interest rate and Exchange Rates	5
126	EXCAUSx	Canada / U.S. Foreign Exchange Rate	Group 7: Interest rate and Exchange Rates	5
127	LTY	Long-term yield	Group 7: Interest rate and Exchange Rates	2
128	TMS	Term spread	Group 7: Interest rate and Exchange Rates	1
129	DFY	Default yield	Group 7: Interest rate and Exchange Rates	1
130	DFR	Default returns	Group 7: Interest rate and Exchange Rates	1
131	RREL	Relative T-bill rate	Group 7: Interest rate and Exchange Rates	1
132	S&P 500	S&P 500's Common Stock Price Index: Composite	Group 8: Stock Market	5
133	S&P: indust	S&P 500's Common Stock Price Index: Industrials	Group 8: Stock Market	5
134	S&P div yield	S&P 500's Composite Common Stock: Dividend Yield	Group 8: Stock Market	2
135	S&P PE ratio	S&P 500's Composite Common Stock: Price-Earnings Ratio	Group 8: Stock Market	5
136	VIXCLSx	S&P 500 implied volatility	Group 8: Stock Market	1
137	DE	Dividend Payout Ratio	Group 8: Stock Market	1
138	SVAR	S&P 500 Realized variance	Group 8: Stock Market	1
139	BM	Book-to-Market Ratio	Group 8: Stock Market	1
140	NTIS	Net Equity Expansion	Group 8: Stock Market	1
141	RA-BEX	Risk aversion in Bekaert et al. (2022)	Group 8: Stock Market	1
142	EPU	Economic Policy Uncertainty in Baker et al. (2016)	Group 9: Uncertainty	1
143	EPU-FISCAL	Fiscal Policy (Taxes OR Spending) EPU in Baker et al. (2016)	Group 9: Uncertainty	1
144	EPU-TAX	Taxes EPU in Baker et al. (2016)	Group 9: Uncertainty	1
145	EPU-GOV	Government spending EPU in Baker et al. (2016)	Group 9: Uncertainty	1
146	EPU-HEALTH	Health care EPU in Baker et al. (2016)	Group 9: Uncertainty	1
147	EPU-NATIONAL	National security EPU in Baker et al. (2016)	Group 9: Uncertainty	1
148	EPU-ENTITLEMENT	Entitlement programs EPU in Baker et al. (2016)	Group 9: Uncertainty	1
149	EPU-REGULATION	Regulation EPU in Baker et al. (2016)	Group 9: Uncertainty	1
150	EPU-FINANCIAL	Financial Regulation EPU in Baker et al. (2016)	Group 9: Uncertainty	1
151	EPU-TRADE	Trade policy EPU in Baker et al. (2016)	Group 9: Uncertainty	1
152	EPU-SOVEREIGN	Sovereign debt, currency crises EPU in Baker et al. (2016)	Group 9: Uncertainty	1
153	MAC-UN	Macro Economic Uncertainty in Jurado et al. (2015)	Group 9: Uncertainty	1
154	MPU-WORLD	Monetary EPU in Baker et al. (2016)	Group 9: Uncertainty	1
155	MPU-HRS	Monetary Policy Uncertainty in Husted et al. (2020)	Group 9: Uncertainty	1
156	CPU	Climate Policy Uncertainty Index in Gavriilidis (2021)	Group 9: Uncertainty	1
157	GPR	Geopolitical Risk index in Caldara and Iacoviello (2022)	Group 9: Uncertainty	1

Table OA.2 – continued from previous page

Number	Name	Description	Group	tcode
158	EMV	Daily Infectious Disease Equity Market Volatility in Baker et al. (2020)	Group 9: Uncertainty	8
159	GEPU	Global EPU in Baker et al. (2016)	Group 9: Uncertainty	2
160	CAY	consumption-wealth ratio in Lettau and Ludvigson (2001)	Group 10: Other state variable	1
161	YC	income-consumption ratio in Santos and Veronesi (2006)	Group 10: Other state variable	1
162	CA	consumption-wealth ratio in Roussanov (2014)	Group 10: Other state variable	1

Table OA.3. Regression of UMVE on consumption measures

This table presents results from regressing quarterly returns on the unconditional mean-variance efficient (UMVE) portfolio of currencies by Chernov et al. (2022) on quarterly growth rates of NIPA aggregate consumption or/and CEX asset holders' consumption at a monthly frequency. "NIPA Aggregate" is NIPA aggregate consumption by the Bureau of Economic Analysis. "CEX Asset holders" is the consumption of households who have a positive financial asset from the data of the Consumer Expenditure Survey by the Bureau of Labor Statistics. *t*-statistics are based on the Newey and West (1987) with three months lag. ***, **, * denote the statistical significance at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)
NIPA Aggregate	0.009*** (2.765)		0.008*** (2.721)
CEX Asset holders		0.003 (1.258)	0.003 (1.149)
Intercept	0.012*** (2.737)	0.022*** (5.876)	0.012*** (2.763)
R^2_{adj}	0.032	0.003	0.033
<i>N</i>	418	418	418

Table OA.4. Dynamics of Price of Consumption Risk from Currency portfolios with UMVE

This table presents the dynamics of the price of risk from the currency portfolios using returns on the unconditional mean-variance efficient (UMVE) portfolio of currencies by Chernov et al. (2022) (Panel A) as well as the price of consumption risk for the currency portfolio using NIPA aggregate consumption (Panel B) and CEX asset holders' consumption (Panel C) based on a regression of the following equation: $\hat{\gamma}_t = a + \beta X_t + \epsilon_t$ where $\hat{\gamma}_t$ is the price of consumption risk estimated by the cross-sectional nonparametric estimation in Roussanov (2014) using N assets: $[\hat{\alpha}_t \ \hat{\gamma}_t]' = (\hat{c}\hat{v}'_t W \hat{c}\hat{v}_t)^{-1} \hat{c}\hat{v}'_t W \hat{m}_t$ where $\hat{c}\hat{v}_t$ is $N \times 2$ vector of ones and nonparametrically estimated conditional covariances, W is the weighting matrix, and \hat{m}_t is $N \times 1$ vector of the nonparametrically estimated conditional expectation of excess returns. For nonparametric estimations, the Epanechnikov kernel function is used. For the selection of bandwidth, the bias-corrected Akaike Information Criterion is used. For the conditioning information set, the first three principal components of 162 variables are used. X_t is a state variable that is standardized to a unit standard deviation – sc (Stock market wealth-to-aggregate consumption ratio), detrended sc, dfy (default yield spread, the difference between BAA and AAA-rated corporate bond yields), and yc (labor income-to-aggregate consumption ratio). “NIPA Aggregate” is NIPA aggregate consumption by the Bureau of Economic Analysis. “CEX Asset holders” is the consumption of households who have a positive financial asset from the data of the Consumer Expenditure Survey by the Bureau of Labor Statistics. “Currencies” is 6 portfolios sorted on forward discounts Lustig et al. (2011). t -statistics are based on the Newey and West (1987) with three months lag. ***, **, * denote the statistical significance at 1%, 5%, and 10%, respectively.

	detrended sc		sc		dfy		yc	
	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat
	Panel A: UMVE							
Currencies	-7.84	-4.27***	-8.56	-5.84***	2.60	0.68	9.89	7.69***
	Panel B: NIPA Aggregate							
Currencies	-130.38	-3.40***	-142.23	-4.67***	35.23	0.79	161.82	5.70***
	Panel C: CEX Asset holders							
Currencies	-10.96	-2.27**	-15.49	-3.33***	6.89	1.44	14.74	2.95***

Table OA.5. Dynamics of Price of Consumption Risk from Currency portfolios considering Transaction costs

This table presents the dynamics of the price of consumption risk from the currency portfolios using NIPA aggregate consumption and CEX asset holders' consumption based on a regression of the following equation: $\hat{\gamma}_t = a + \beta X_t + \epsilon_t$ where $\hat{\gamma}_t$ is the price of consumption risk estimated by the cross-sectional nonparametric estimation in Roussanov (2014) using N assets: $[\hat{\alpha}_t \ \hat{\gamma}_t]' = (\hat{c}\hat{v}'_t W \hat{c}\hat{v}_t)^{-1} \hat{c}\hat{v}'_t W \hat{m}_t$ where $\hat{c}\hat{v}_t$ is $N \times 2$ vector of ones and nonparametrically estimated conditional covariances, W is the weighting matrix, and \hat{m}_t is $N \times 1$ vector of the nonparametrically estimated conditional expectation of excess returns. For nonparametric estimations, the Epanechnikov kernel function is used. For the selection of bandwidth, the bias-corrected Akaike Information Criterion is used. For the conditioning information set, the first three principal components of 162 variables are used. X_t is a state variable that is standardized to a unit standard deviation – sc (Stock market wealth-to-aggregate consumption ratio), detrended sc, dfy (default yield spread, the difference between BAA and AAA-rated corporate bond yields), and yc (labor income-to-aggregate consumption ratio). “NIPA Aggregate” is NIPA aggregate consumption by the Bureau of Economic Analysis. “CEX Asset holders” is the consumption of households who have a positive financial asset from the data of the Consumer Expenditure Survey by the Bureau of Labor Statistics. “Currencies” is 6 portfolios sorted on forward discounts Lustig et al. (2011). “Currencies net” is 6 portfolios sorted on forward discounts Lustig et al. (2011) considering transaction costs based on bid-ask quotes. t -statistics are based on the Newey and West (1987) with three months lag. ***, **, * denote the statistical significance at 1%, 5%, and 10%, respectively.

	detrended sc		sc		dfy		yc	
	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat	$\hat{\beta}$	t -stat
Panel A: NIPA Aggregate								
Currencies	-130.38	-3.40***	-142.23	-4.67***	35.23	0.79	161.82	5.70***
Currencies net	-95.45	-3.70***	-97.55	-4.75***	19.95	0.61	110.43	5.70***
Panel B: CEX Asset holders								
Currencies	-10.96	-2.27**	-15.49	-3.33***	6.89	1.44	14.74	2.95***
Currencies net	-5.47	-1.87*	-7.62	-3.12***	0.32	0.14	8.90	3.59***

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