How Financial Innovations and Accelerators Drive Booms and Busts in US Consumption

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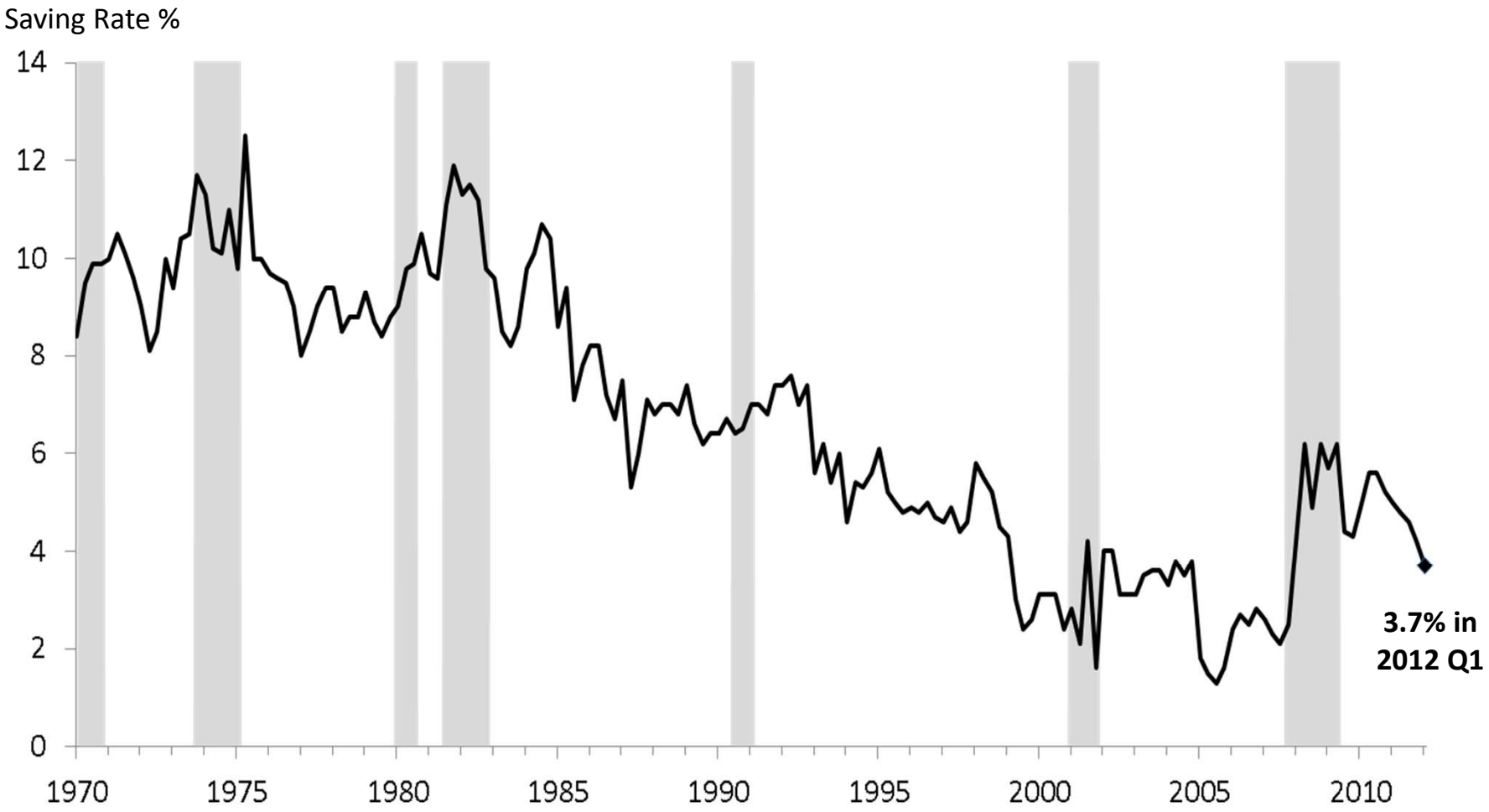
* Thanks to J.B. Cooke, Kurt Johnson, and David Luttrell for providing research assistance. The views expressed are those of the authors, and are not necessarily those of the Federal Reserve Bank of Dallas or of the Federal Reserve System.

Research Agenda

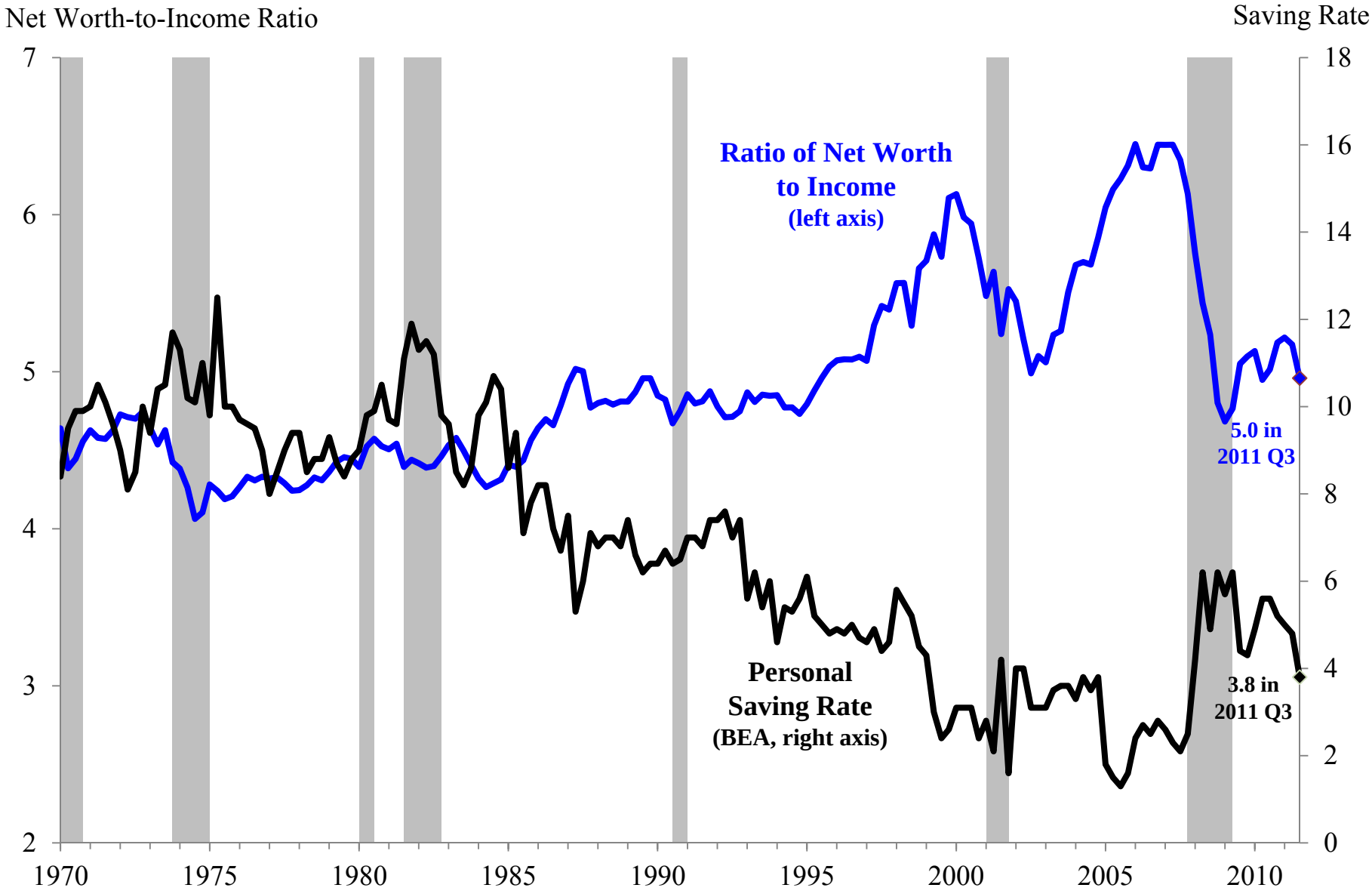
- Standard models did not account for longer run trends in saving nor for the fall in consumption and the jump in saving in recent recession

The Fall and Recent Rise in Household Saving Rate



Sources: BEA, Federal Reserve, authors' calculations, and "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Trends in Saving Reflect More Than Movements in Household Net Worth



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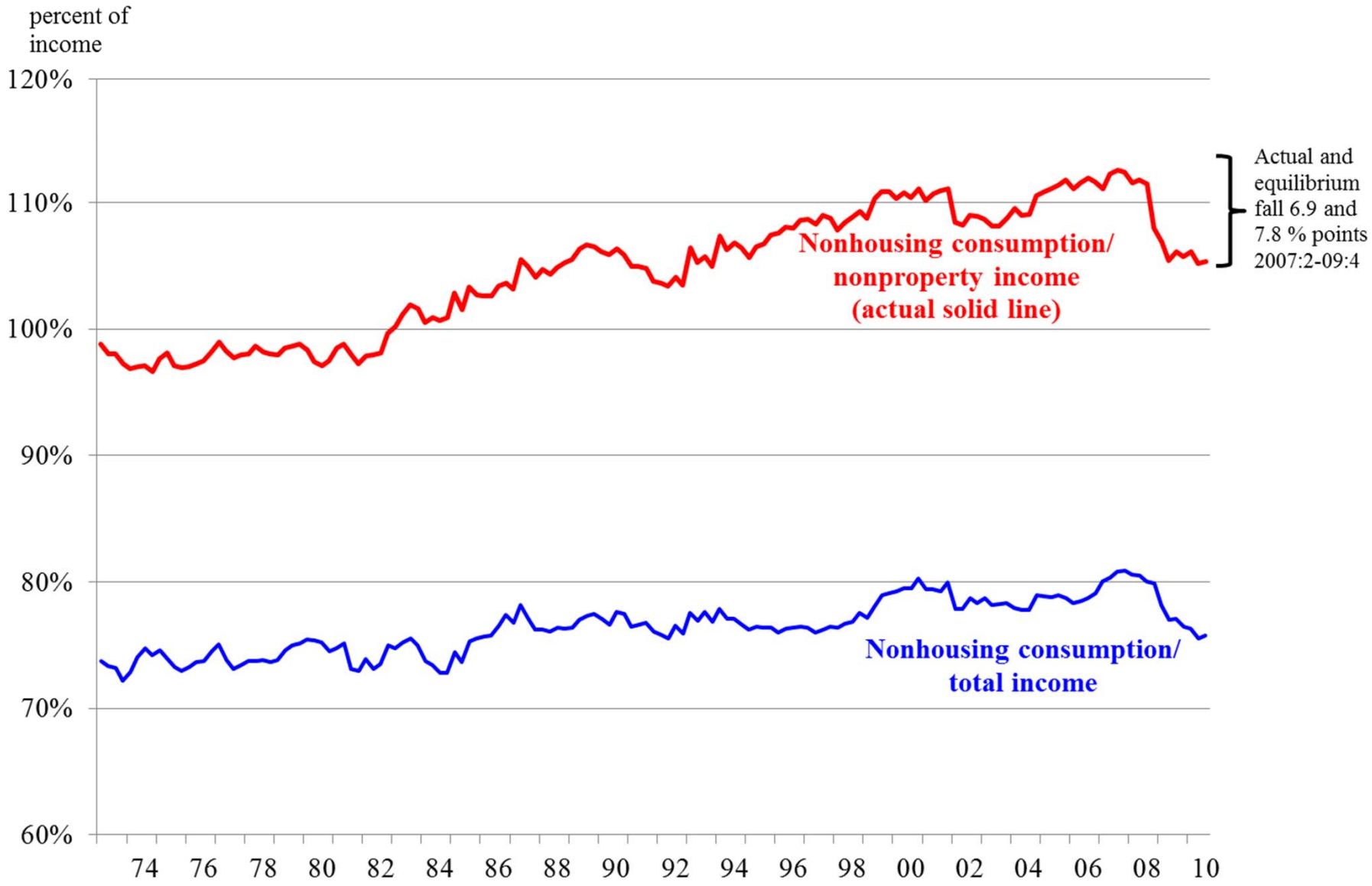
After Booming, the Consumption-to-Income Ratio Falls Since the Housing and Financial Crisis



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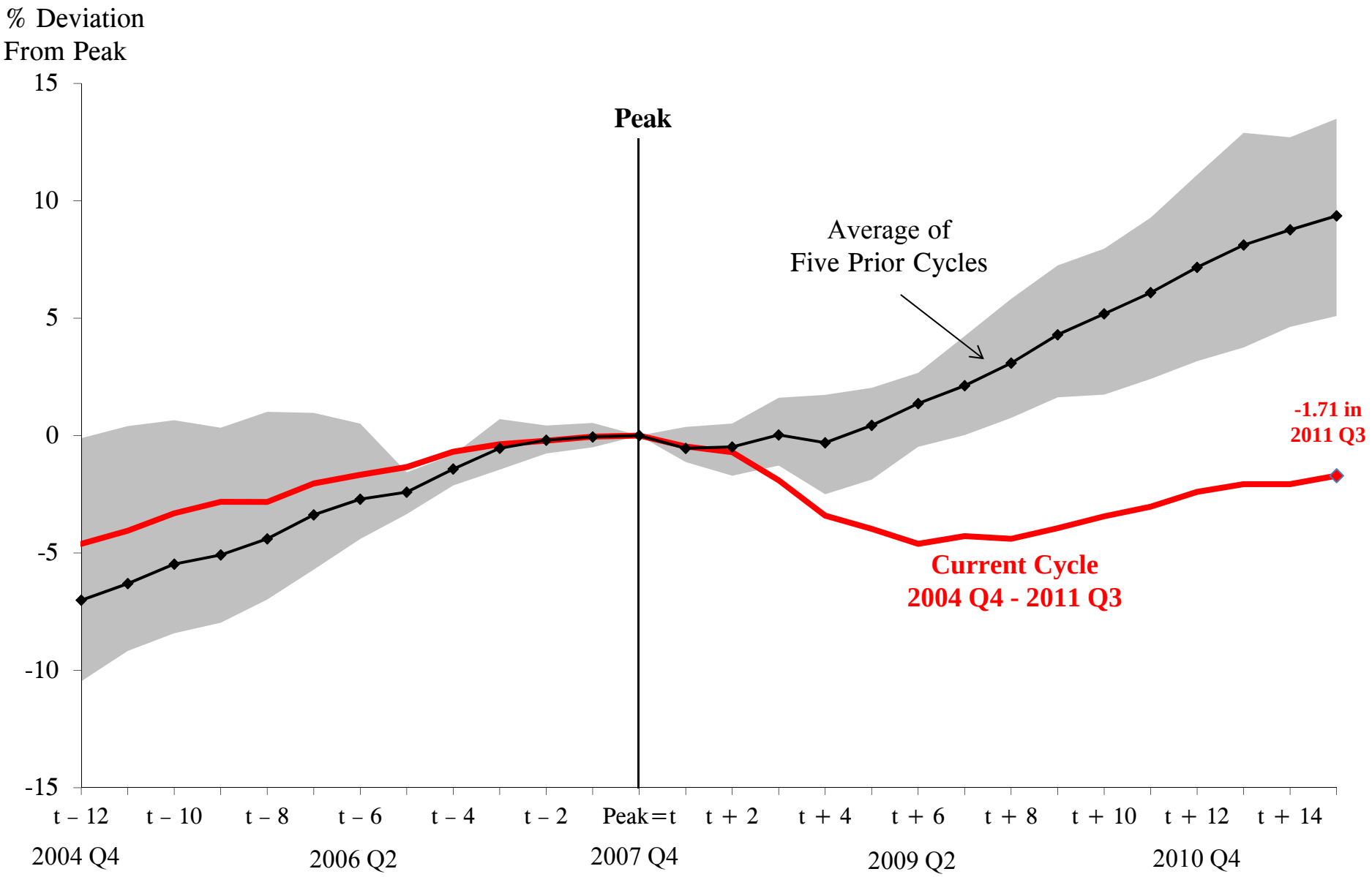
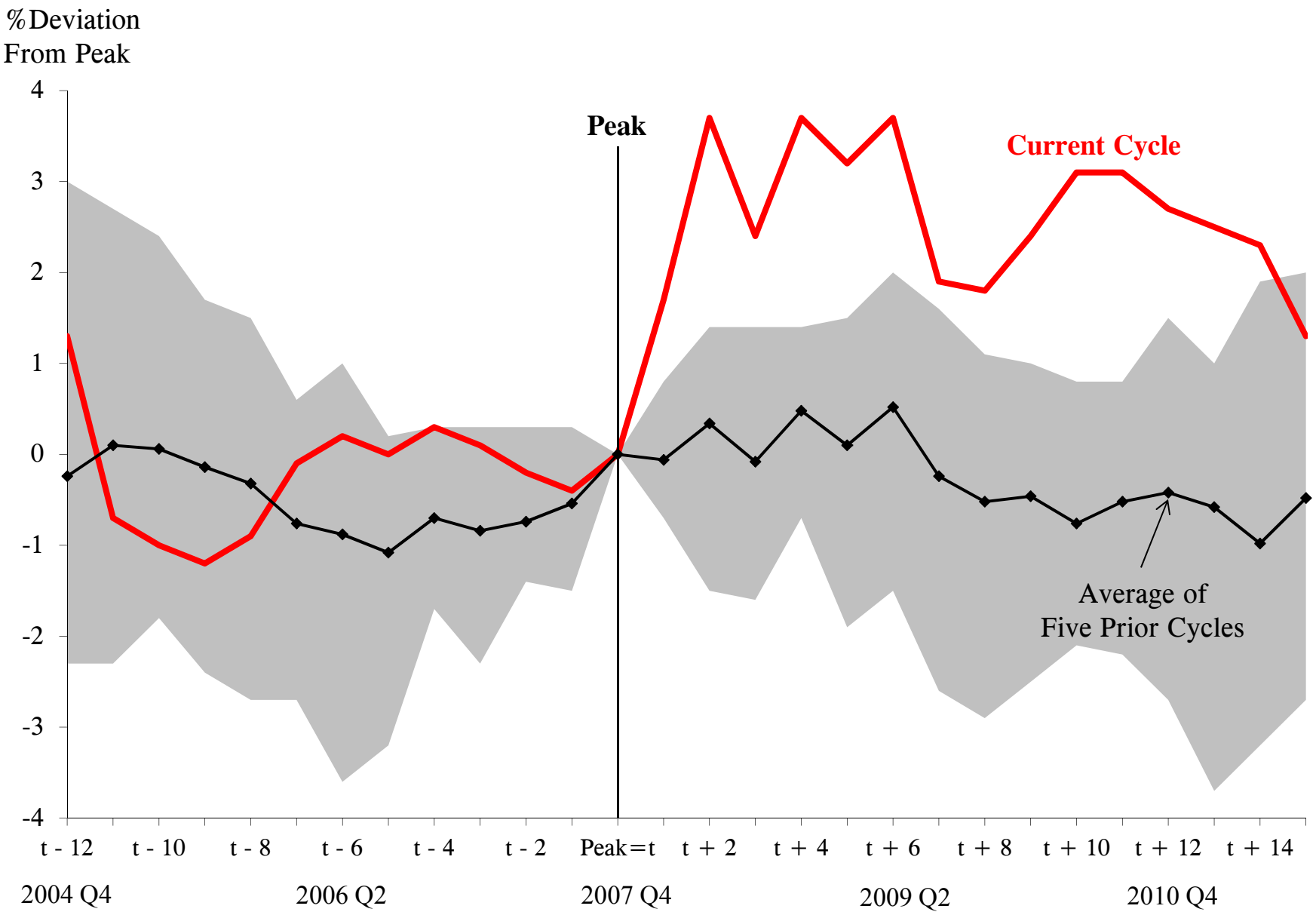
Real Per Capita Consumption Weak in Current Cycle



Notes: The grey area indicates the range of the last five major recessions (1970, 1974, 1981-82, 1990, and 2001), excluding the very short 1980 recession. Sources: BEA, authors' calculations, and "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Personal Saving Rate Rose in Recent Cycle, Before Ebbing



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Research Agenda

- Standard models did not account for longer run trends in saving nor for the fall in consumption and the jump in saving in recent recession
- To capture these developments, a good model of aggregate consumer spending needs to look beyond the "usual suspects" – income, wealth, interest rates, and to account for the evolving credit market architecture of U.S. household finance entailing three changes to standard models
- Firstly, account for changes in the composition of net wealth
- Secondly and thirdly, identify and quantify how financial innovations have altered two of the financial accelerators affecting household spending:
  - Shifts in consumer credit standards affecting non-real estate credit
  - Changes in the liquidity of housing wealth that alter the 'housing wealth' effect or mpc of housing wealth (the collateral role of housing)
- Part of effort to endogenize elements in the household sector in stages
- Analysis will focus on modeling non-housing consumption relative to non-property (non-asset) income with some detailed wealth information and controls for shifting consumer and mortgage conditions. (Need to exclude property income from income when estimating wealth effects.)

Augmenting Consumption Models for Differentiated Credit and Wealth Effects I

- To account for shifting long-run relationships, use an updated Ando-Modligliani-Brumberg consumption function, as opposed to more popular Hall type Euler equation.
- Life-cycle, permanent income model with non-housing consumption implying

$$\ln c_t = \alpha_0 + \ln y_t + \gamma A_{t-1}/y_t + \ln(y_t^p/y_t) + u_t \qquad (2.2)$$

- Note that savings rate:

$$sr_t \approx -\ln(c_t/y_t) = -[\alpha_0 + \gamma A_{t-1}/y_t + \ln(y_t^p/y_t) + u_t].$$

- For realism - add expected income growth, uncertainty (Δ unemployment rate, Δur_t) and intertemporal substitution => standard REPIH model *:*

$$\ln c_t = \alpha_0 + \ln y_t + \alpha_1 r_t + \alpha_2 \vartheta_t + \alpha_3 (E_t \ln y^p{}_t - \ln y_t) + \gamma A_{t-1}/Y_t + \varepsilon_t \quad (2.4)$$

While aggregate swings in total wealth have some information about consumption, they can't account for a large downshift in the saving rate over time and miss most of the uptick during the Great Recession

Augmenting Consumption Models for Differentiated Credit and Wealth Effects II

- Substitute proxies for uncertainty (ϑ) like changes in unemployment (Δur)
- Add in a consumer credit conditions index, ***CCI***
- Divide total wealth into *NLA* (net liquid assets = liquid assets – debt), gross housing assets (*HSG*), and illiquid financial assets (*IFA:* stocks and bonds)
- Add in a housing liquidity index (***HLI***), time-varying mpc of housing

$$\ln c_t = \alpha_{0t} + \ln y_t + \alpha_{1t} r_t + \alpha_2 \vartheta_t + \alpha_{3t} E_t \ln (y^p{}_t / y_t) + \alpha_4 CCI_t + \underbrace{\gamma_1 NLA_{t-1}/y_t + \gamma_2 IFA_{t-1}/y_t + \gamma_3 HLI_t \, x \, HSG_{t-1}/y_t}$$

3 Wealth Components where housing has a collateral effect

Treat r.h.s. as equilibrium ln c and estimate an ECM:

$$\Delta \ln c_t = \lambda\{\alpha_{0t} + \alpha_{1t} r_t + \alpha_2 \vartheta_t + \alpha_{3t} E_t \ln (y^p{}_t / y_t) + \alpha_4 CCI_t + \gamma_1 NLA_{t-1}/y_t + \gamma_2 IFA_{t-1}/y_t + \gamma_4 HLI \, x \, HSG_{t-1}/y_t + (\ln y_t - \ln c_{t-1})\} + \beta_1 \Delta \ln y_t + \beta_2 \Delta nr_t + \beta_3 \Delta ur_t + \varepsilon_t \quad (2.5)$$

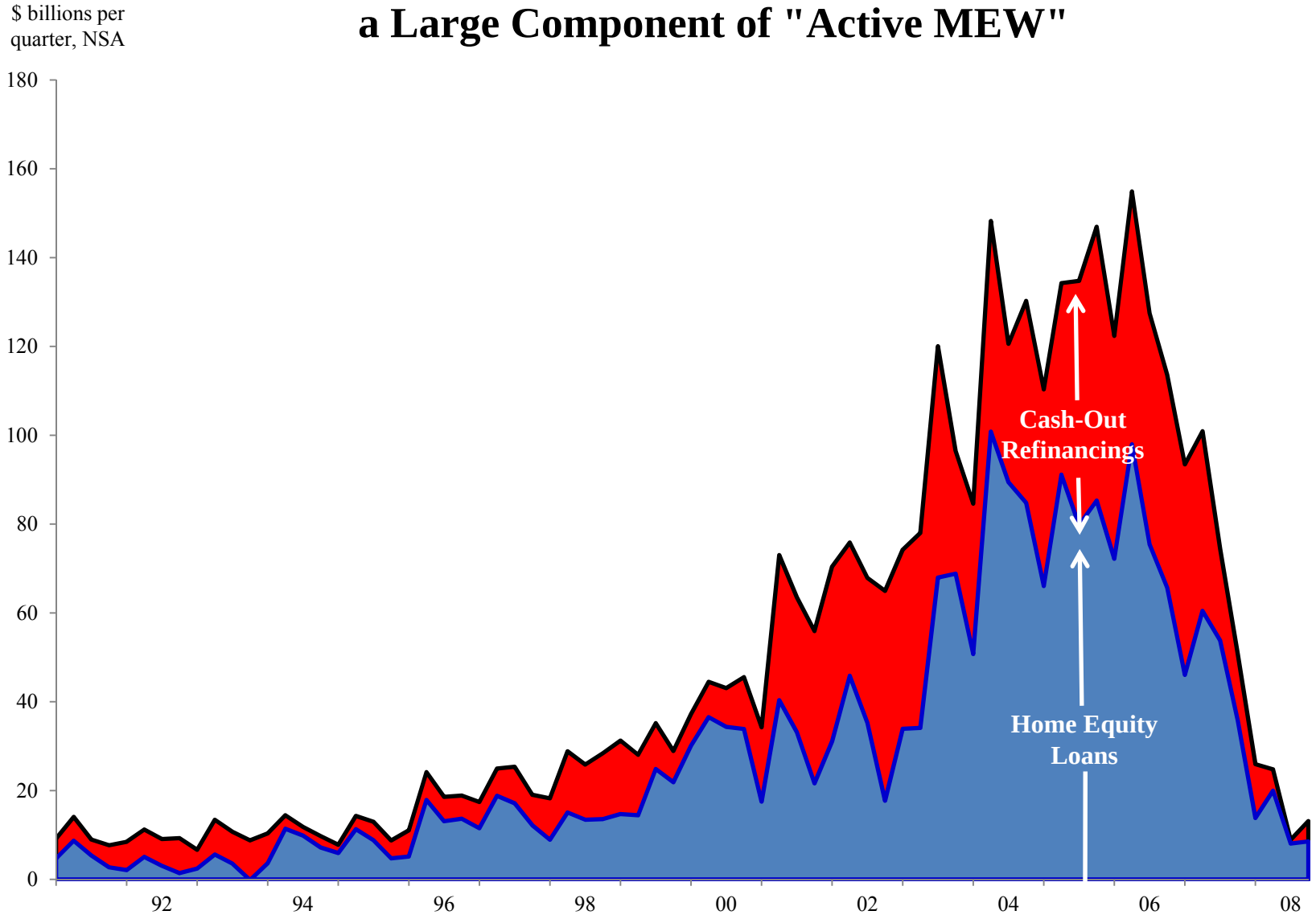
Housing 'Wealth' Versus Collateral Effects

- Under perfect capital markets with dynastic, Ricardian households, house prices have small negative effect on total consumption, perhaps small positive effect on nonhousing consumption.
- Positive estimated US housing 'wealth' effect may arise from:
  - Omitted future income expectations, because permanent income not current income matters.
  - Non-rational expectations.
  - Non-dynastic family behavior (mixed evidence of stronger housing wealth effect for older households);
- *HLI* allows for a collateral role for housing to affect non-housing consumption. See if the collateral view or conventional 'housing wealth' view is supported by assessing $HLI_t * HSG_{t-1}/y_t$ (collateral) versus HSG_{t-1}/y_t ('wealth' effect).

The Time-Varying Liquidity of Housing Wealth and Mortgage Equity Withdrawal

- MEW = Net Change Mortgage Debt – residential investment
- 3 main sources of change
  - home equity and 2nd mortgages
  - Cash-out mortgage refinancing : refinance old mortgage with larger new one
  - Don't fully roll over capital gains into next home purchase
- Relationship to house price appreciation changes over time due to changes in taxes, regulations, and innovation
- Active MEW HE, 2nd mortgages, cash-out refi's linked to C
- HLI measures ability to tap housing wealth – the mpc out of housing wealth
- US fixed rate mortgage option to refinance at lower interest rate

Cash-Out Refinancings Have Been a Large Component of "Active MEW"



Sources: updated data based on Greenspan and Kennedy (2008) and "Financial Literacy and Mortgage Equity Withdrawals," by John Duca and Anil Kumar, Dallas Fed Working Paper No. 1110, August 2011. Free cash extracted from these two components is roughly equal to "Active MEW" with some minor differences.

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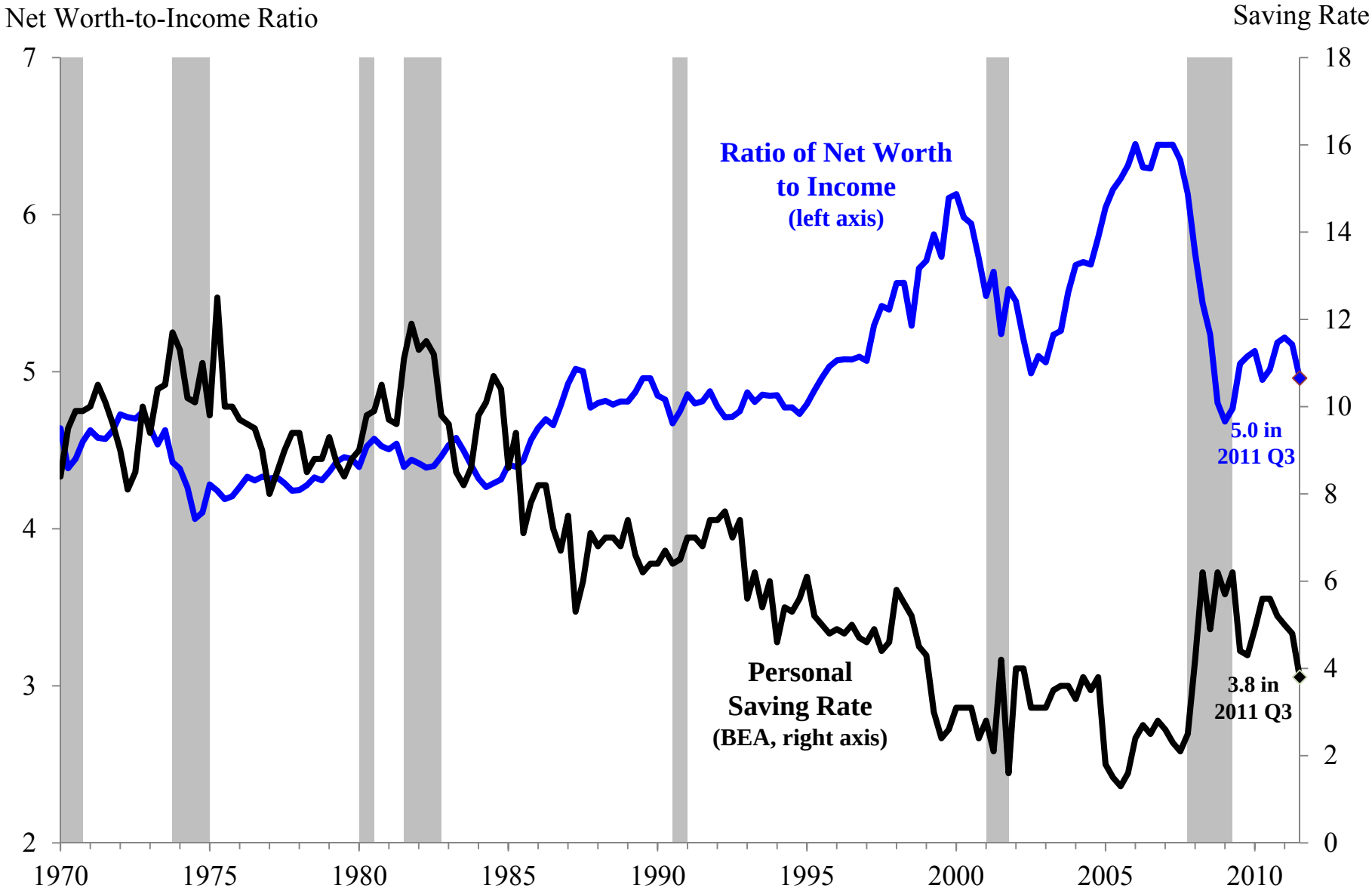

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Vast Change in U.S. Credit Market Architecture Since 1970

- Falling IT costs transformed payment & credit screening systems.
- Spread of credit card ownership.
- Securitization of conventional and, later, subprime mortgages.
- Tax changes e.g., 1986 Tax Reform Act.
- Deregulation, e.g., removal of deposit rate ceilings.
- New products – home equity lines of credit, cash-out mortgage refinancings ("refi's") … etc.
- Should structurally alter the consumption function
- Challenge of modeling changes in a parsimonious and economically meaningful way. Have some ways of proxying for ***CCI***, but not ***HLI***, using available, direct data measurement

Consumer Credit Index (*CCI*)

- Use diffusion index: how has bank's willingness to make consumer installment loans changed from 3 months ago: more willing (+2), somewhat more willing (+1), unchanged (0), somewhat less willing(-1), and much less willing (-2)
- Model index, adjust it for cyclical and interest rate effects:

  A) Model Credit standards = f[real riskless funding costs (-), outlook (+), quality loan portfolio (+), burden of regulation (-)]

$$CR = 15.27 - 3.03*\Delta RFF_t^{**} + 0.96*\Delta LEI2_t^{**} - 12.15*\Delta 4DEL_t^{**} + 26.47*MMDA_t^{**}$$
$$(4.51)\quad (-4.20)\qquad (4.75)\qquad (-2.80)\qquad (3.67)$$

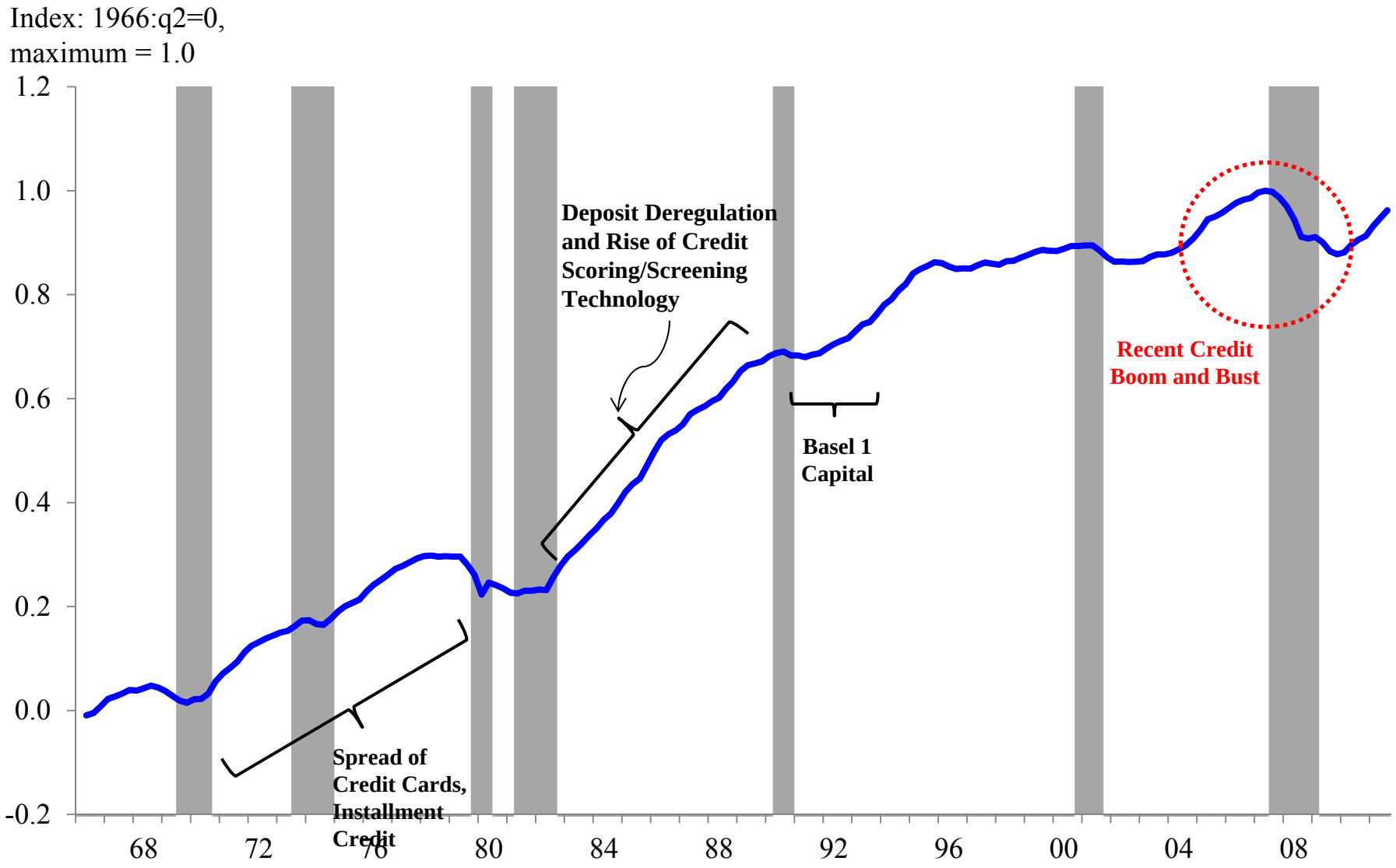
$$- 2.80*REGQ_t^{*} - 47.56*DCON_t^{**} - 4.93*LIBOR3_t^{**} - 20.38*LEHMAN_t^{**}$$
$$(-2.43)\qquad (-10.48)\qquad (-2.95)\qquad (-2.68)$$

$R^2 = 0.80$, AR(1) = 0.75^{**} (t stat.: 14.78), standard error = 9.09, LM(2) = 0.59, and Q(24) = 20.46

  B) $CRadjust = CR - 3.03*\Delta RFF_t - 0.96*\Delta LEI2_t - 12.15*\Delta 4DEL_t$

  C) Convert *CRadjust* into levels: ratio average growth rate of the ratio of real per capita consumer loan extensions (1966-1982:q4) to real per capital non-property income to the average of *CRAdjust* over this time period (.007390/7.5984).

Updated Figure 2: Consumer Credit Conditions Index Rises Sharply from 1970 to Mid-1990s, and Swings Since the Mid-2000s



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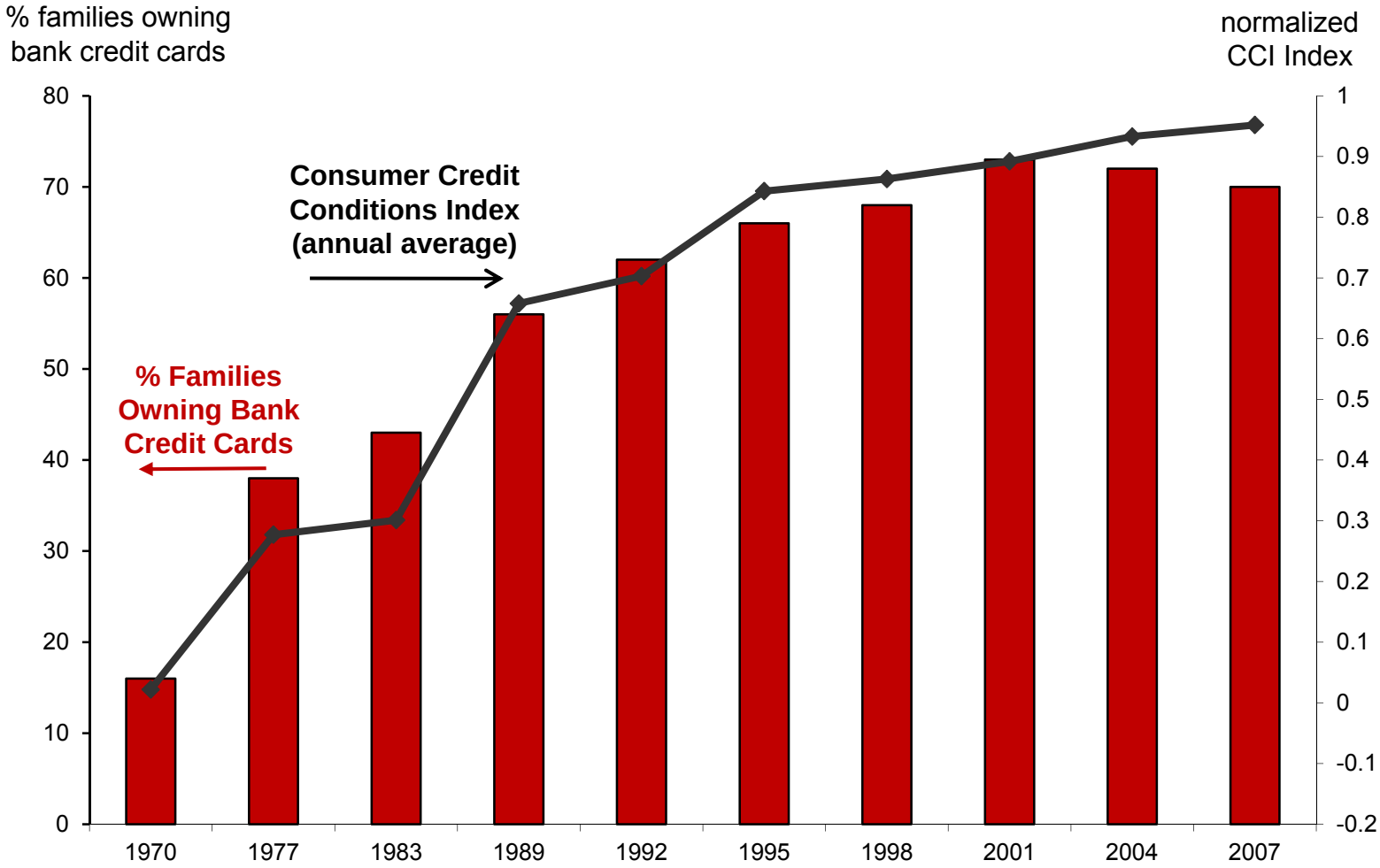
Credit Card Ownership Rates and the Consumer Credit Conditions Index



Notes: All credit cards generally excludes cards limited to only one particular retailer. Bank cards are those on which households can carry-over balances. Sources: Durkin (2000), Bertaut and Haliassios (2006) for 1992 data, Bucks, et al., (2007, 2009) for 2001-07, and authors' calculations using Bucks, et al. (2009) figures for bank card ownership in 2004 and 2007 in "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Outline of Model and Estimating *HLI*

- Estimate a two equation state space model of
  - Non-housing consumption spending (equation 2.5)
  - Mortgage refinancing (*REFI*) as a function of observable interest rate incentives to refinance mortgages and unobserved shifting costs of refinancing and the ability to borrow against housing wealth:

$$REFI = rr_1 REFI_{-1} + rr_2 \mathbf{HLI} + h(X) + rr_2 \mathbf{HLI} * h(X) + u^r$$

- Estimate housing liquidity ***HLI*** (the changing ability to borrow against housing wealth) as a common state/'local level' variable, interacted with other variables, in joint model
- The joint model of consumption and refinancing yields more precise estimates of the housing wealth mpc because ceteris paribus, refinancing rises with the liquidity of housing wealth
- Find housing collateral rather than traditional 'wealth' effect
- Plausible estimates of ***CCI*** and ***HLI*** effects, consistent with the historical narratives of market and regulatory practices

Housing Liquidity Index and Refinancing

- Mortgage refinancing model:

$$REFI_t = rr_1 REFI_{t-1} + rr_2 \boldsymbol{HLI}_t + h(\boldsymbol{X}_t) + rr_3 \boldsymbol{HLI}_t * h(\boldsymbol{X}_t) + u_t$$

$\boldsymbol{HLI}_t$ = liquidity of housing wealth

$\boldsymbol{X}_t$ = constant and interest rate incentives to refinance etc., including

PosGap = gap outstanding v. new mortgage rate if >0, 0 otherwise (+)

Low = 1 if avg. new mortgage rate is a 30 quarter low (+)

Payback = 1 after a 30 quarter low in interest rates X # lows in last 2 yrs

$\boldsymbol{RateFall}^e$ = 2 qtr average of index of interest rate expectations (U. Michigan), higher reading implies expect low rates (+)

LiborSpread = 3 month USD LIBOR - 3 month US T-bill rate (-)

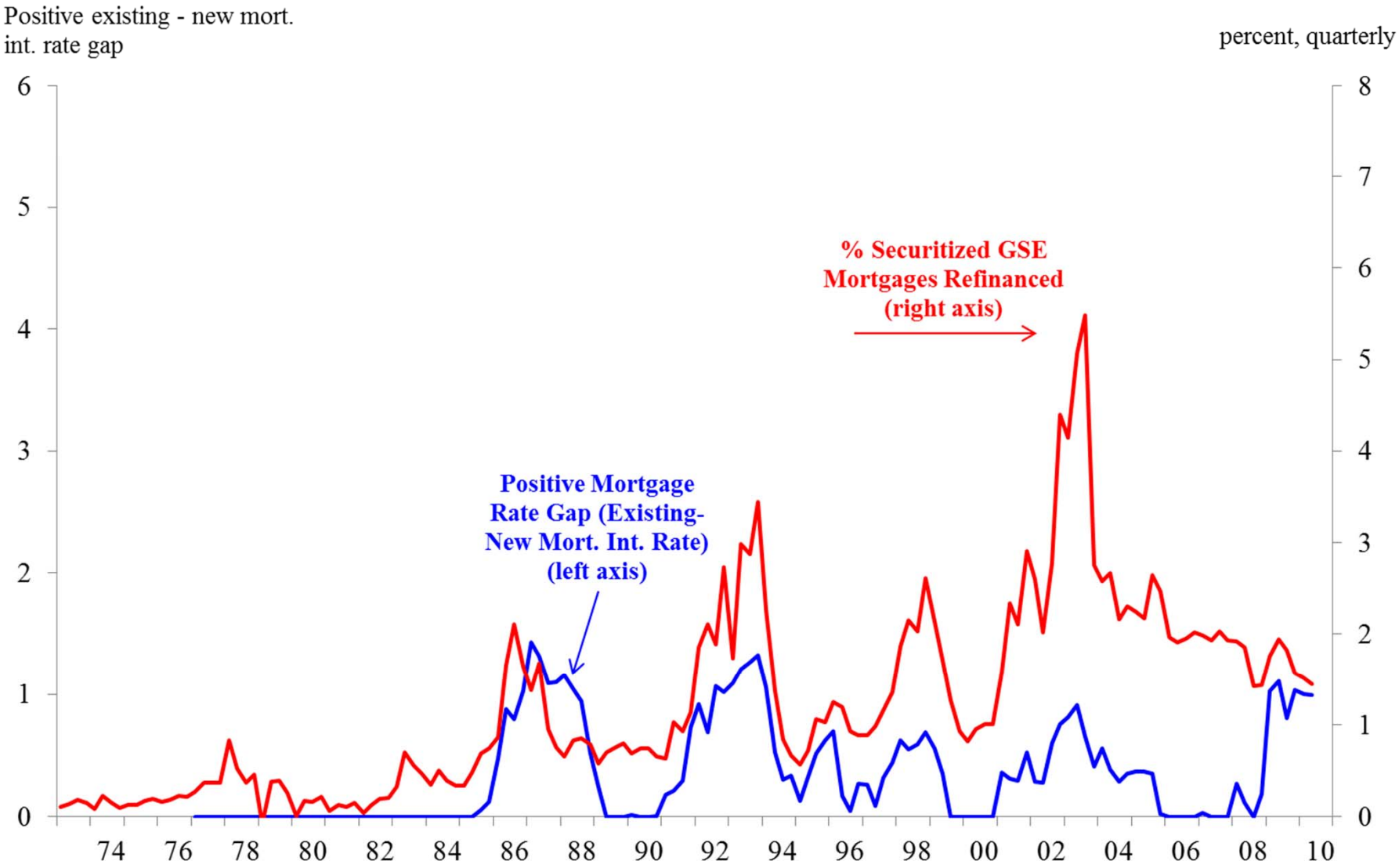
HSG/Y - MDEBT/Y = net housing wealth-to-income ratio (+, since more net equity => bigger variable incentive to refinance)

MortDel = 60-day plus delinquency rate on mortgages (-)

The Intuition Behind the Link Between the Housing Liquidity Index and Refinancing

- There are fixed costs to refinancing (fees, title insurance, nonpecuniary costs) which are not directly observable: latent
- The benefits in terms of lower interest rates are observable, but the benefits in terms of using a mortgage refinancing to borrow against housing equity are latent.
- *HLI* partially proxies for the latent fixed costs and the ability to replace the old mortgage with a larger mortgage. As financial innovation and regulatory changes lower these barriers and costs, *HLI* increases in value. In this sense, *HLI* is inversely related to these fixed costs/barriers and reflects the impact of financial innovations and regulation.
- Indeed, notable movements in our estimates of *HLI* coincide with major changes in regulation and financial practices.

Figure 4: U.S. Financial and Tax Innovations Linked to Changes in Refinancing Sensitivity to Swings in Mortgage Interest Rates



Sources: Mortgage Bankers Association, FHFA, authors' calculations, and "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Table 1 Two-Equation State Space Estimates of the Refinancing Equation

Dep. Variable: % Securitized GSE Mortgages Refinanced, 1973:q1-2010:q2

	Coefficient	*t-ratio*
h(X) part of refi equation		
PosGap(t)	0.300**	3.67
PosGap(t-1)	0.289**	2.64
PosGap(t-2)	-0.342**	-4.20
Payback(t)	-0.132**	-7.01
Low(t)	0.169*	2.45
Low(t-1)	0.168**	2.98
Low(t-2)	-0.098*	-2.46
Libor Spread	-0.092**	-3.70
Ssd81x Expected interest rate fall	0.171+	1.96
Net housing wealth/income	0.089	1.57
Overall equation		
Lagged refi rate	0.644**	12.11
HLI + *HLI x h*(X)	34.47**	5.99

Log Likelihood	568.49	R^2	0.971
AIC	-7.22	SIC	-6.68

Source: "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Figure 5: Estimated M.P.C.'s out of Housing Wealth From State Space Models

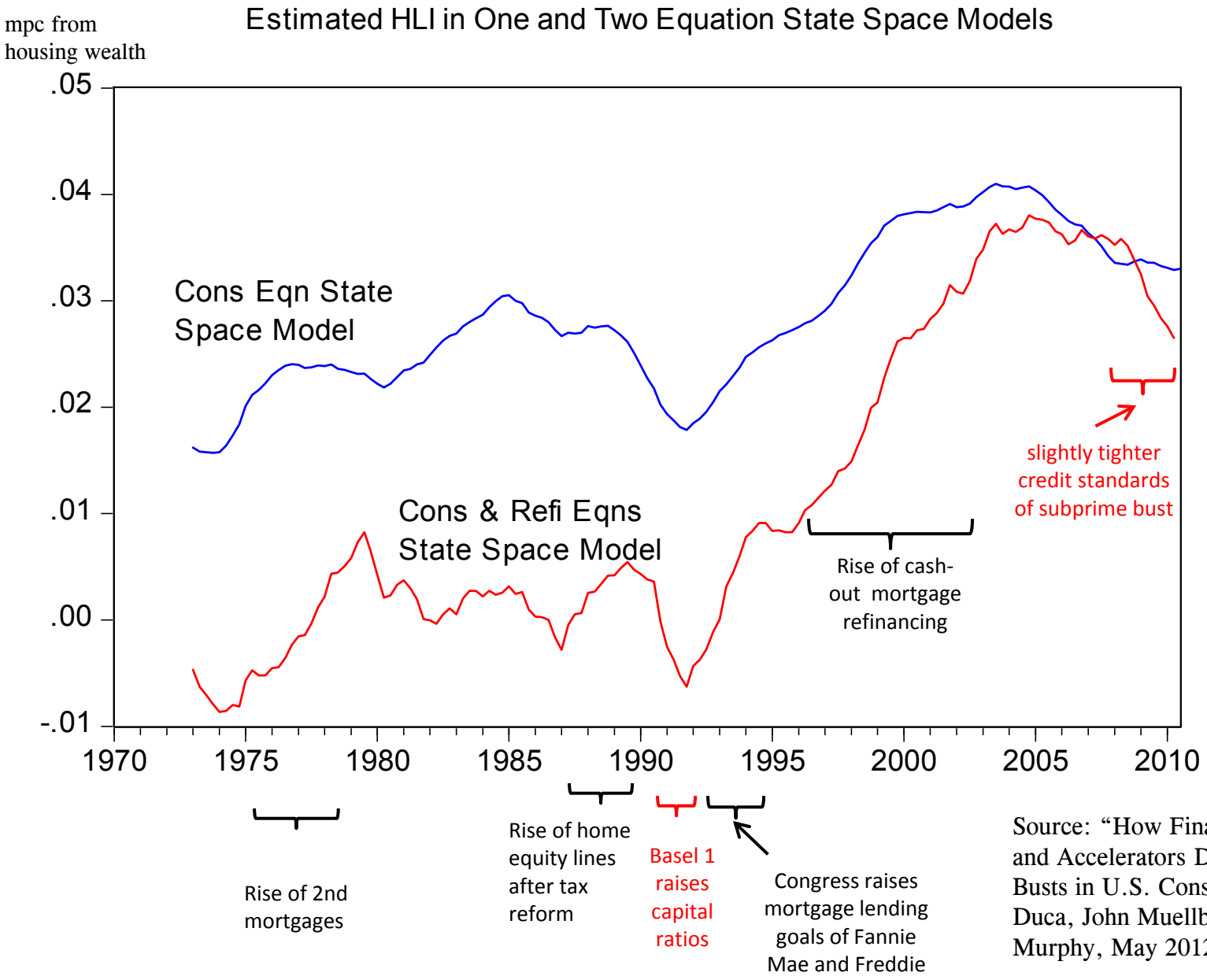


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Table 3: OLS and State Space Estimates of the Consumption Function

Dependent variable: $\Delta \ln c_t$ (consumption excluding housing services), Sample: 1973 q1 - 2010 q2

	Basic Equation OLS		One Equation State Space		Two Equation State Space	
	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat
Speed of adjustment (λ)	0.092*	3.16	0.261**	3.27	0.530**	10.06
Long Term Effects:						
Intercept	-0.017	0.95	-0.148+	1.88	-0.110	67.0
Unsecured credit conditions, *CCI*	-	-	0.106*	2.60	0.108	6.44
Lagged real interest rate	-0.0048	1.14	-0.0019	0.82	-0.0021	2.79
Future income growth	0.519*	1.76	0.333*	2.10	0.236	3.67
Net liquid assets / income	0.072+	1.84	0.089+	1.81	0.147	7.76
Illiquid financial assets / income	0.046**	3.57	0.019*	2.27	0.019	5.65
Housing wealth / income	0.050*	2.23	-	-	-	-
HLI x housing wealth / income	-	-	1	-	1	-
Short Run Effects:						
ΔLog income	0.272**	4.77	0.220**	3.38	0.103*	2.05
ΔNominal interest rate	-0.0064**	6.79	-0.0042**	4.55	-0.0036**	5.62
ΔUnemployment rate	-0.0090**	6.61	-0.0057**	4.84	-0.0049**	5.36
Oil shocks dummy	-0.0056*	2.12	-0.0045+	1.78	-0.0081**	6.54
State space housing wealth mpc:						
Maximum	-		0.041		0.038	
(Rmse)			(0.0024)		(0.0014)	
Equation SE ×100	0.53		0.44		0.40	
Adjusted R^2	0.54		0.67		0.74	
P Values (OLS Regression)*:*						
AR(5)/MA(5)	0.58		0.22		0.11	
Heteroscedasticity	0.00		0.00		0.00	
RESET(2)	0.15		0.24		0.57	
Normality	0.75		0.17		0.25	

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2 Eq. State Space (HLI, CCI) Model Outperforms NeoClassical Consumption Model

- **Better fit** (corrected R^2 of .74 vs. .54; SE about 25% lower), reflects significance of *CCI* and *HLI*, along with disaggregating wealth and controlling for uncertainty
- **Faster speed of adjustment** (53% vs. 9%) suggests more sophisticated model overcomes misspecification of the neoclassical model
- **Current income growth becomes less significant**—suggests that the 2 eq. model does a better job in controlling for the effects of credit constraints and collateral
- **2 eq. state space model outperforms 1 eq. state space model**: fit, speed of adjustment, and tighter standard error bands

Sensitivities of Consumption to Wealth

Estimated $ Change in Annual Total Consumption
Per $100 Increase In Wealth
(Marginal Propensity to Consume, mpc)

Net Liquid Assets	Illiquid Financial Assets	Gross Housing Assets
$14.7	$1.9	$3.8 at peak

Source: "How Financial Innovations and Accelerators Drive Booms and Busts in U.S. Consumption," by John Duca, John Muellbauer, and Anthony Murphy, May 2012.

Estimated Wealth Effects

	MPC out of net liquid assets	MPC out of illiquid financial assets	Peak MPC out of housing wealth
US – Excluding Housing Services	**0.147**	**0.019**	**0.038**
US - Total Consumption	0.163	0.023	0.051
UK - Total Consumption	0.114	0.022	0.043
Australia - Total Consumption	0.159	0.022	0.049

- **Ranking of mpc's by liquidity** consistent with recent micro and some macro studies.
- **Collateral role** of housing consistent with recent micro studies.
- **Housing 'wealth' mpc** lower than in recent macro studies, e.g., Carroll, Otsuka and Slacalek (*JMCB*, 2011, Table 4) suggest that the long run housing wealth mpc is between 8% and 16%

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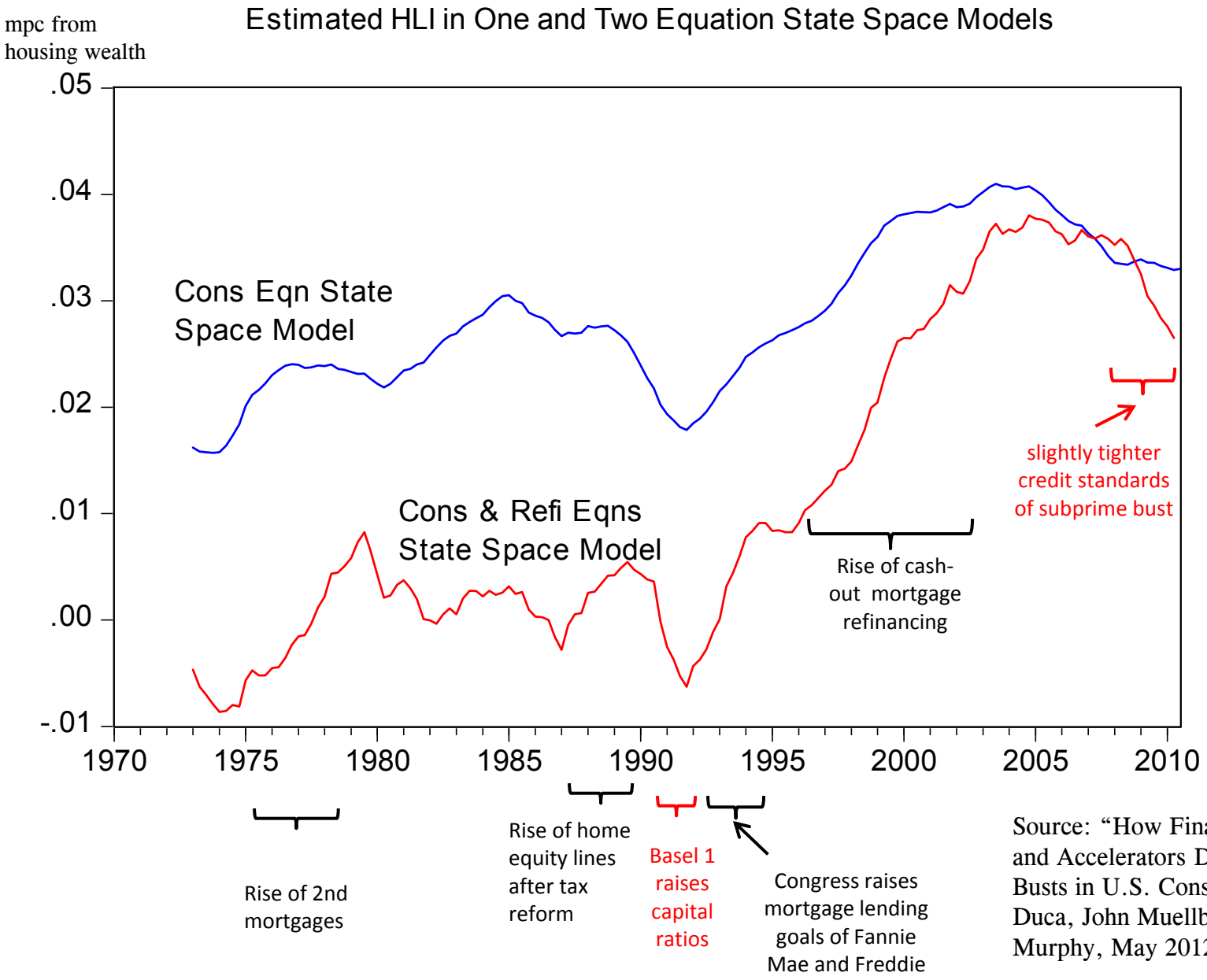

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Figure 7: Long-run Equilibrium Relationship in Credit-Augmented Model Tracks the Fall in the Consumption-to-Income Ratio Since the Financial Crisis

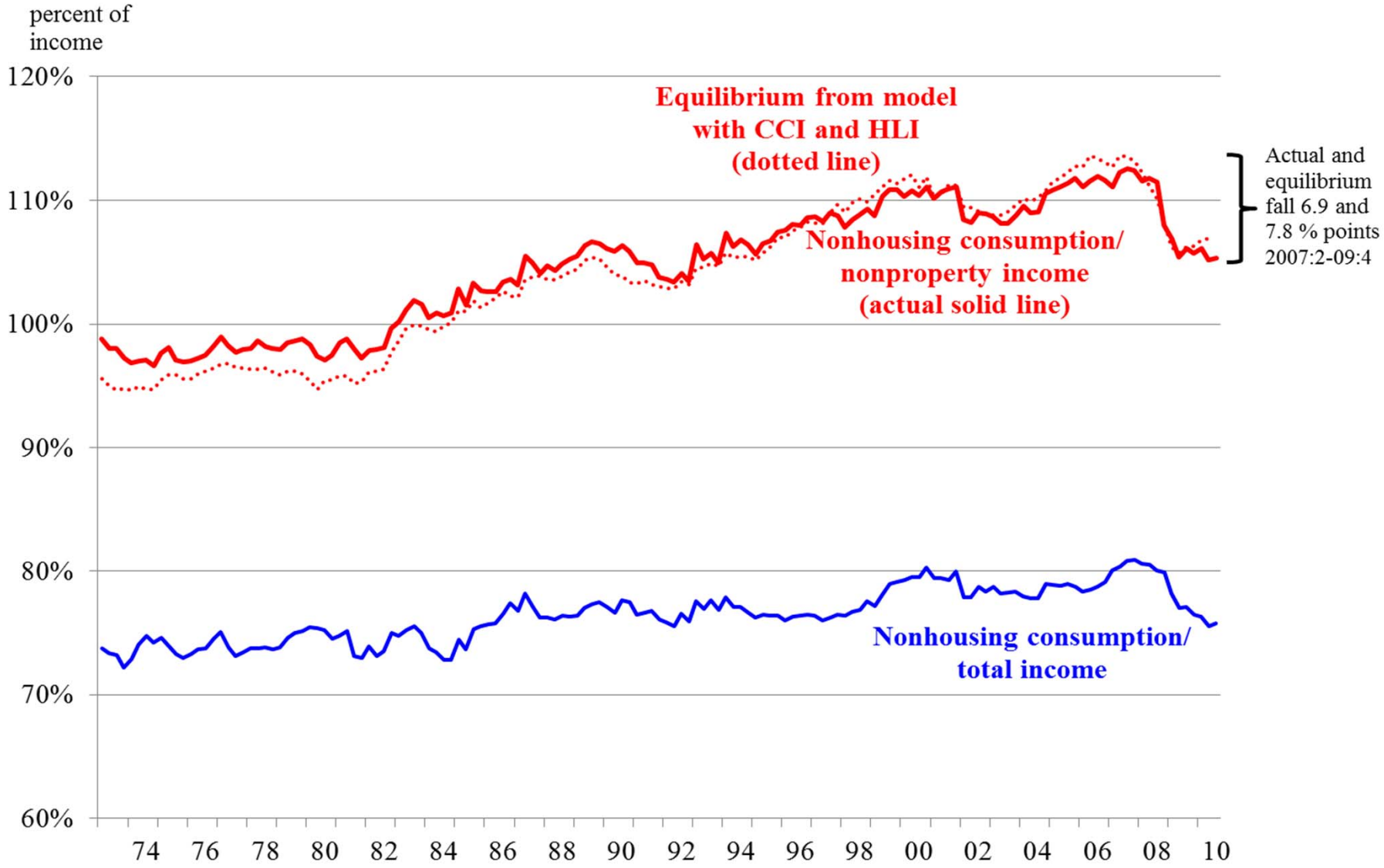

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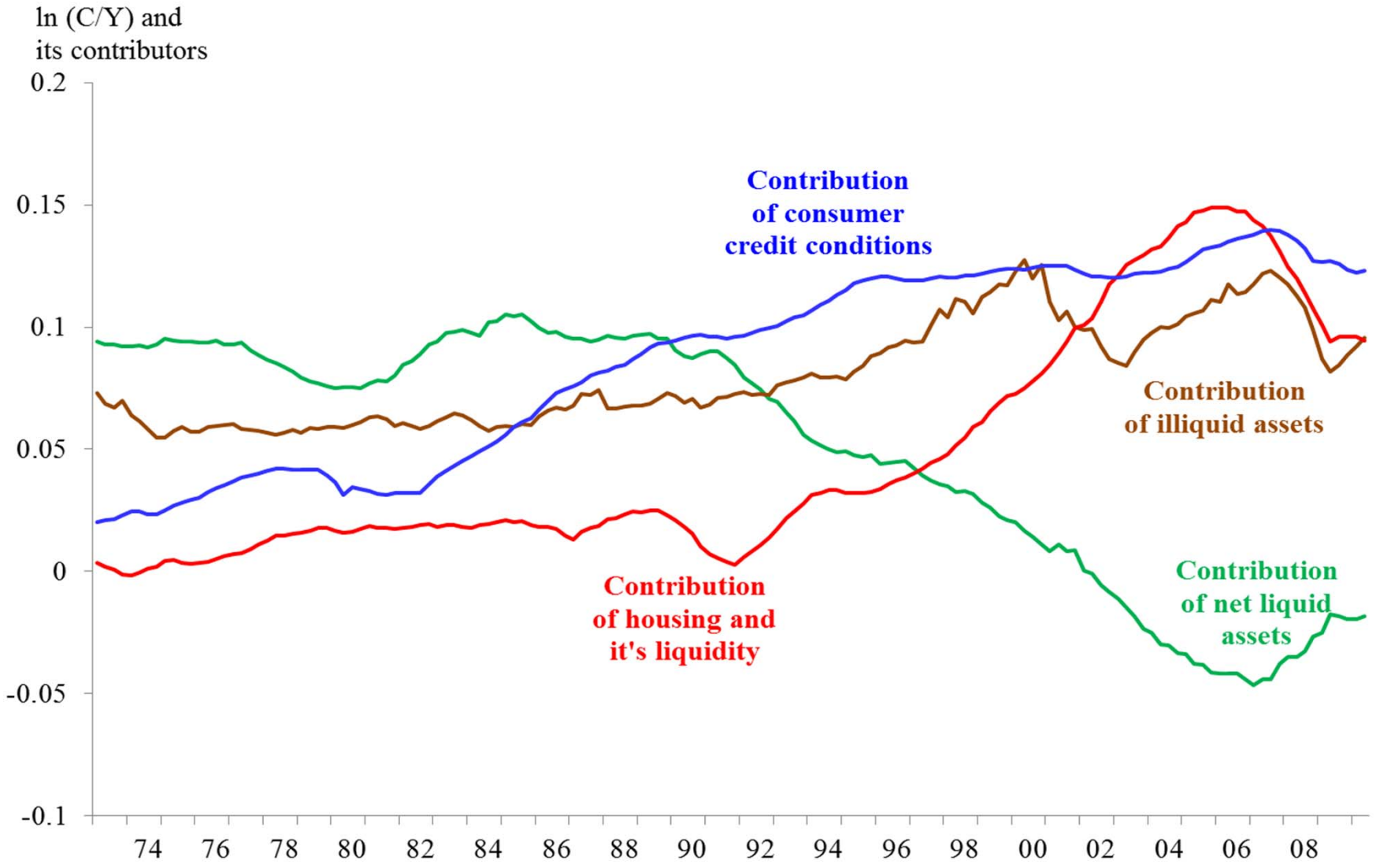
Figure 8: Estimated Equilbrium Components of Log Ratio of NonHousing Consumption to NonProperty Income



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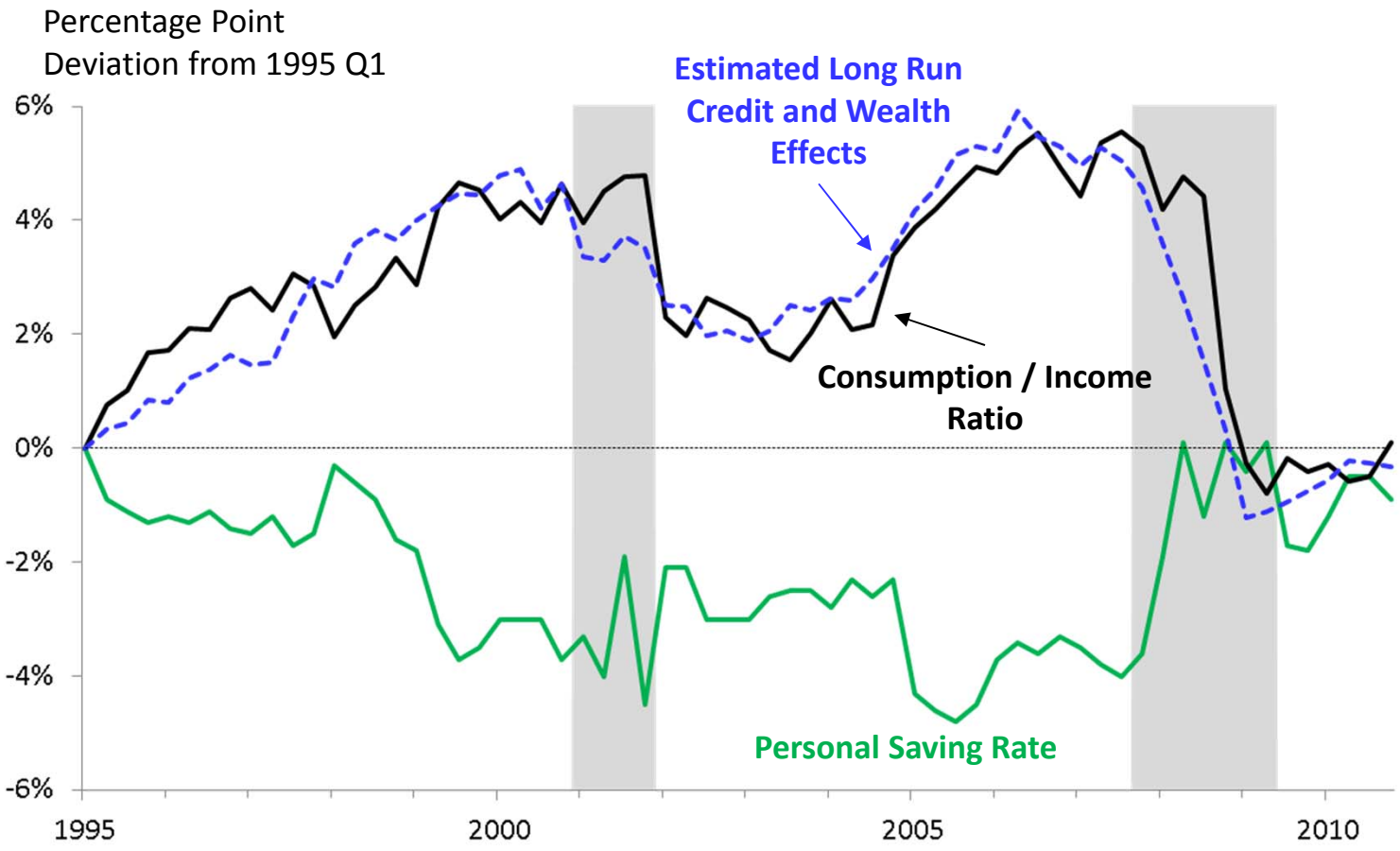
Our Model Fits Well – Wealth and Credit Effects are Key Drivers of Household Spending



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Cointegration Findings

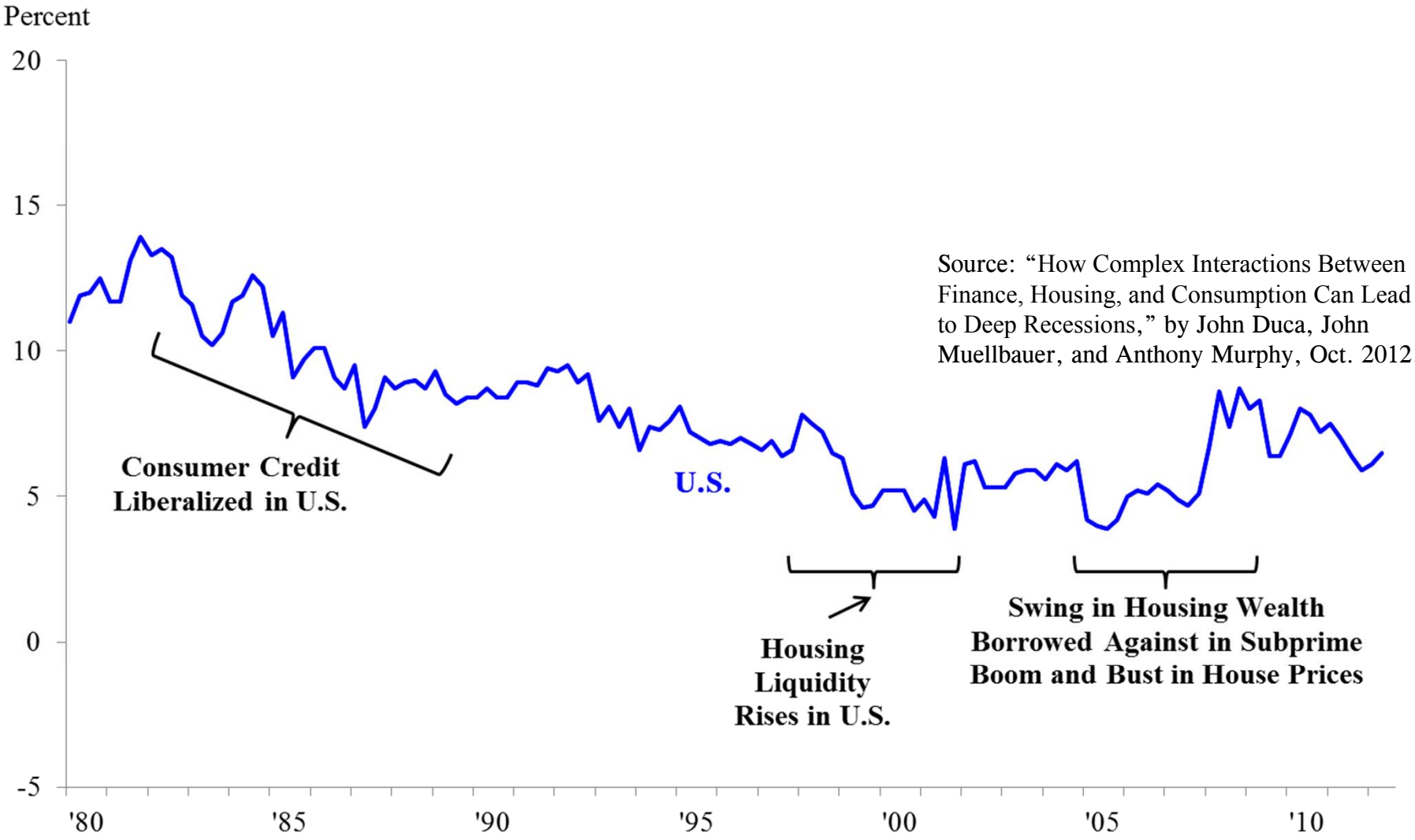
- Cointegration NOT found for vectors including only
  - consumption, income, 3 wealth ratios
  - consumption, income, 3 wealth ratios, CCI
  - consumption, income, NLA/y, IFA/y, and HLI x housing wealth/y
- Cointegration only found for vector including consumption, income, NLA/y, IFA/y, and HLI x housing wealth/y, and CCI. Also, the non-consumption components are weakly exogenous in a VECM, reflecting that consumption is granger caused by income, wealth, HLI, and CCI in a long-run sense.
- These results are
  - not only consistent with other findings that models of consumption need to account for both consumer and housing credit constraints
  - but also address concerns that the consumption variables reflect endogenous choices (tenure and mobility for the refinancing equation and the key drivers in the consumption equation).

Conclusions – Understanding the Booms and Busts in U.S. Consumption

- Important role for financial frictions in consumption:
  - Exogenous supply of unsecured consumer credit;
  - Changing liquidity of housing wealth;
  - Financial innovations and frictions affect both channels.
- Back of the envelope calculations for 2007 to 2009:
  - Ratio of C/Y falls (savings rate rises) by about 6%;
  - Some impact of reversal in consumer credit (1-⅔%) ;
  - Large impact of falling housing wealth and mortgage debt from peak and, to a much lesser extent, its liquidity (5%).

Both Financial Frictions and Evolving Financial Architecture Play Critical Roles in Booms and Busts in U.S. Consumer Spending and in many countries where finance is being transformed

Gross Household Saving Rates Fall in Financially Liberalized Anglo-American Economies, but Generally Not in Non-Financially Liberalized Advanced Economies



Source: "How Complex Interactions Between Finance, Housing, and Consumption Can Lead to Deep Recessions," by John Duca, John Muellbauer, and Anthony Murphy, Oct. 2012.

Gross savings rates with some minor definitional differences across countries. Sources: Statistisches Bundesamt; Swiss Federal Statistical Office; Office for National Statistics; and Bureau of Economic Analysis.

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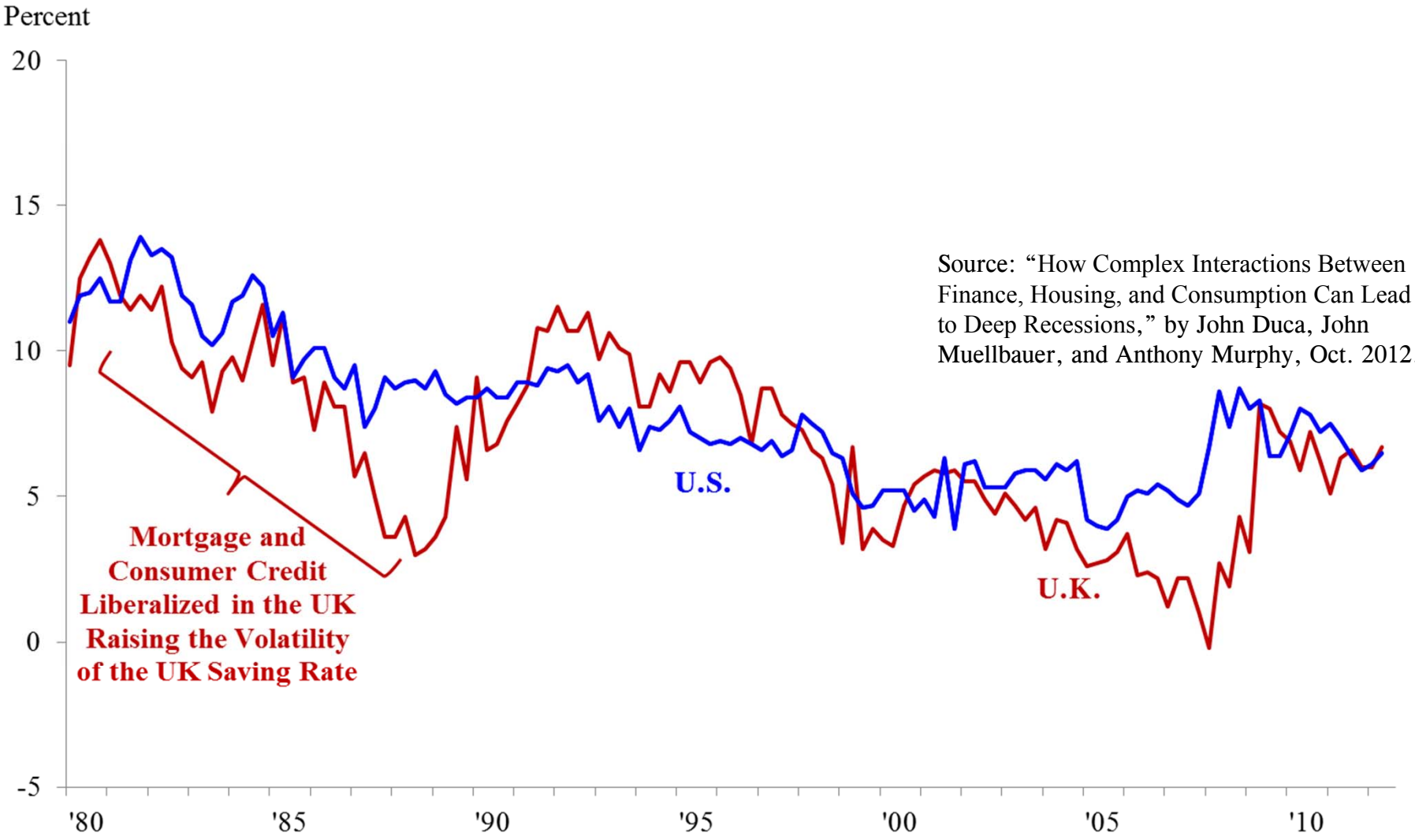

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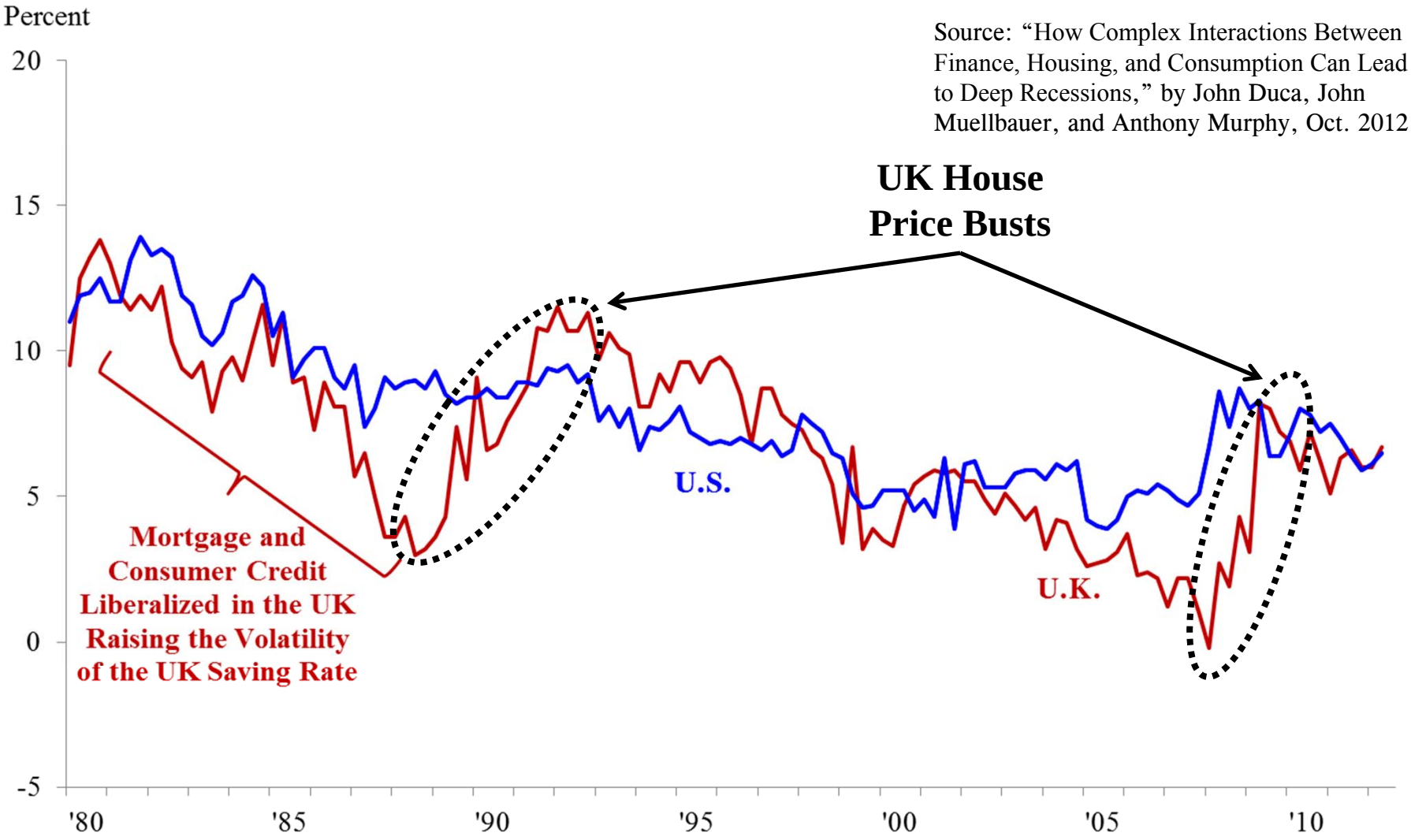

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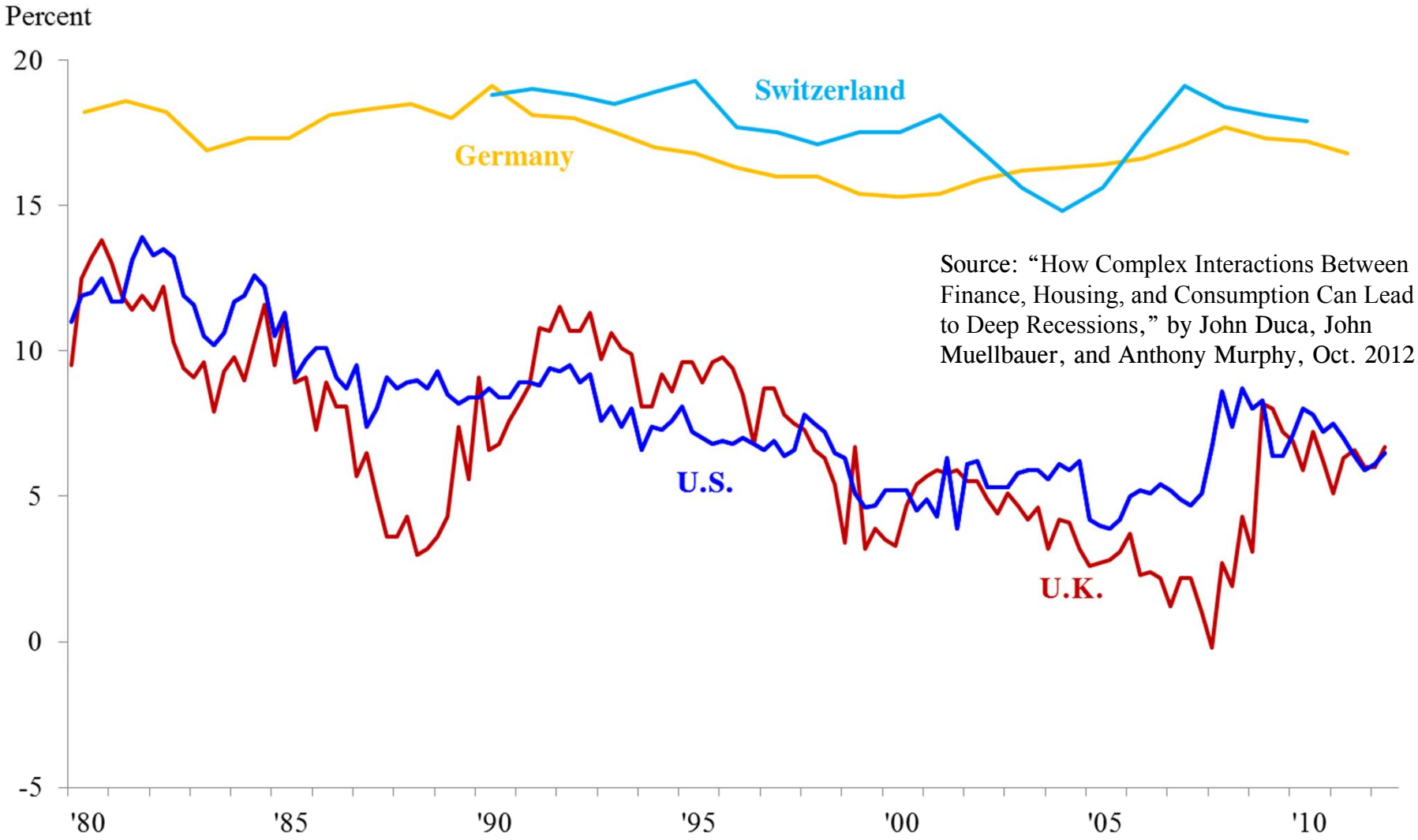

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