Tax News

Identifying Tax Expectations from Municipal Bonds with an Application to Household Consumption

Lorenz Kueng

Kellogg and NBER

Two Basic Questions

1. How predictable are personal income tax rates in the U.S.?

2. Does household consumption respond to news about future taxes?

Answer in Two Parts

1. Part: Identify Tax News Shocks from Bond Prices

   Use **no arbitrage** between taxable and tax-exempt bond yields (prices)

   $(1 - \theta_{t,m}) y^T_{t,m} = y^{\mathcal{M}}_{t,m} \quad \Rightarrow \quad \theta_{t,m}$ time series identifies **timing of news shock**

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in vector form: $\theta_t \quad \Rightarrow \quad \mathbb{E}_t \tau$ term structure identifies **expected persistence** of tax shock

$\Rightarrow$ **entire path of expected tax rates** $\mathbb{E}_t \tau$

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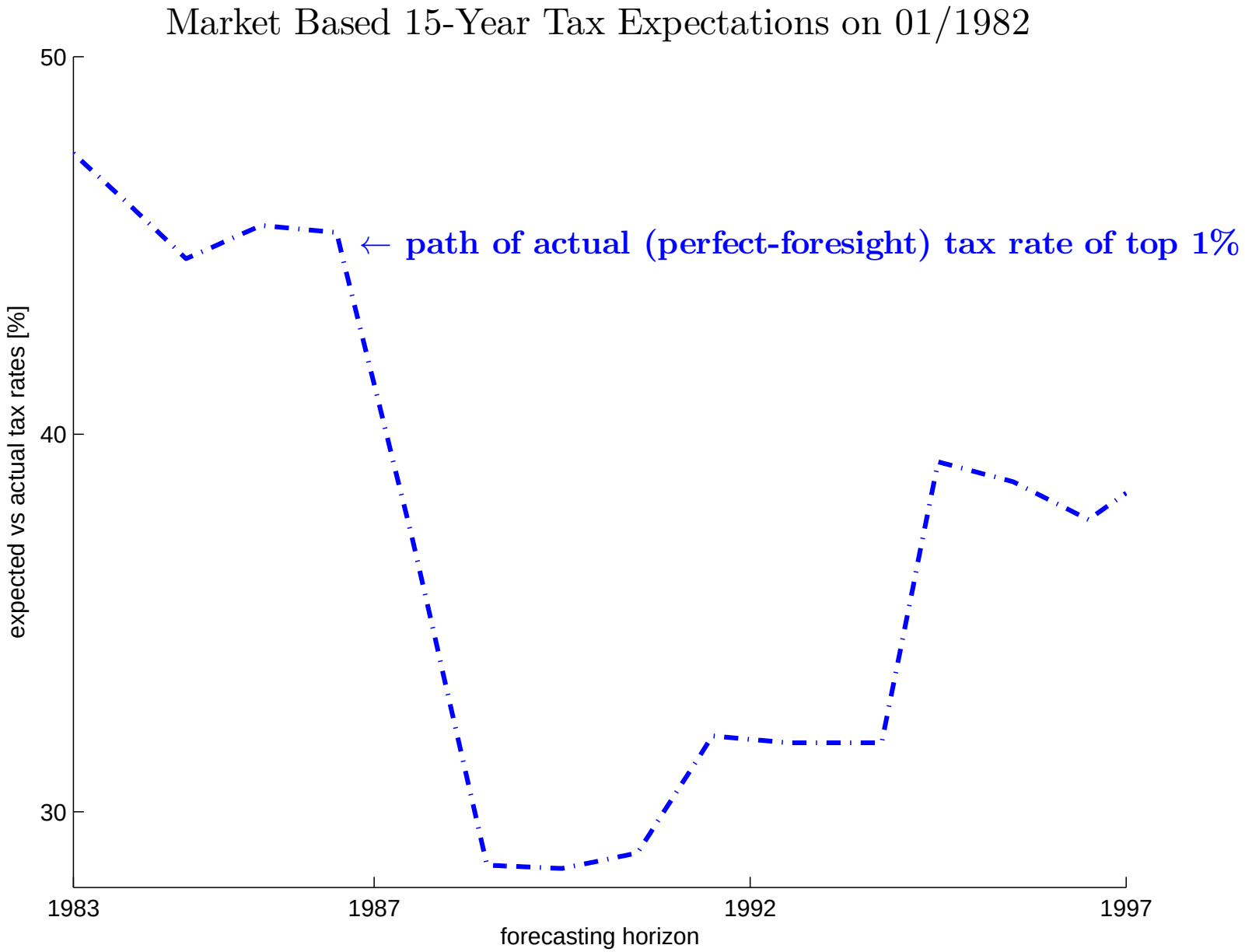
Let me start with a **preview of the results**.

1st Part: Identify Tax News from Bond Yields



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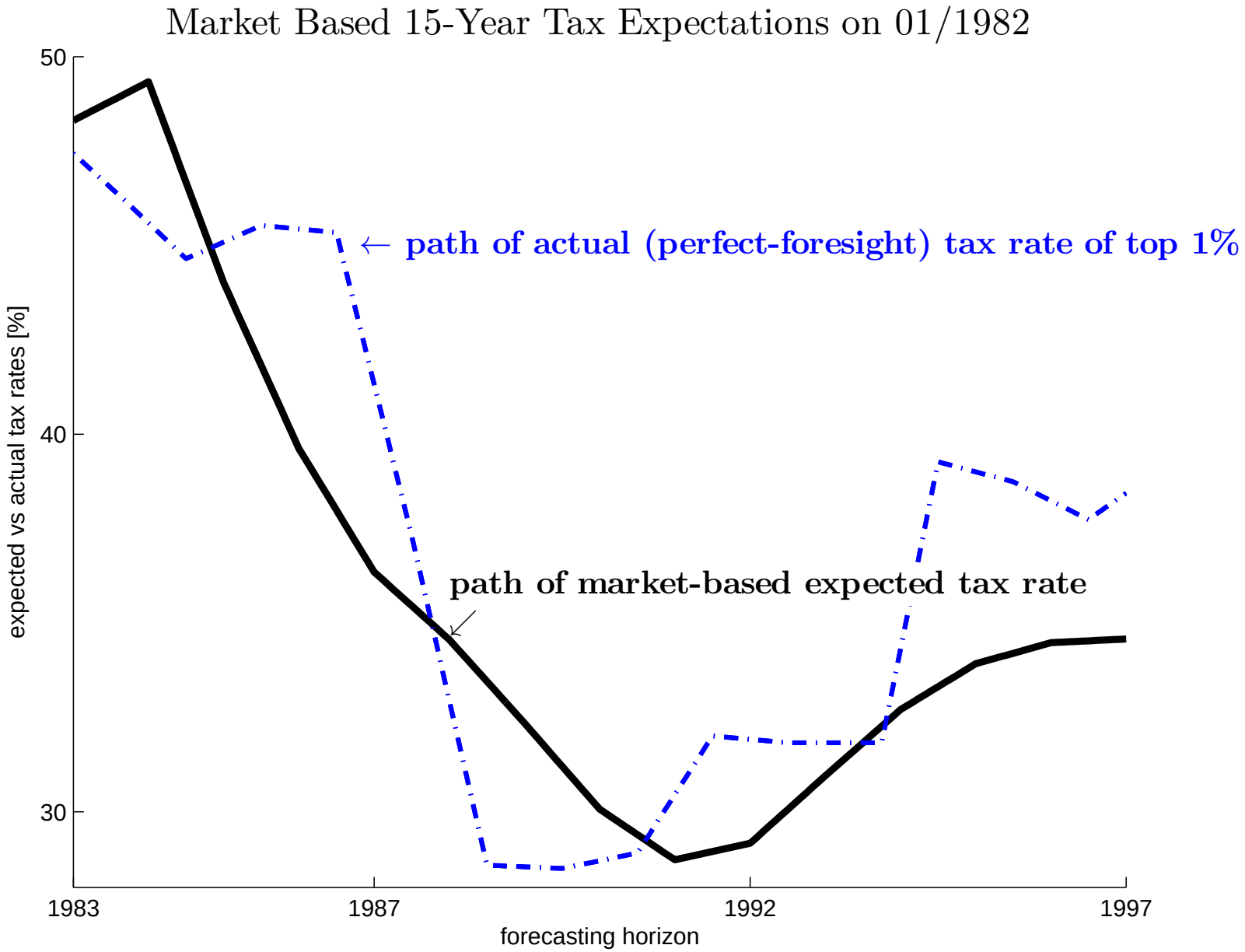
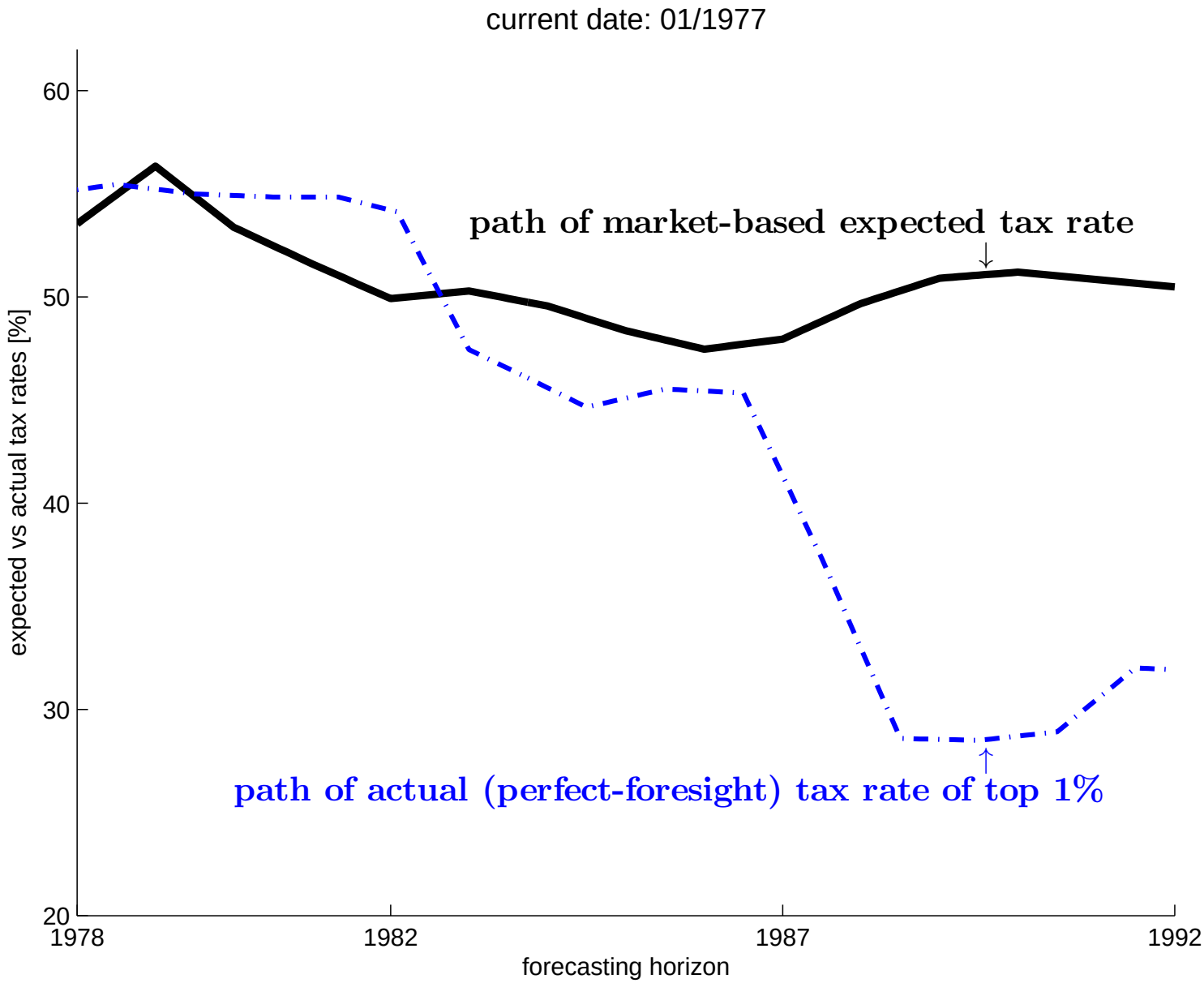
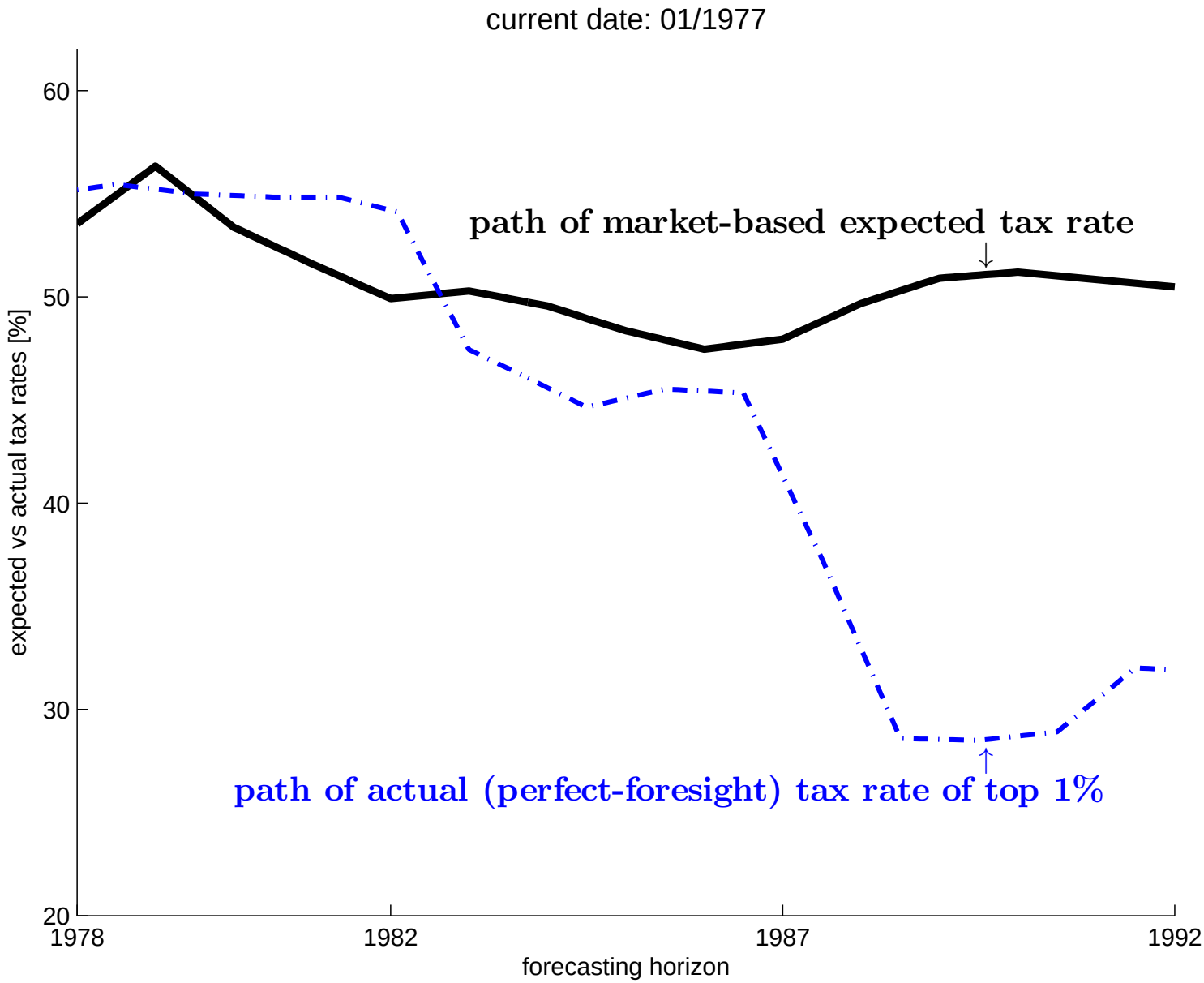
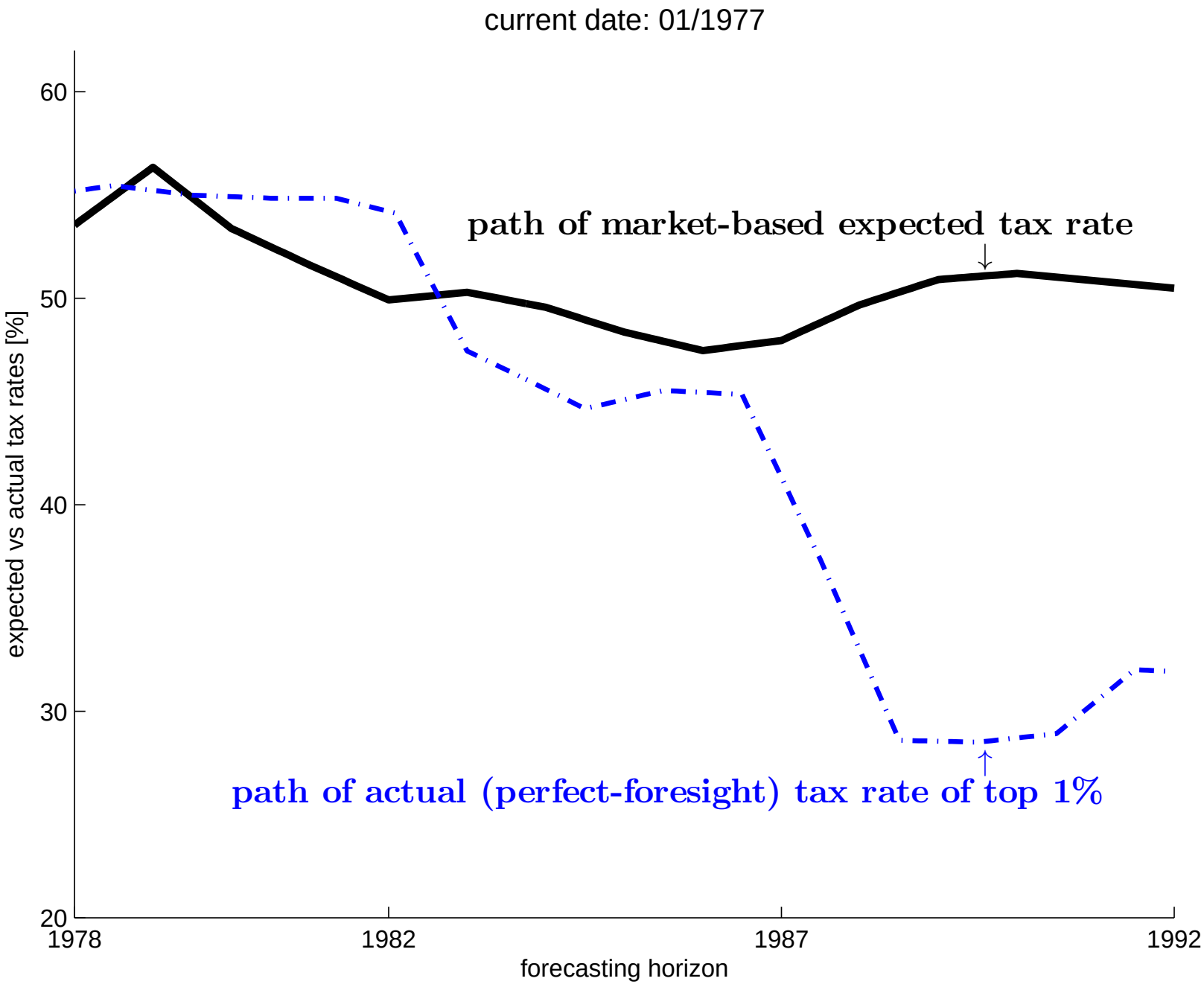


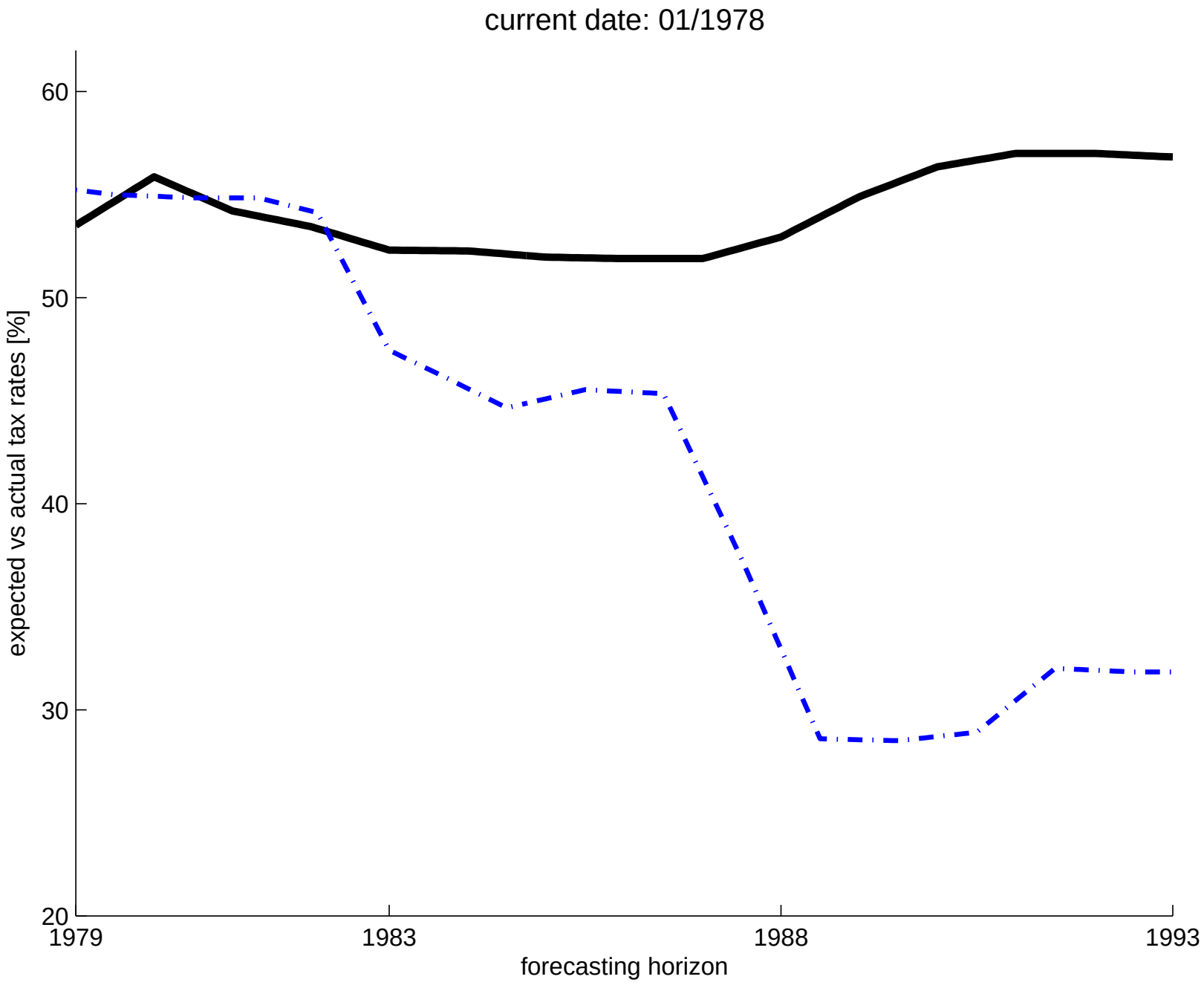
The Path of Expected Tax Rates in the Run-Up to the Reagan Tax Cuts



The Path of Expected Tax Rates in the Run-Up to the Reagan Tax Cuts – The Movie




current date: 01/1977
path of market-based expected tax rate
path of actual (perfect-foresight) tax rate of top 1%
expected vs actual tax rates [%]
forecasting horizon
60
50
40
30
20
1978
1982
1987
1992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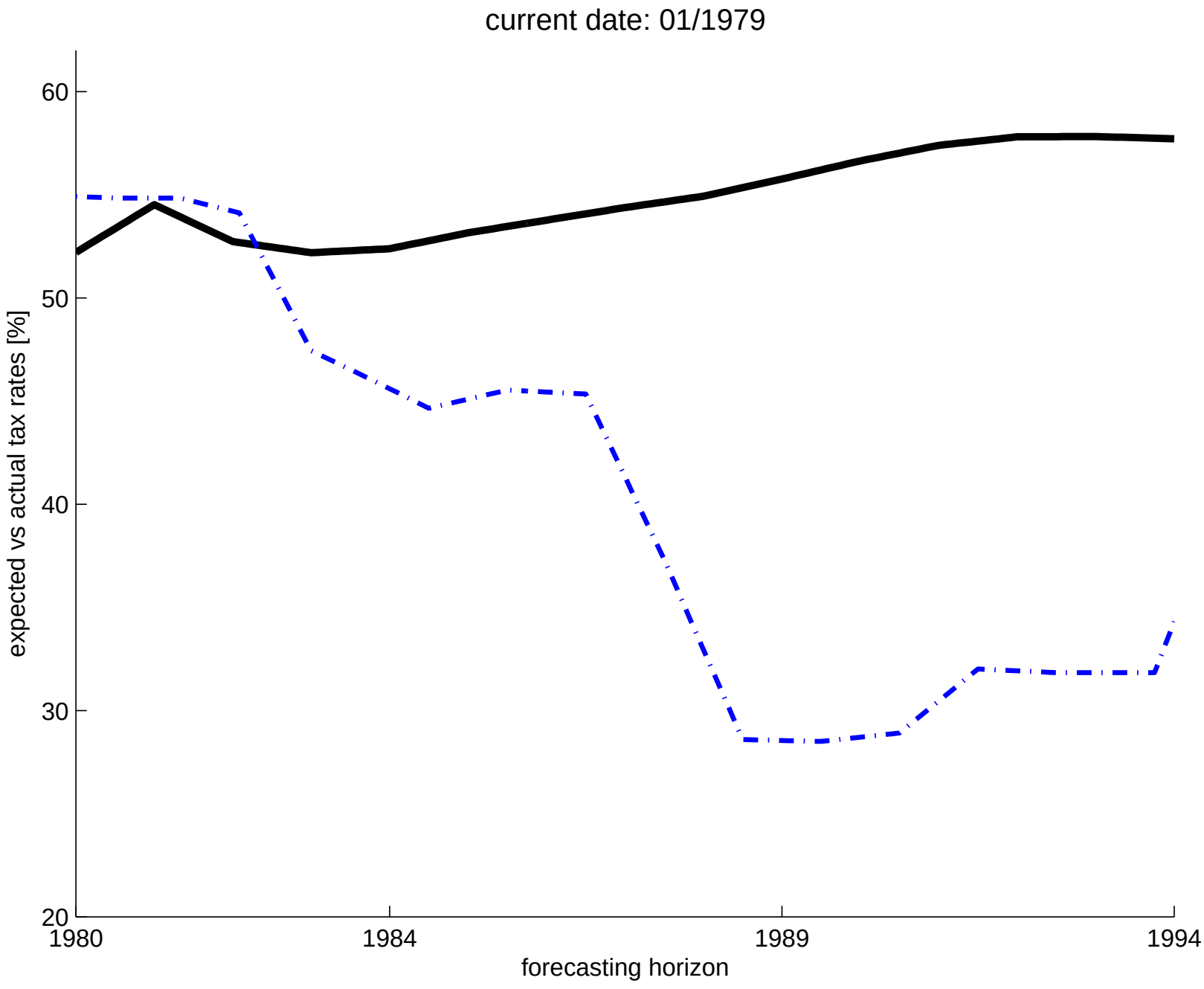
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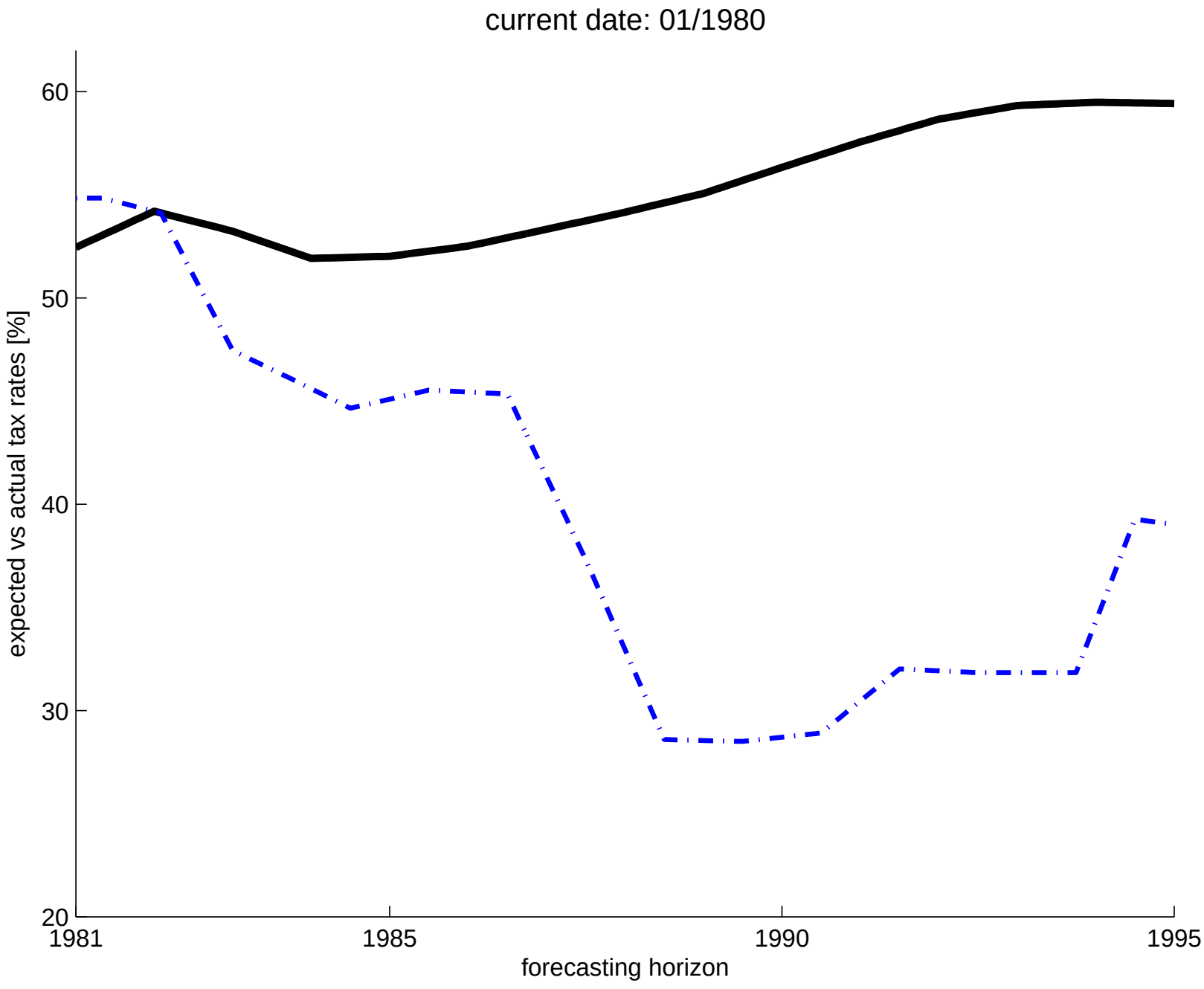
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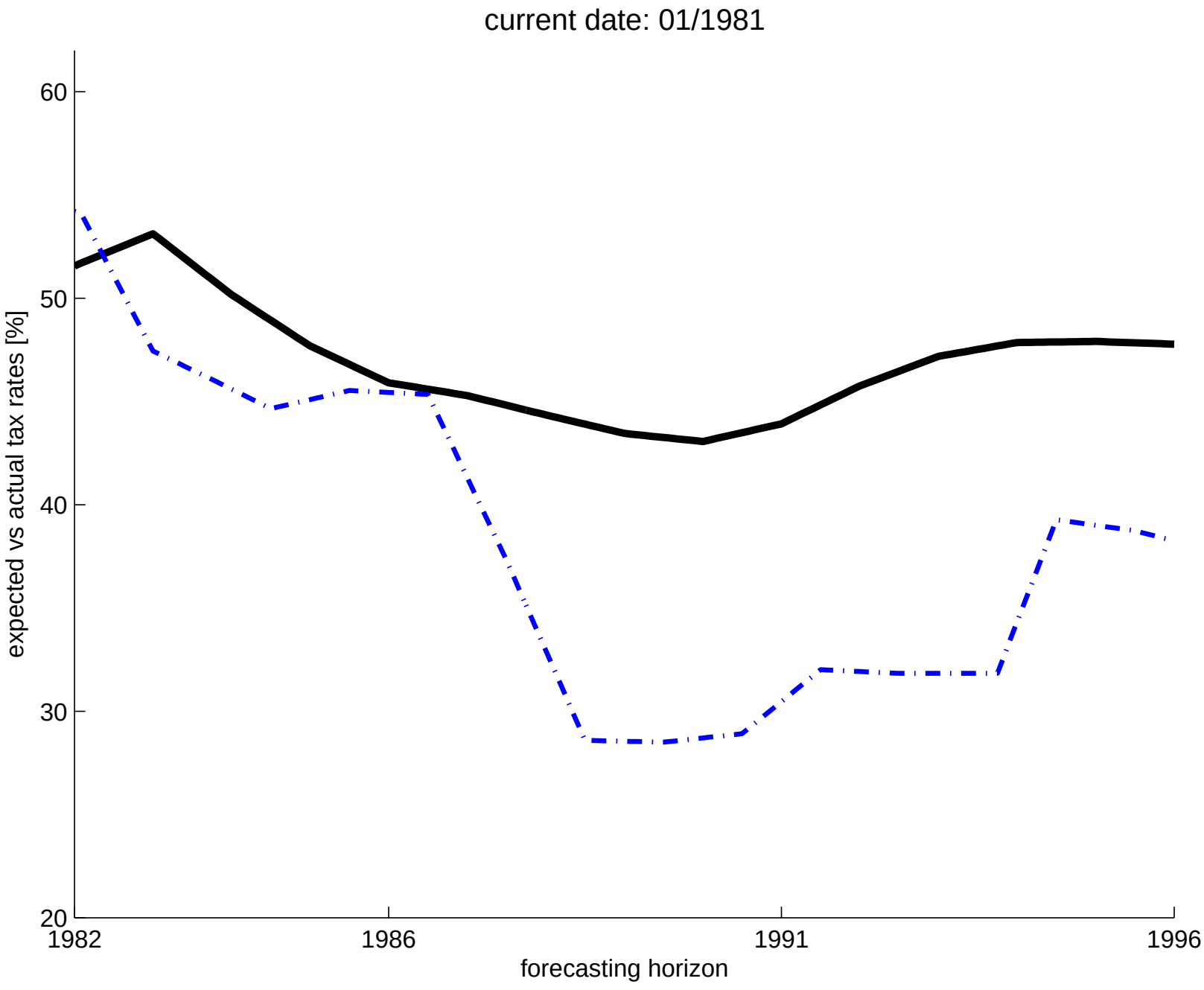
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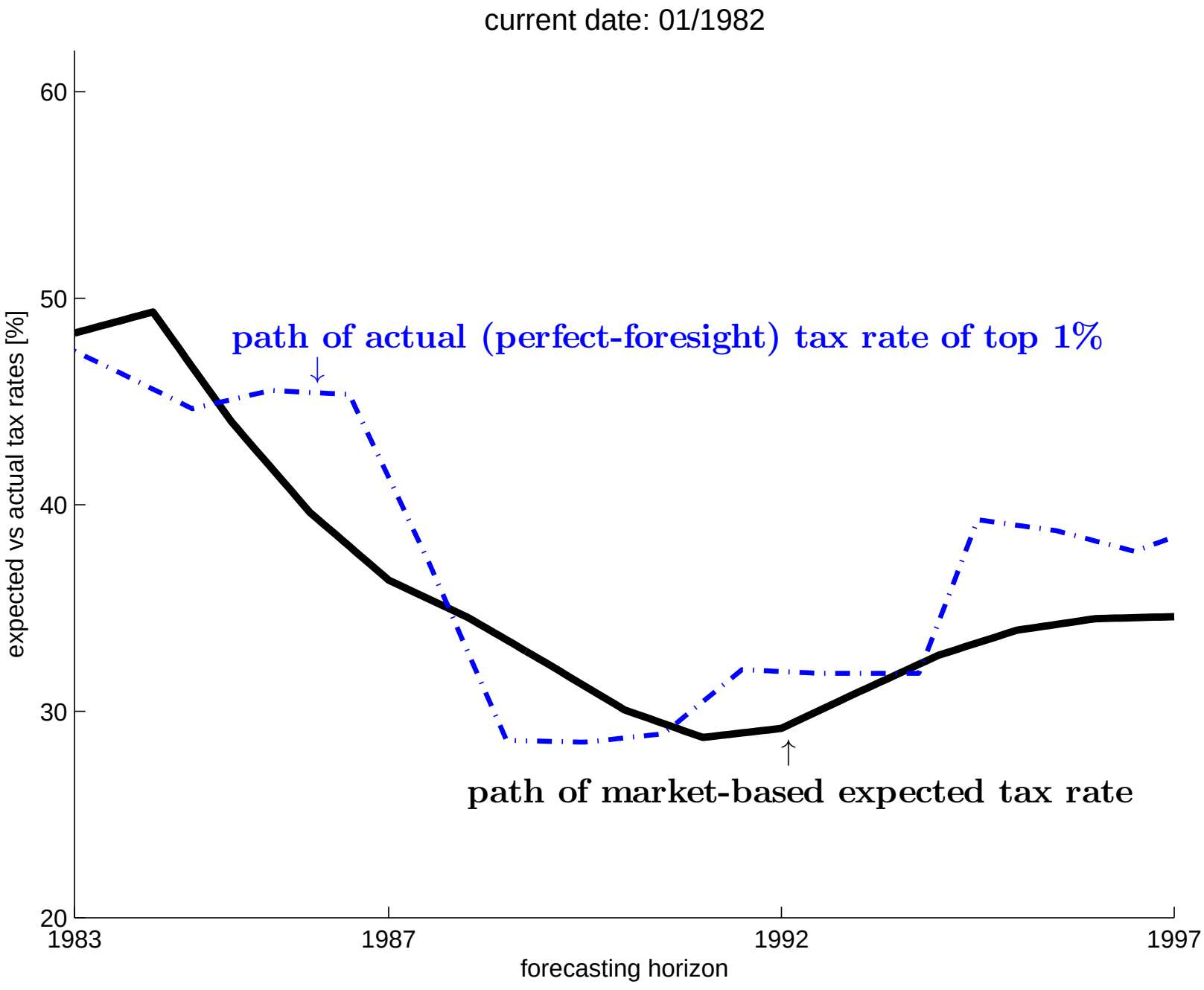
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2nd Part: Consumption Response to News

$$\Delta c_t \approx \beta \cdot \Delta \mathbb{E}_t[\text{ Annuity-Value of Lifetime Tax Liability }]$$

Basic Rational-Expectations Life-Cycle Model : $\beta = -1$

Cash-on-Hand Model : $\beta = 0$

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- Response of **lower-income HHs** (AGI$\leq p_{50}$) weaker
$$\hat{\beta} = -0.10 \ (0.23)$$
- Two possible explanations:
  1. lower-income HH more liquidity constrained or less forward-looking
  2. external validity of news shock breaks down

Contributions to the Literature

1. **tax forecasting** (e.g. Fortune, Poterba, Ang etal)
2. macro effects of **news shocks** (e.g. Beaudry–Portier, Ramey, Schmitt-Grohe–Uribe, Mertens–Ravn) and **expectation formation** (e.g. Mankiw–Reis, Woodford)
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3.a) **consumption theory**: in general

	news		**expected shock**		**unexpected shock**	
data	small	large	small	large	small	large
micro	–	–	Shea Parker	Paxon Hsieh Browning+		Fuchs-Schuendeln
macro	Leeper+		Wilcox	Campbell+		

3.b) **consumption** theory : **response to tax shocks**

	news	**withholding**	**rebate**	**refund**	**payment**
micro	–	Souleles 02	Parker+ 06	Souleles 99	Kueng 11b
macro	Poterba 88	Blinder 81	Taylor 09	–	–

1ST Part: Identify Tax News Shocks

1. Accounting for **Factors other than Tax News**
   - 1.1 choice of bond data
   - 1.2 modeling the term structure of yield spreads (relating θ_t to $\mathbb{E}_t\tau$)
2. Identify **Marginal Investor** (which tax rate $\mathbb{E}_t\tau$?)

   A. **Portfolio Evidence**
   - 2.1 households vs. corporations (Flow of Funds)
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Factors other than federal income taxes that might affect the municipal yield spread:

1. **credit risk** $\Rightarrow$ I use **AAA general-obligation** (GO) **state bonds**

Evidence 1: Historical Bond Default Rates [in %]

	Municipal Bonds		**Corporate Bonds**	
	Moody's	S&P	Moody's	S&P
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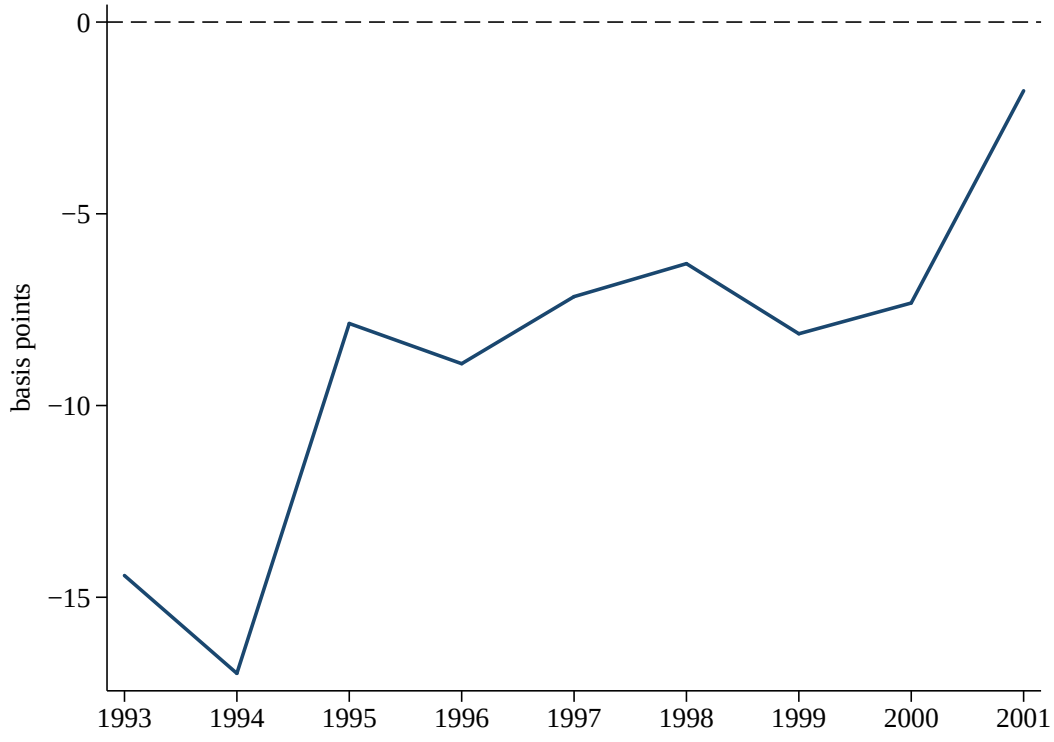
Evidence 2: AAA GO vs. Pre-Refunded [7-yr]



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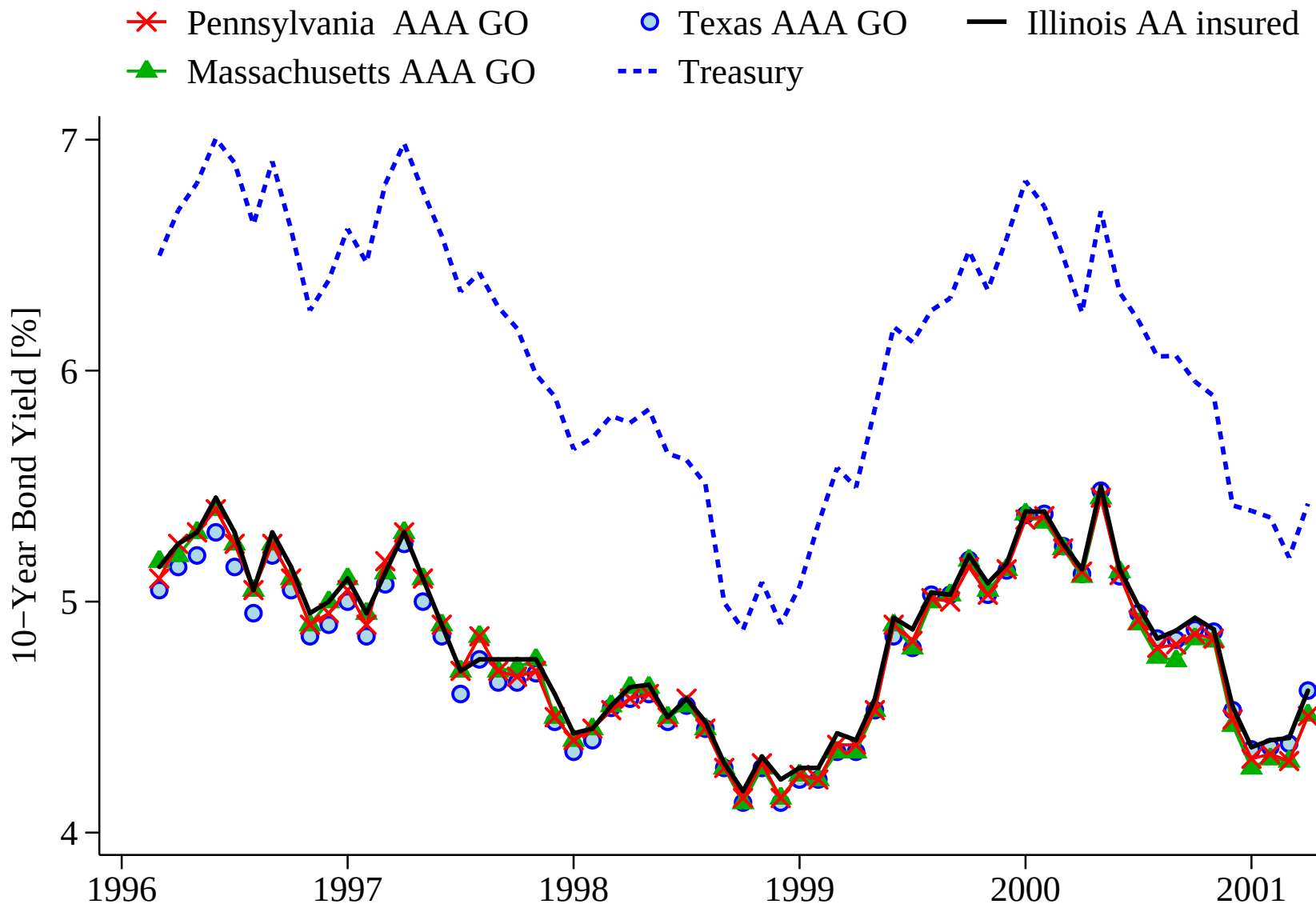
Evidence 3: Default Risk and State Taxes



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3. **liquidity risk** $\Rightarrow$ I use **state bonds**
   $\Rightarrow$ I use **off-the-run Treasuries**
   $\Rightarrow$ I explicitly **model remaining risk factor**

Roadmap

1st Part: Identify Tax News Shocks

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   - 1.2 **modeling the term structure of yield spreads** (relating θ_t to $\mathbb{E}_t\tau$)
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   - 2.1 households vs. corporations
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3. Validate the Model with Two Natural Experiments
4. Solve for the Path of Expected Tax Rates as a function of the Term Structure of Yield Spreads (backing out $\mathbb{E}_t\tau$ from θ_t)

2nd Part: Estimate Consumption Response

1.2 Term Structure Model of Muni Spreads

The **yield y^T of a taxable Treasury** par bond with maturity m at date t is implicitly defined by the pricing equation

$$1 = \sum_{s=1}^{m} \mathbb{E}_t[D_s(1-\tau_s)y^T_{t,m}] + \mathbb{E}_t[D_m]$$

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Similarly, using liquidity shocks λ, the **tax-exempt municipal yield $y^{\mathcal{M}}$** is defined by

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I **solve for the relative municipal yield spread** $y^{\mathcal{M}}_{t,m}/y^T_{t,m}$ in terms of fundamentals.

1.2 Term Structure Model of Muni Spreads

The **break-even tax rate θ (BETR)**

$$\theta_{t,m} \equiv 1 - \frac{y^{\mathcal{M}}_{t,m}}{y^{T}_{t,m}} \qquad \text{(i.e. } \theta \text{ such that } (1-\theta)y^{T} = y^{\mathcal{M}} \text{)}$$

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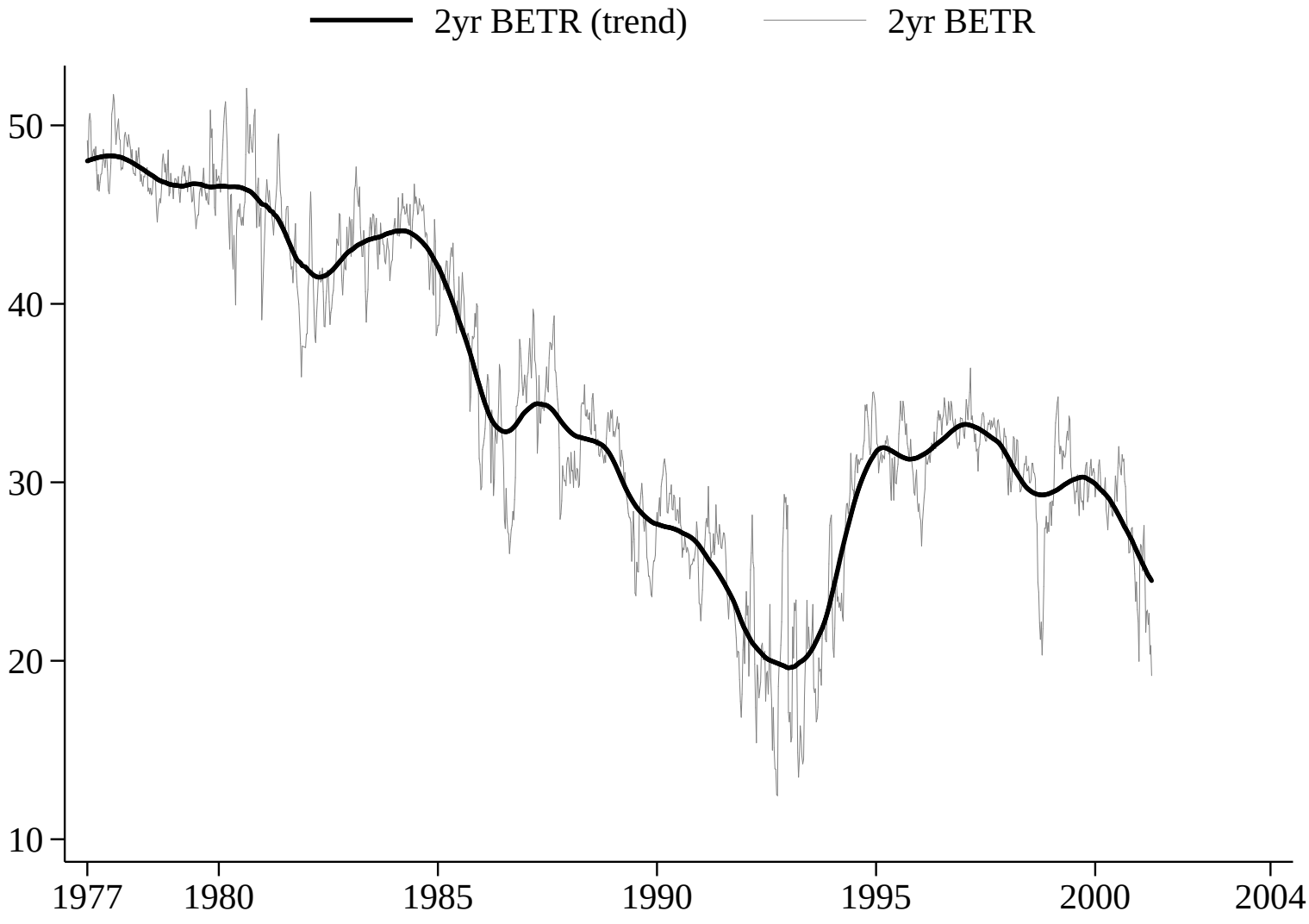

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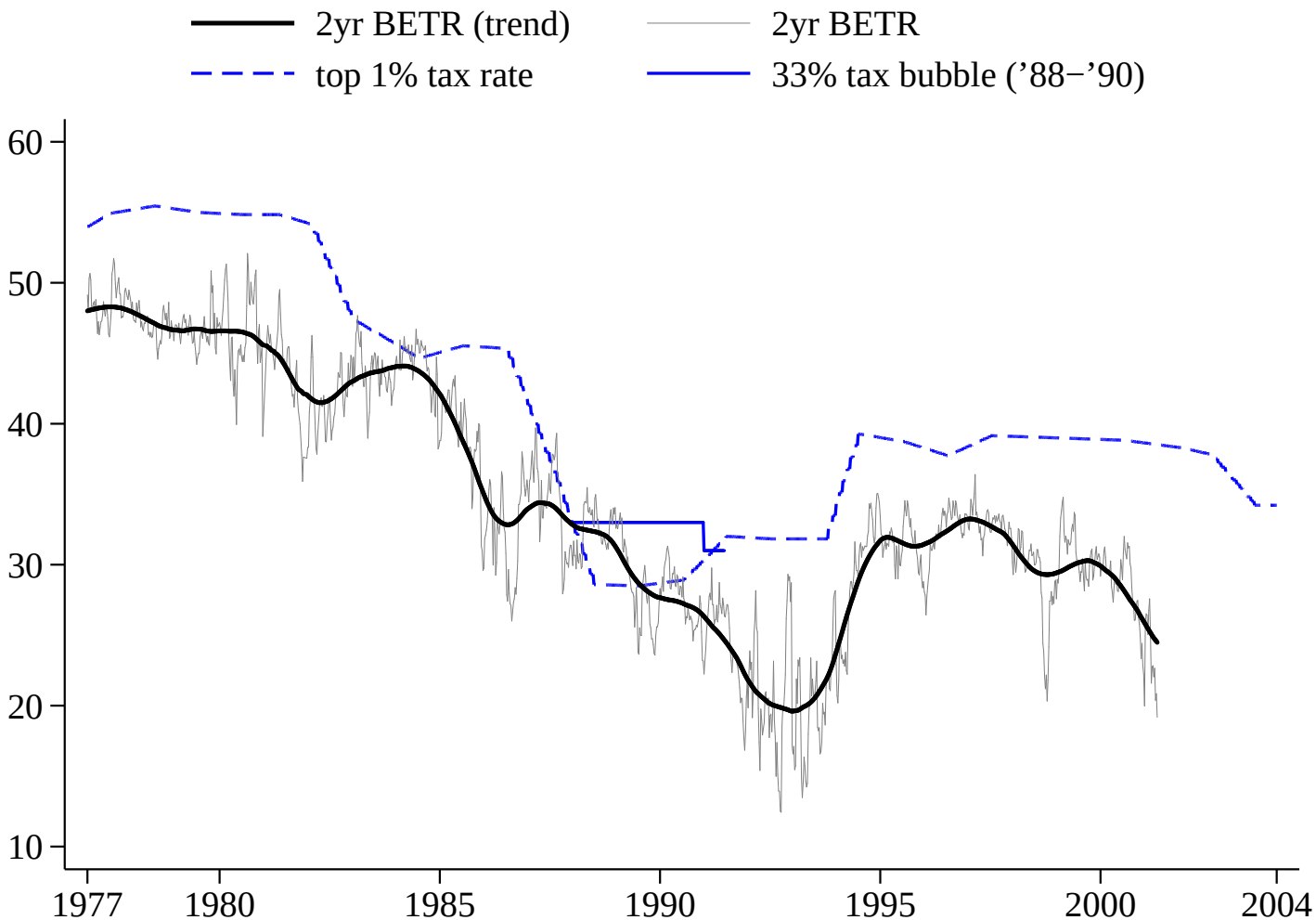

1.2 Term Structure Model of Muni Spreads

The **break-even tax rate θ (BETR)** is a weighted average of the path of **expected tax rates $\mathbb{E}_t\tau$** (annuity weights) plus a liquidity risk premium and a tax risk premium.

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$$\underbrace{-\frac{\sum_{s=1}^{m}\mathbb{E}_t[D_s\cdot\lambda_{s,m}]}{y^{T}_{t,m}\sum_{i=1}^{m}\mathbb{E}_t[D_i]}}_{\geq 0} + \underbrace{\frac{\sum_{s=1}^{m}\mathbb{C}\mathrm{ov}_t(D_s,\tau_s)}{\sum_{i=1}^{m}\mathbb{E}_t[D_i]}}_{\leq 0}$$

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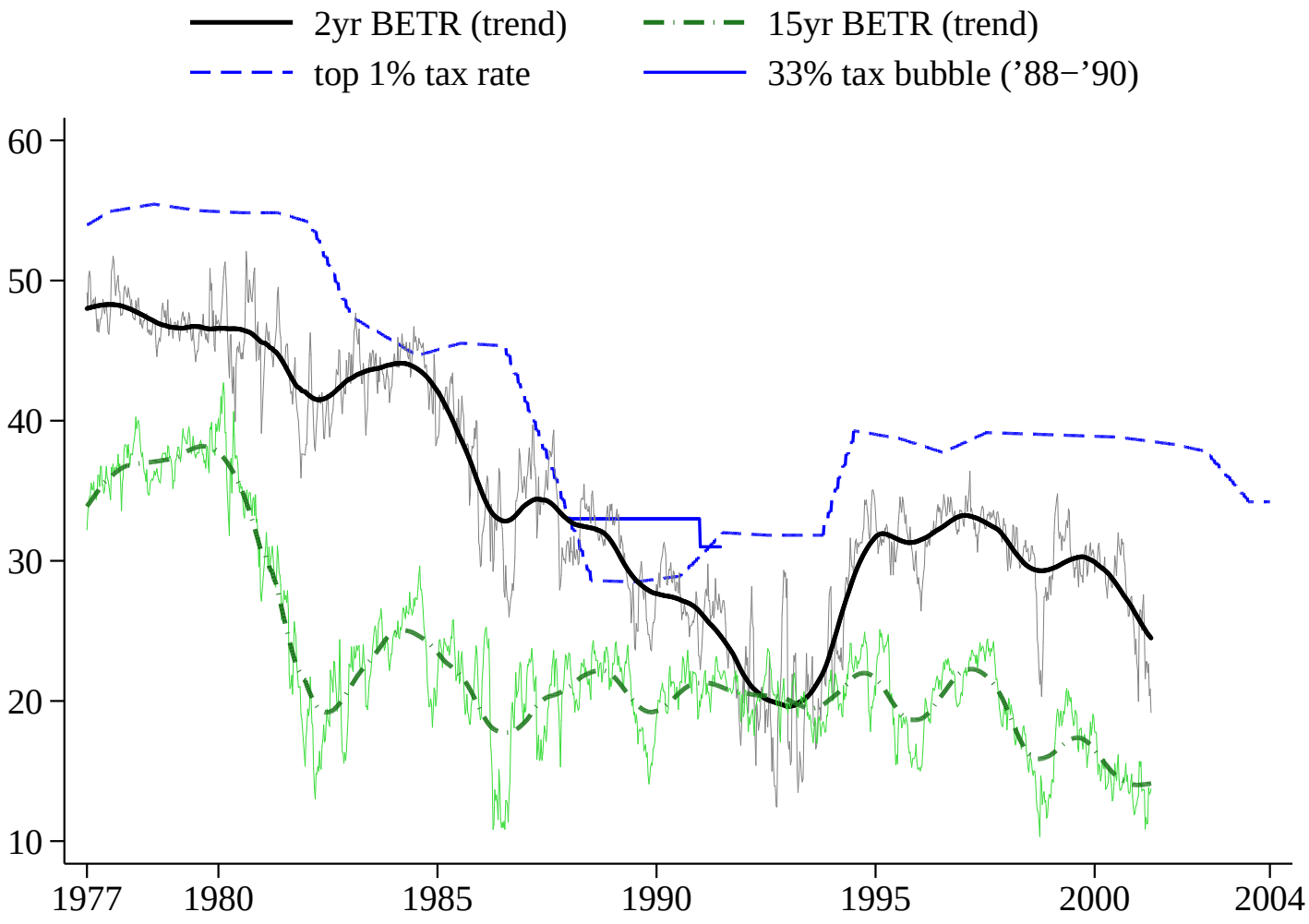

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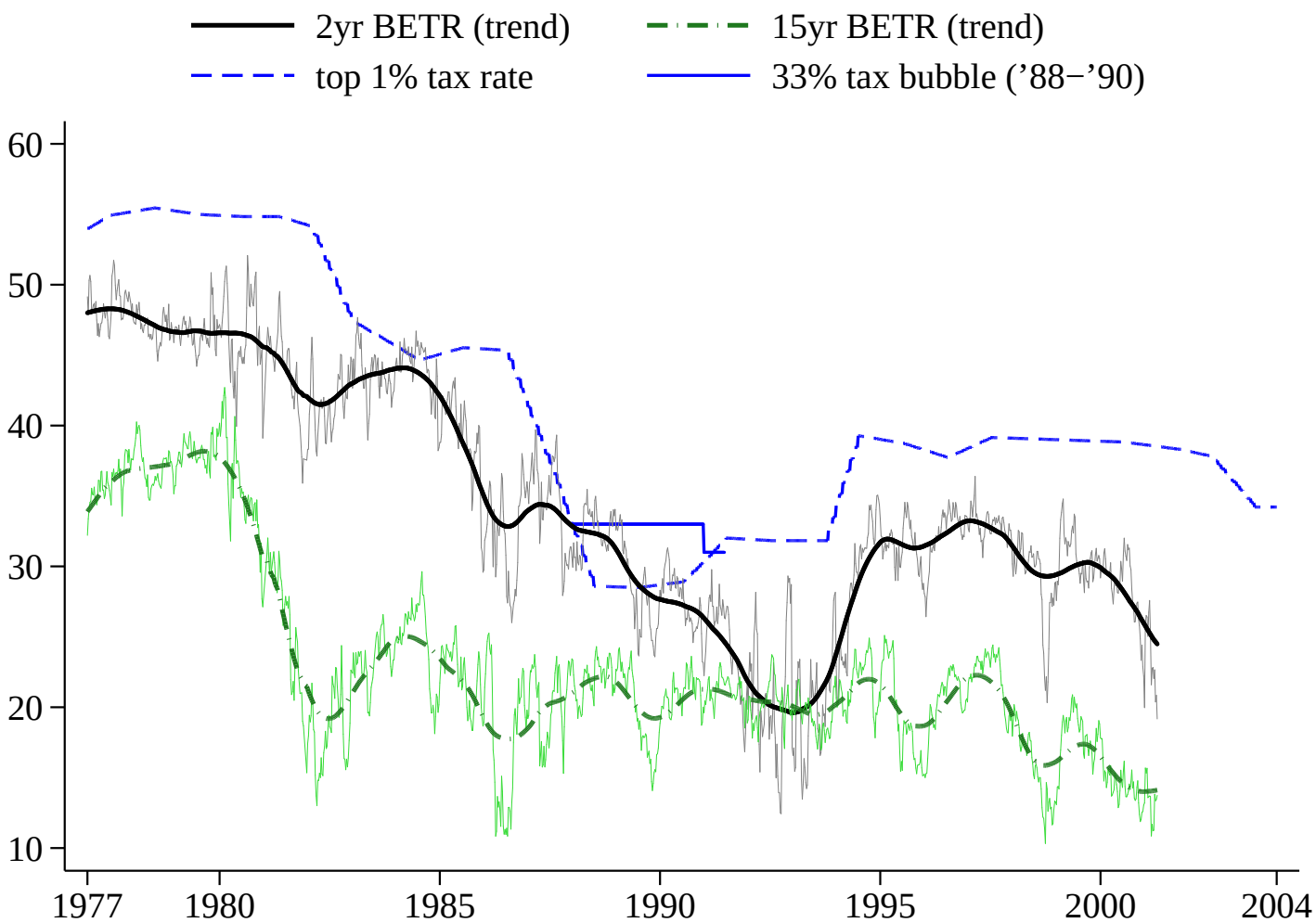

Stacking the entire term structure of BETRs:

$$\theta_t = W_t \, \mathbb{E}_t \tau - \Lambda_t$$

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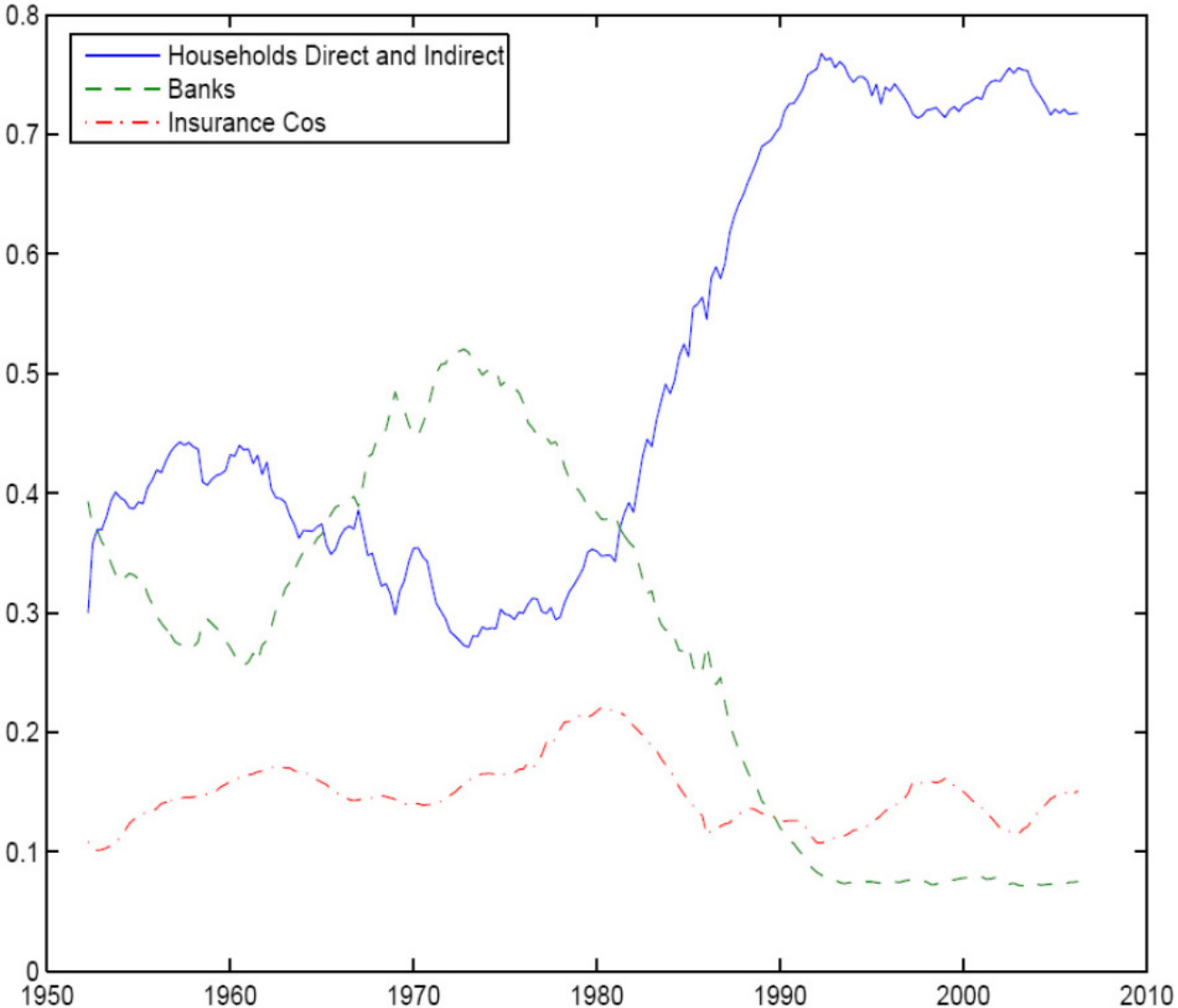
2ND Part: Estimate Consumption Response

2. Who is the Marginal Investor?

2.1 **Municipal debt ownership**: **Flow of Funds**



Source: Ang, Bhansali, Xing (2007)

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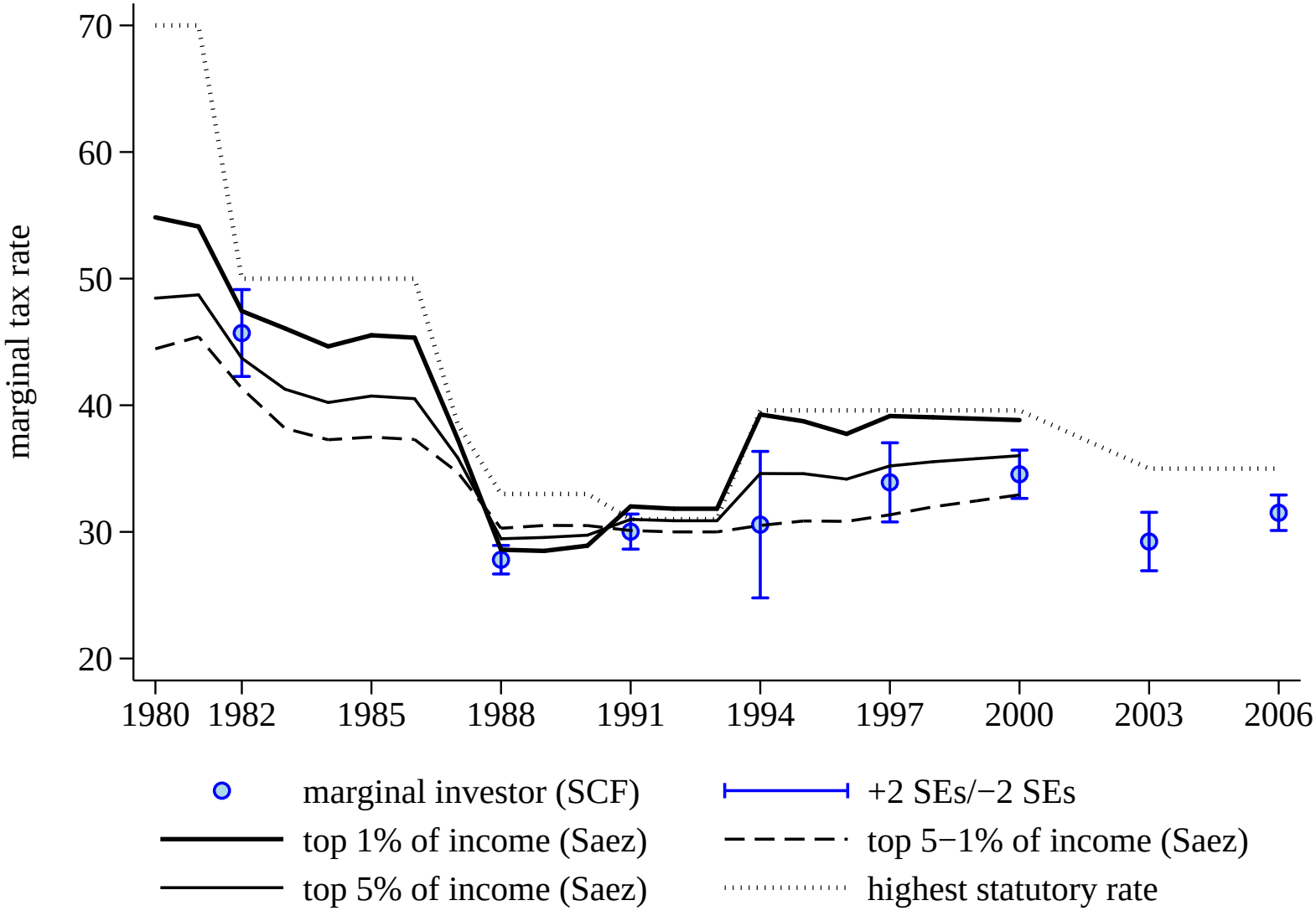
2.2 Marginal tax rate of the marginal investor: SCF



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- During **presidential elections in 1992 and 2000**, both candidates had different campaign proposals for the top tax rate
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  $\Rightarrow$ **additional variation to test the model**

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- IEM is operated by the U of Iowa Business School
  - contracts pay \$1 if candidate wins, \$0 otherwise
  - bets are limited to \$500 $\Rightarrow$ no hedge of tax risk
  - price of contract $\approx$ probability of candidate winning

Let $\mathbf{p_t} = \mathbf{Pr_t}[\textbf{Bush wins election}]$, then by the law of iterated expectations

$$\mathbb{E}_t\tau = p_t \cdot (\mathbb{E}_t[\tau|\text{Bush}] - \mathbb{E}_t[\tau|\text{Gore}]) + \mathbb{E}_t[\tau|\text{Gore}]$$

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Plugging this in the bond model

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yields a **system of regressions**

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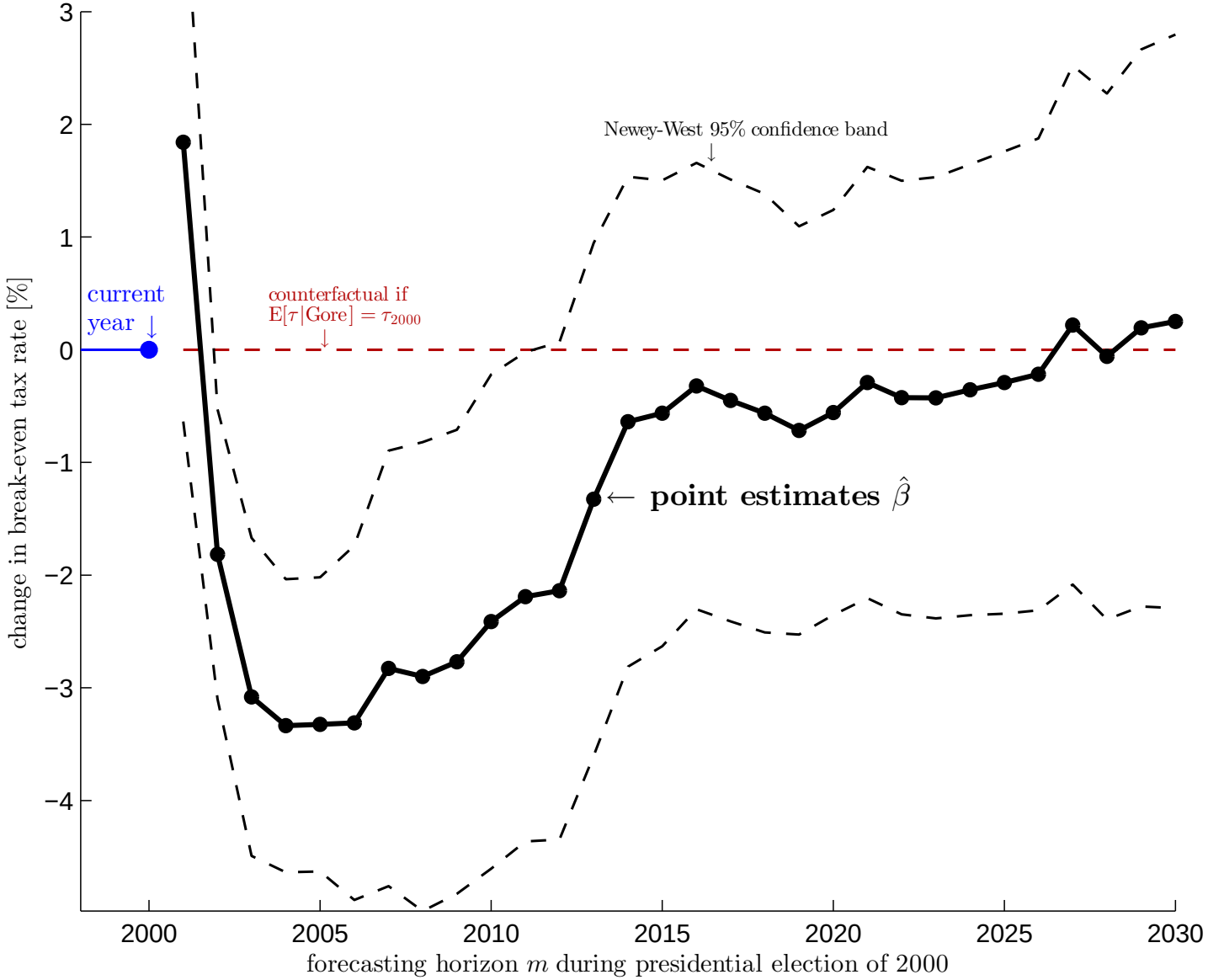
Model delivers **interpretation of population parameter**

$$\beta = \mathbb{E}[W_t] \ \ (\mathbb{E}_t[\tau|\text{Bush}] - \mathbb{E}_t[\tau|\text{Gore}])$$

$$\theta_t = p_t \cdot \beta + (\alpha + Z_t\Gamma + \epsilon_t)$$

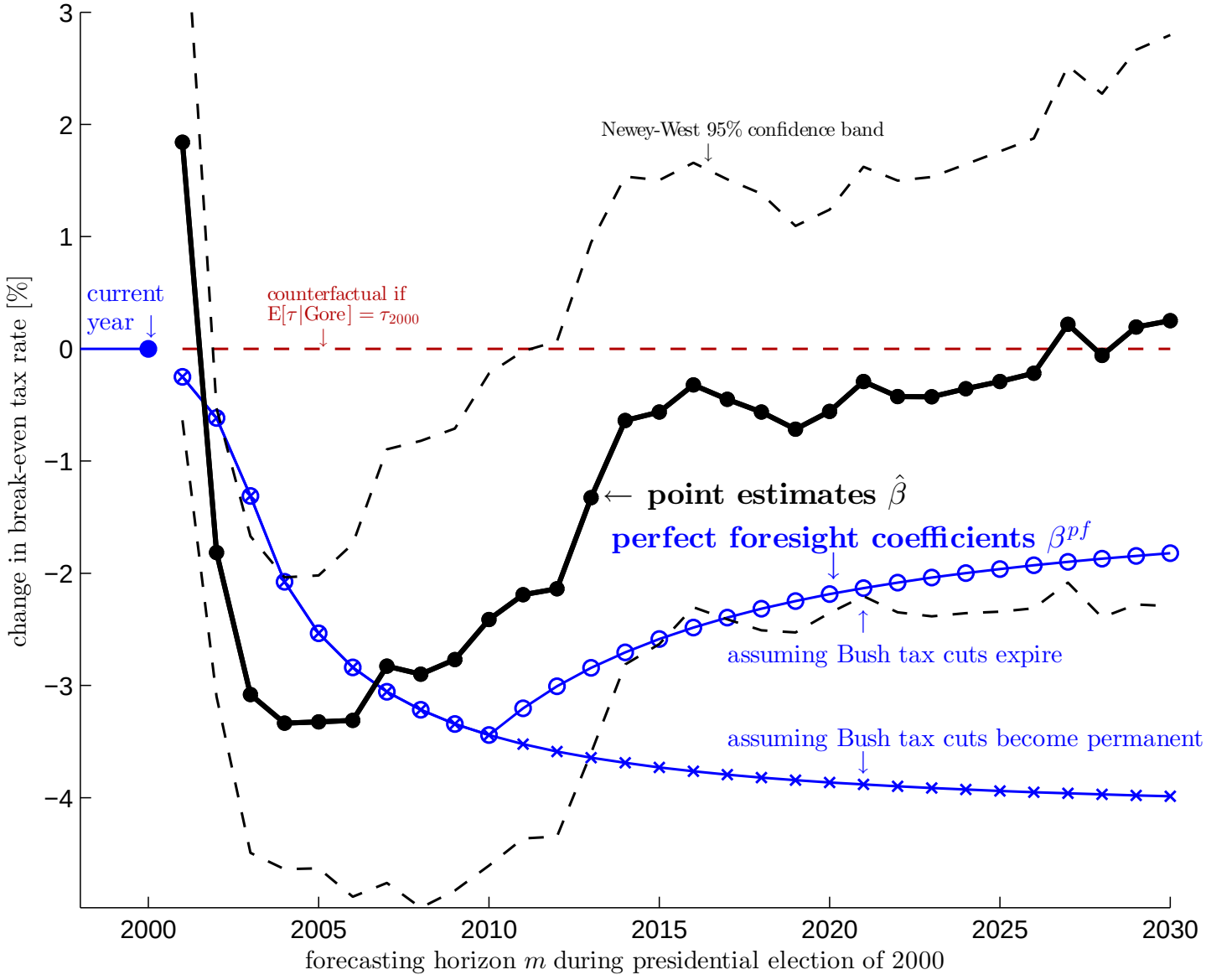
Response of Break-Even Tax Rate to	W. Bush in 2000	Clinton in 1992
1 year	0.019	0.121**
	(0.012)	(0.051)
2 year	-0.018***	0.075*
	(0.007)	(0.044)
3 year	-0.031***	0.122***
	(0.007)	(0.039)
5 year	-0.033***	0.076***
	(0.007)	(0.025)
7 year	-0.028***	0.084***
	(0.010)	(0.021)
10 year	-0.024**	0.090***
	(0.011)	(0.021)
20 year	-0.006	0.035**
	(0.009)	(0.015)
30 year	0.003	0.040**
	(0.013)	(0.017)

Break-even tax rate response $\beta = \mathbb{E}[W_t]\mathbb{E}[\tau|\Delta\text{Bush}]$ during presidential election in 2000



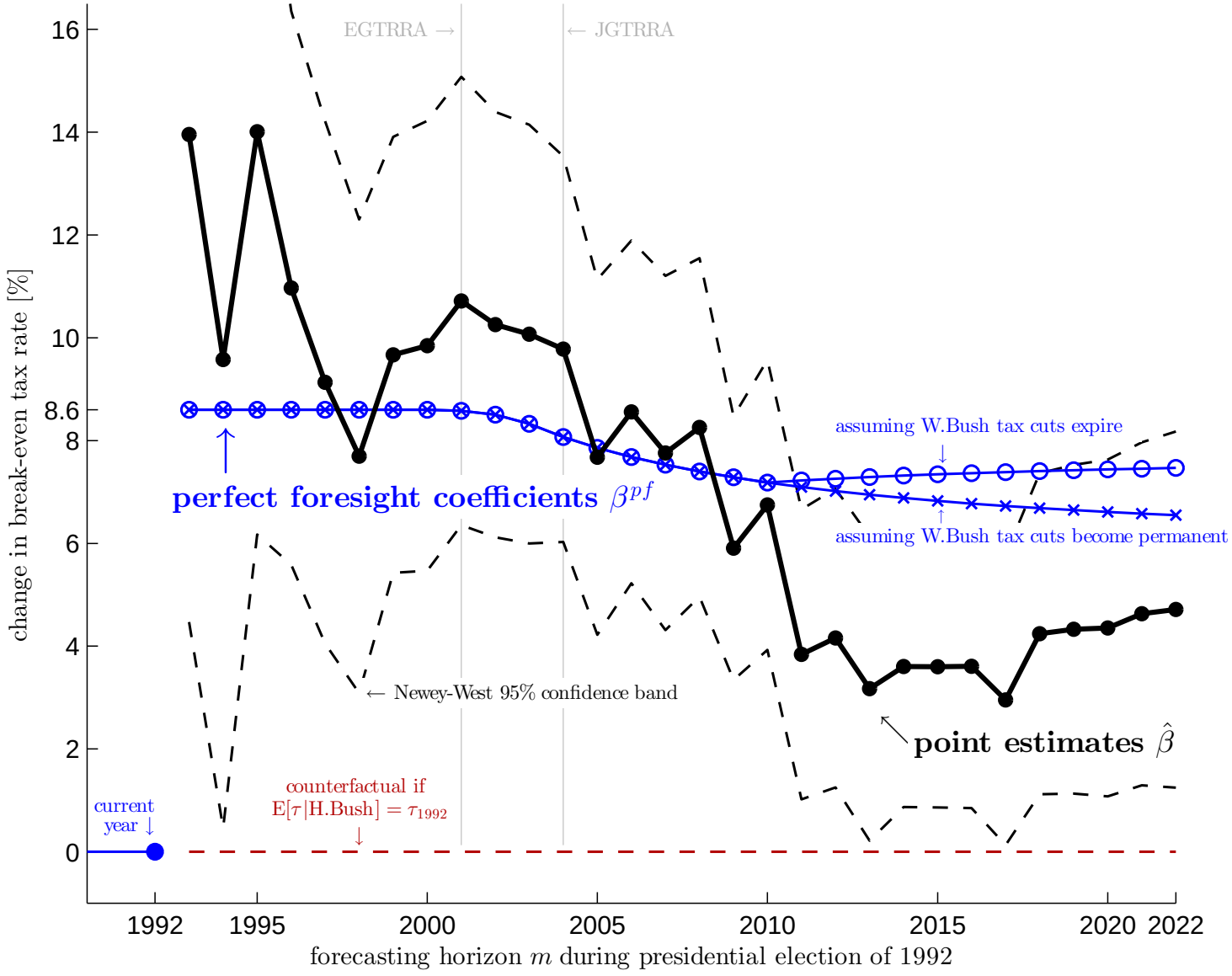
estimated coefficients $\beta = \mathbb{E}[W_t]\mathbb{E}[\tau|\Delta\text{Bush}]$ vs

perfect foresight coefficients $\beta^{pf} = \mathbb{E}[W_t](\tau^{pf} - 39.6\%)$



estimated coefficients $\beta = \mathbb{E}[W_t]\mathbb{E}[\tau|\Delta\text{Clinton}]$ vs

perfect foresight coefficients $\beta^{pf} = \mathbb{E}[W_t](\tau^{pf} - 31\%)$



Ultimately I am interested in the **inverse mapping**

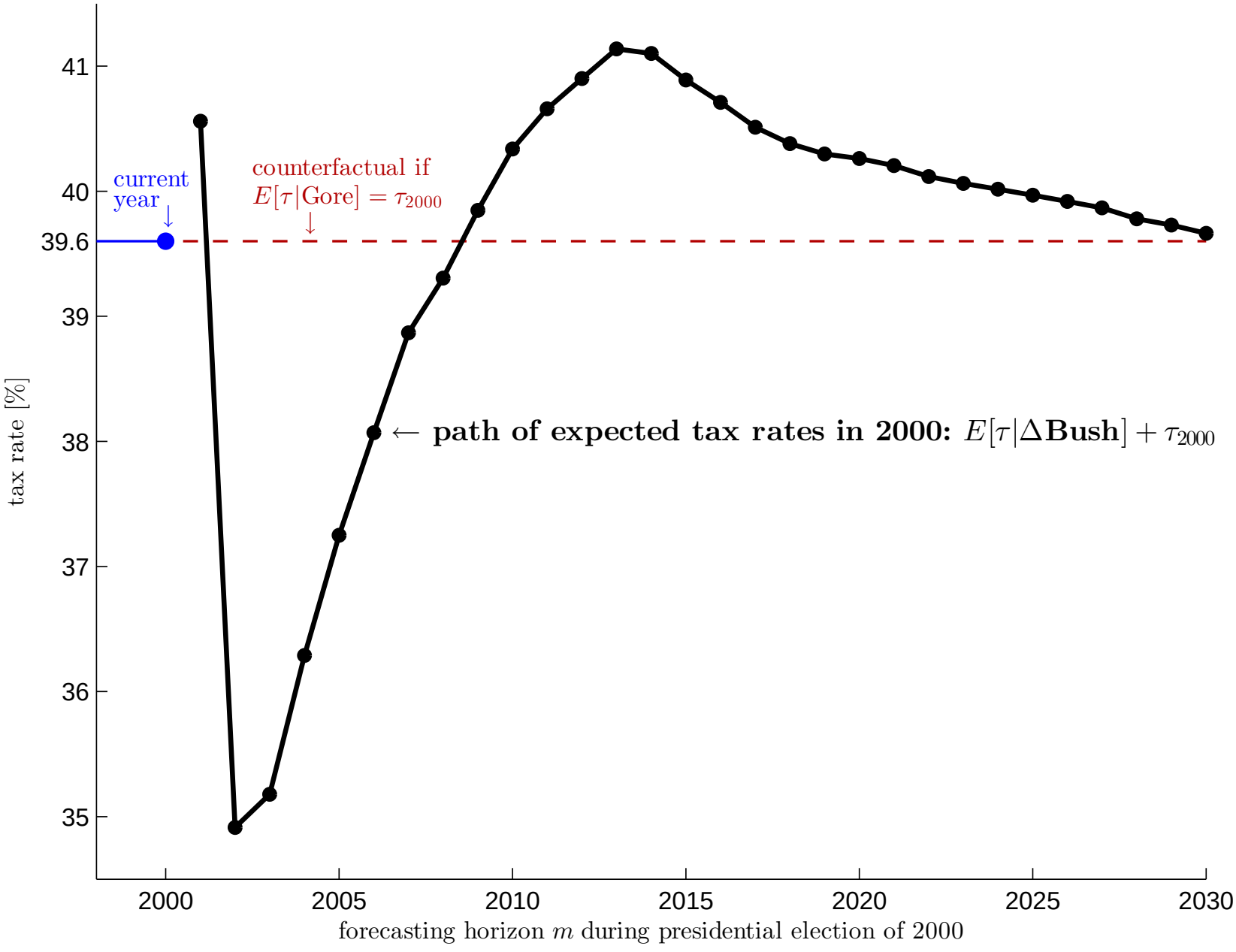
- $\mathbb{E}[\tau|\text{Bush}] - \mathbb{E}[\tau|\text{Gore}] = \mathbb{E}[W_t]^{-1}\beta$

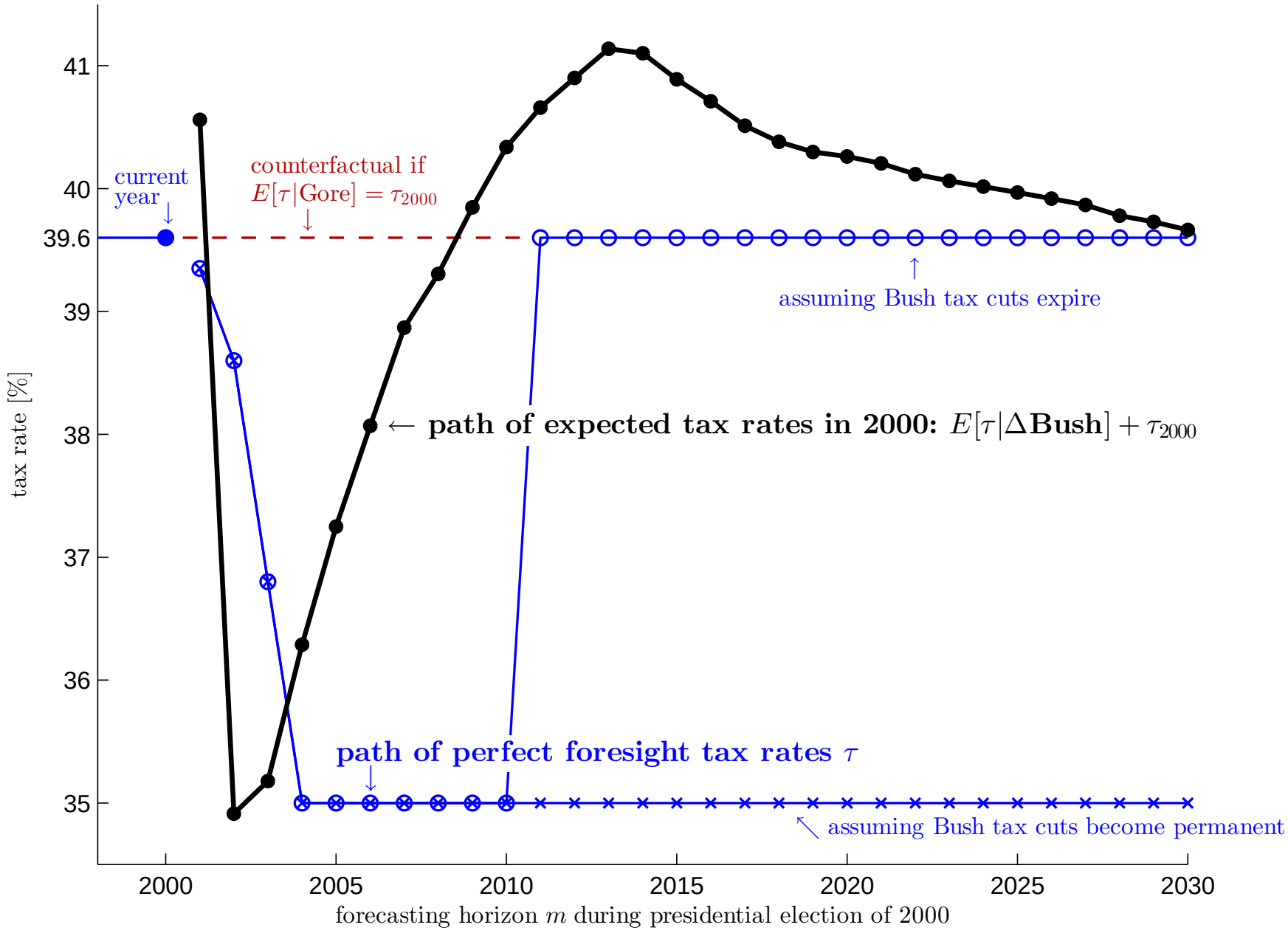
  respectively
- $\mathbb{E}\tau = W_t^{-1}(\theta + \Lambda_t)$

Minor technical difficulty: W_t can be almost singular.
I use a **robust inverse** instead of direct inverse
(ridge 'regression')

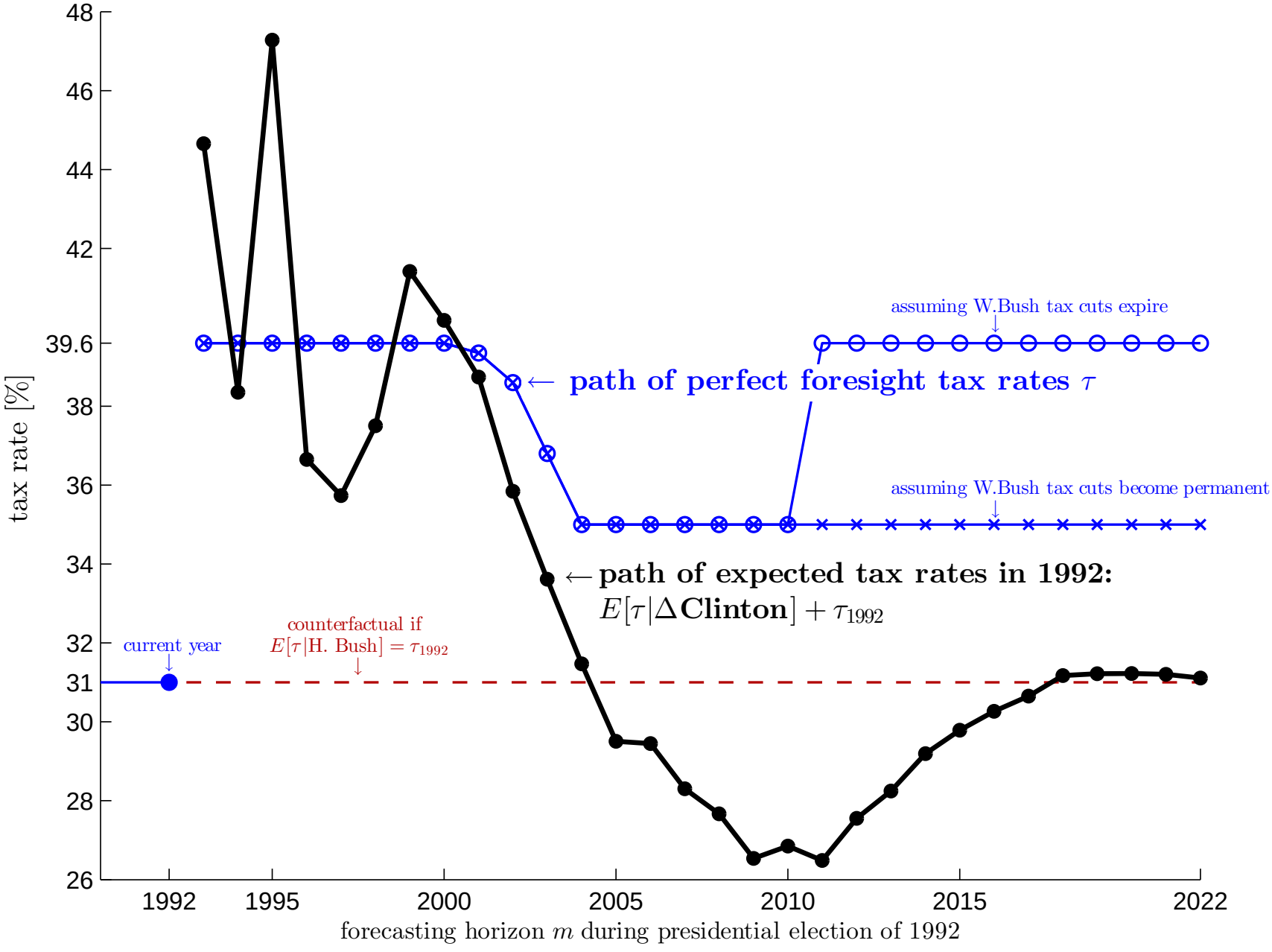
Computing the inverse of the election regression coefficients yields...

Path of expected tax rates $\mathbb{E}_t\tau$ during election in 2000




Path of expected tax rates $\mathbb{E}_t\tau$ vs realized path τ
41
40
39.6
39
38
37
36
35
tax rate [%]
current year
counterfactual if $E[\tau|\text{Gore}] = \tau_{2000}$
assuming Bush tax cuts expire
← path of expected tax rates in 2000: $E[\tau|\Delta\text{Bush}] + \tau_{2000}$
path of perfect foresight tax rates τ
assuming Bush tax cuts become permanent
2000
2005
2010
2015
2020
2025
2030
forecasting horizon m during presidential election of 2000

Path of expected tax rates $\mathbb{E}_t\tau$ vs realized path τ



1ST Part: Identify Tax News Shocks

1. Accounting for Factors other than Tax News
   - 1.1 choice of bond data ✓
   - 1.2 modeling the term structure of yield spreads ✓ (relating θ_t to $\mathbb{E}_t\tau$)
2. Identify Marginal Investor (which tax rate $\mathbb{E}_t\tau$?)

   A. Portfolio Evidence
   - 2.1 households vs. corporations (Flow of Funds) ✓
   - 2.2 locate the marginal investor in the income distribution & check for stability (SCF) ✓

   B. Formal Tests
   - 2.3 two presidential elections as natural experiments ✓

3. **Solve for the Path of Expected Tax Rates** as a function of the Term Structure of Yield Spreads

2ND Part: Estimate Consumption Response

3. Calculating the Path of Expected Tax Rates

I **calculate $\mathbb{E}_t\tau$ for the entire period**, not just for presidential elections

2 assumptions to control for liquidity shocks and premium (attenuation bias):

1. market based **expectations are rational**

$$\theta_t - W_t\tau =$$

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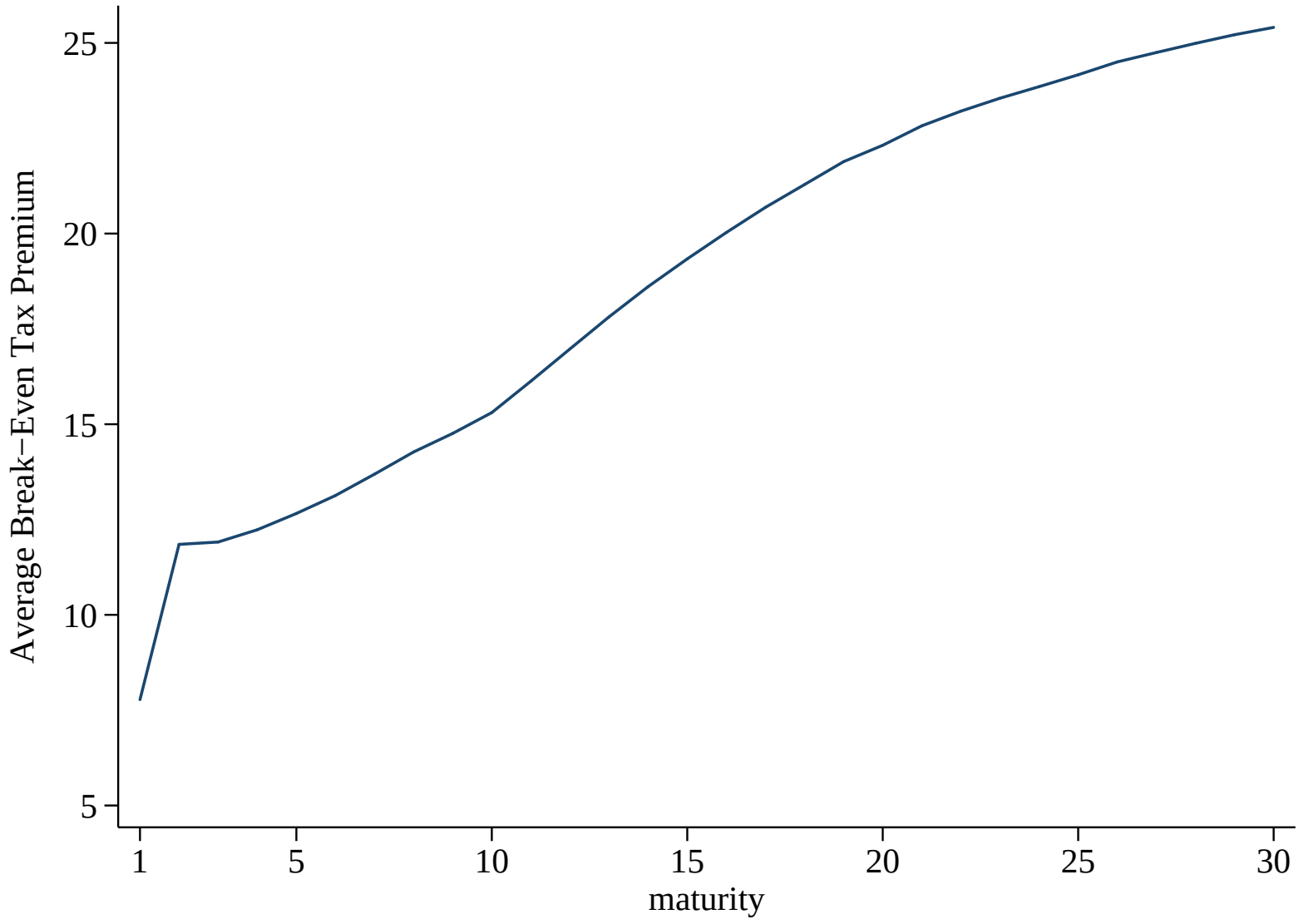
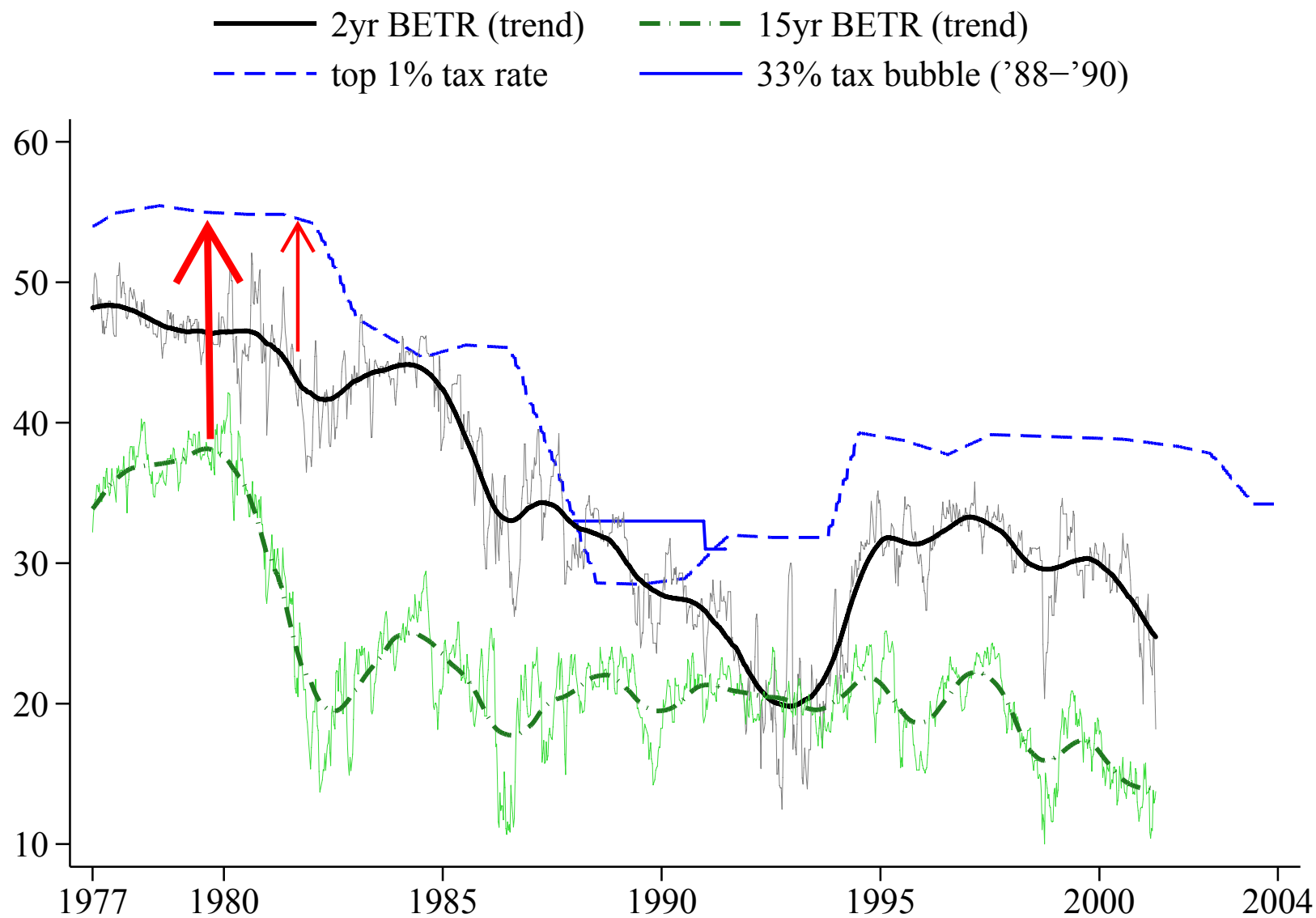
$$\Rightarrow \quad \mathbb{E}[\Lambda_t] = \mathbb{E}[W_t\tau - \theta_t] : \text{ average liquidity premium (global assumption)}$$

Estimated Average BETR Liquidity Premium $\mathbb{E}[\Lambda_t]$



Assumption 1: Zero average BETR forecast error **adjusts the level of the BETR**.



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2. **trend component** of BETRs reflects tax news

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- tax news shocks can be used to study several issues
- consumption response to tax news is just *one* application

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Other applications of tax news shocks include

1. labor supply response (wealth vs. income and substitution effects)
2. taxable income response
3. capital gains realization
4. charitable giving
5. relation with government spending news and Ricardian equivalence
6. etc.

2ND Part: Consumption Response

Under certain assumptions, I show that

$$\Delta c_{it} \approx \underbrace{-\sum_s w_{t,s}^{(M)} \Delta \mathbb{E}_t \bar{\tau}_{i,t+s}}_{\text{tax news shock}} + \text{ controls}$$

$\Rightarrow \Delta\text{PI} =$ change in annuity value of average tax liabilities

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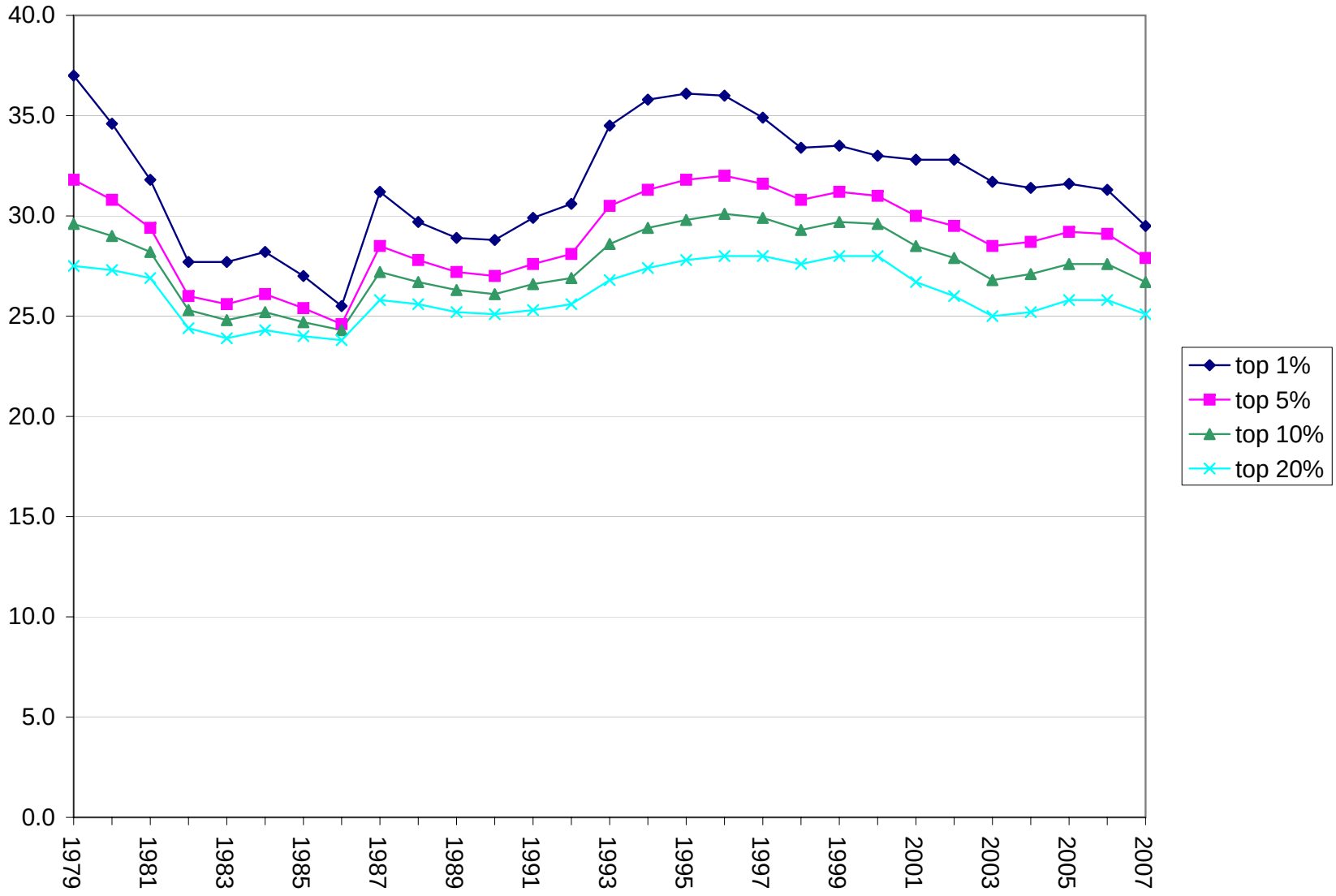
I start with **high-income households** for which

$$\bar{\tau} \approx \tau$$

and I take into account that $\bar{\tau} \neq \tau$, using the following **household consumption regression**

$$\Delta c_{it} = \beta \cdot \sum_s w_{t,s}^{(M)} \underbrace{\frac{\bar{\tau}_{i,t+s}}{\tau_{t+s}} \Delta \mathbb{E}_t \tau_{t+s}}_{\approx \Delta \mathbb{E}_t \bar{\tau}_{i,t+s}} + \alpha_t + \phi' \Delta z_{it} + \epsilon_{it}$$

Definition of High-Income Households based on CBO Estimates of Total Federal Average Tax Rates, 1977-2007



What variation identifies β ?

$$\frac{\bar{\tau}_{i,t+s}}{\tau_{t+s}} \cdot \Delta_t \mathbb{E}_t \tau_{t+s}$$

- **Time series variation :** market expectations $\Delta \mathbb{E}_t \tau$
- **Cross-sectional variation :** non-linearity of average tax rate changes

  $\frac{\bar{\tau}_{i,t+s}}{\tau_{t+s}}$ is an **'importance weight'** of the signal $\Delta \mathbb{E}_t \tau$

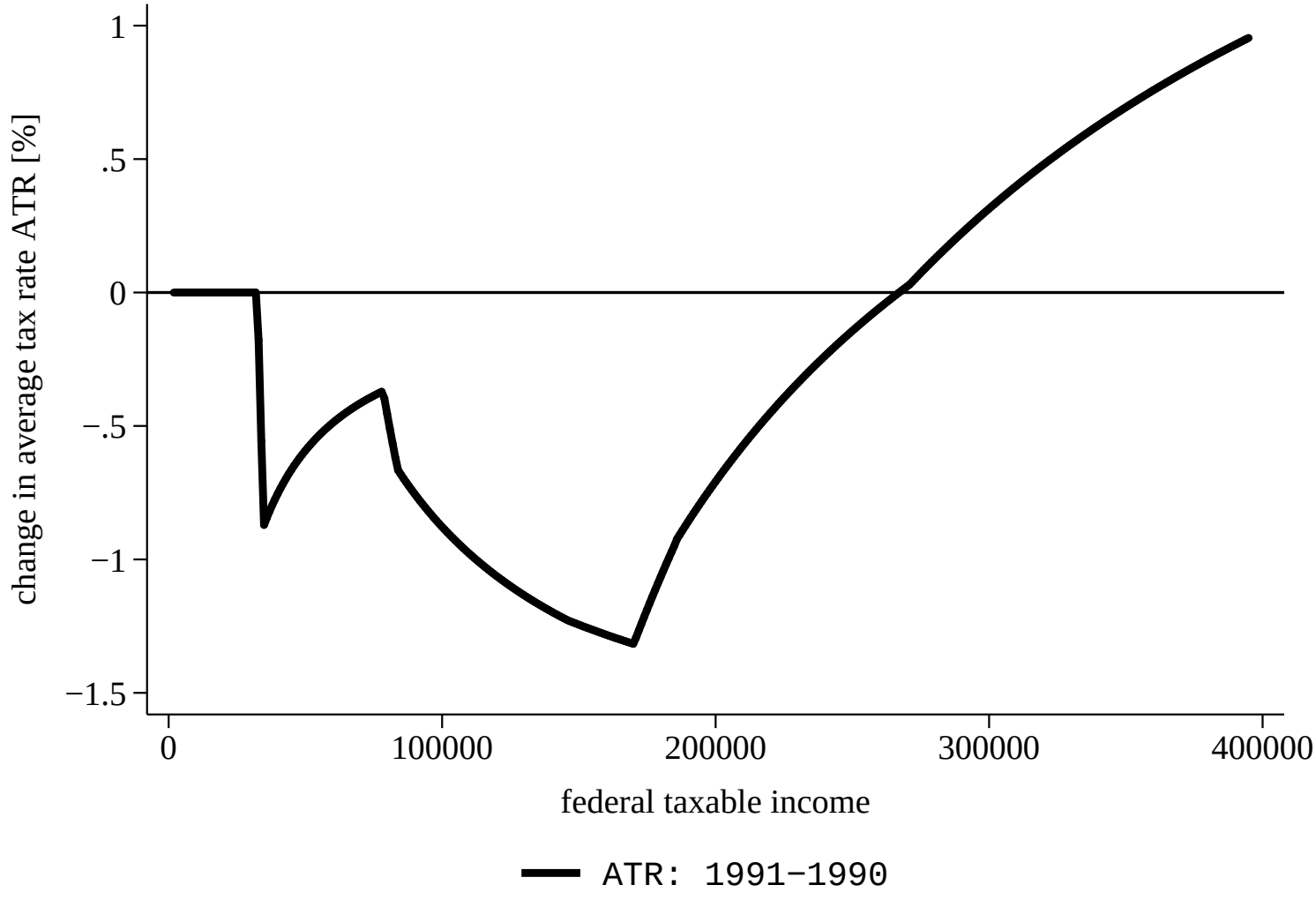
  (calculated by mapping CEX to TAXSIM)

$\Rightarrow$ this **allows** me to use **time fixed effects!**

(turns out to be important)

Non-Linearity of Average Tax Rate Changes

The G.H.W. Bush tax reform as an example (OBRA 1990)



Nondurable Consumption Response of High Income Households to News Shock

tax news shock	**-0.980*****
	(0.318)
age	-0.111***
	(0.049)
age^2/100	0.113**
	(0.052)
Δ adults	1.400***
	(0.169)
Δ kids	0.426***
	(0.204)
BP residual of news shock	-0.007
	(0.105)
monthly FEs	Yes
other HH char, ATR, AGI	Yes
obs (clusters)	28,101 (11,793)
R^2	0.030

I **impute expected lower-bracket rates** proportionally to expected top rates:

$$\mathbb{E}_t \tau_{t+s}(b) = \tau_{t+s}(b) \cdot \frac{\mathbb{E}_t \tau_{t+s}^{top}}{\tau_{t+s}^{top}}$$

This yields the following regression

$$\Delta c_{it} = \beta \cdot \underbrace{\sum_s w_{t,s}^{(M)} \frac{\bar{\tau}_{i,t+s}}{\tau_{t+s}} \Delta \mathbb{E}_t \tau_{t+s}}_{\text{tax news shock}} + \alpha_t + \phi' \Delta z_{it} + \epsilon_{it}$$

Consumption Response to News Shock

Sample		Response	
high-income HHs :	AGI> p_{90}	-0.976*	(0.504)
	AGI> p_{75}	-0.985***	(0.318)
	AGI> p_{50}	-0.522**	(0.213)

Consumption Response to News Shock

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	AGI$>p_{50}$	-0.522**	(0.213)
lower-income HHs :	AGI$\leq p_{50}$	-0.101	(0.232)

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	AGI$>p_{50}$	-0.522**	(0.213)
lower-income HHs :	AGI$\leq p_{50}$	-0.101	(0.232)
no time FE matters :	AGI$>p_{75}$	0.032	(0.057)

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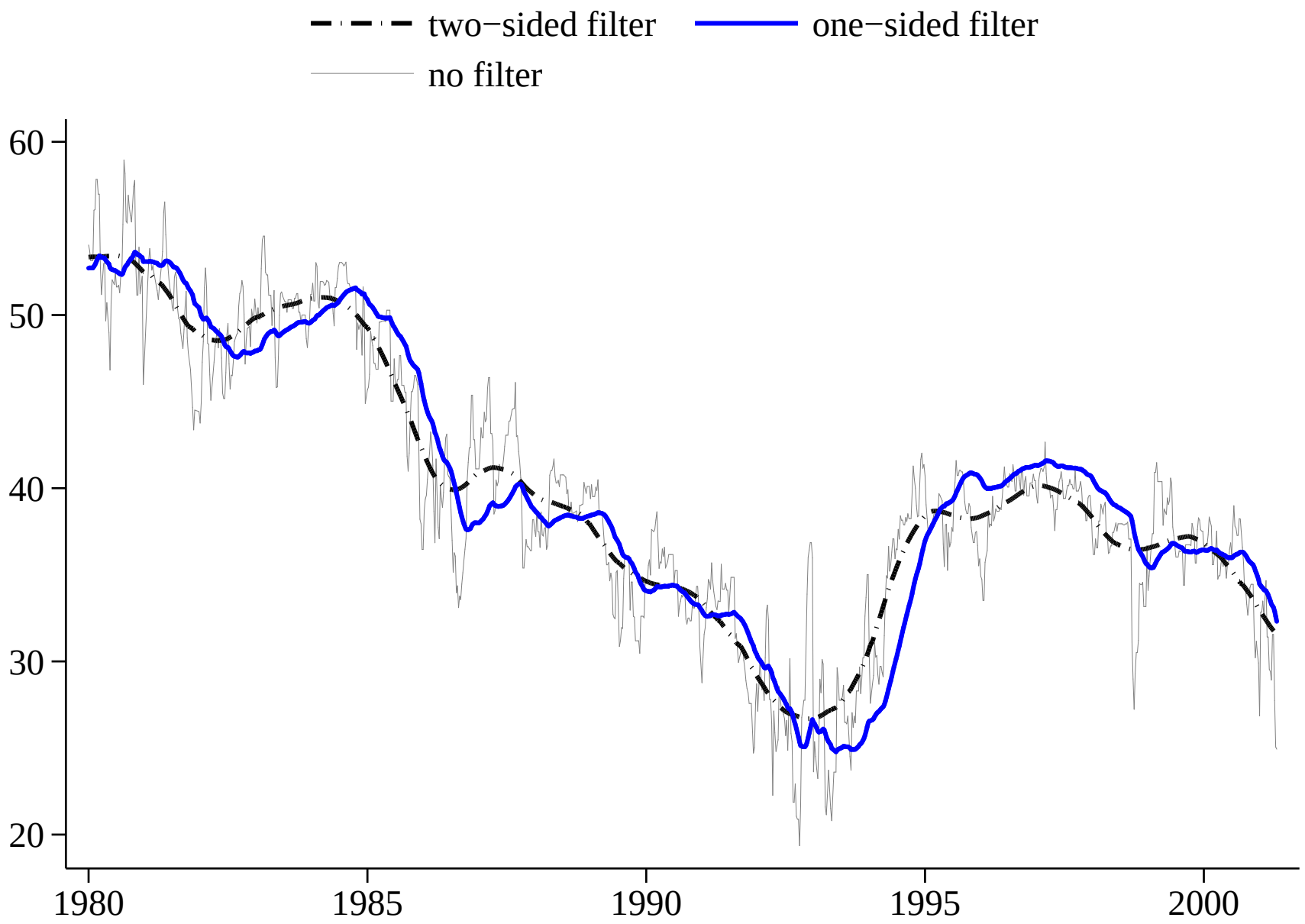
lower-income HHs :	AGI$\leq p_{50}$	-0.101	(0.232)
no time FE matters :	AGI$>p_{75}$	0.032	(0.057)
HH controls don't :	no controls	-1.069***	(0.306)

Further evidence that news drives response of high-income HHs

Sample	Response

news vs. "noise" matters :


two−sided filter
one−sided filter
no filter
60
50
40
30
20
1980
1985
1990
1995
2000

Further evidence that news drives response of high-income HHs

Sample		Response	
news vs. "noise" matters :	no filter	-0.049	(0.101)
	one-sided	-0.789**	(0.309)
	two-sided	-0.985**	(0.318)

Further evidence that news drives response of high-income HHs

Sample		Response	
news vs. "noise" matters :	no filter	-0.049	(0.101)
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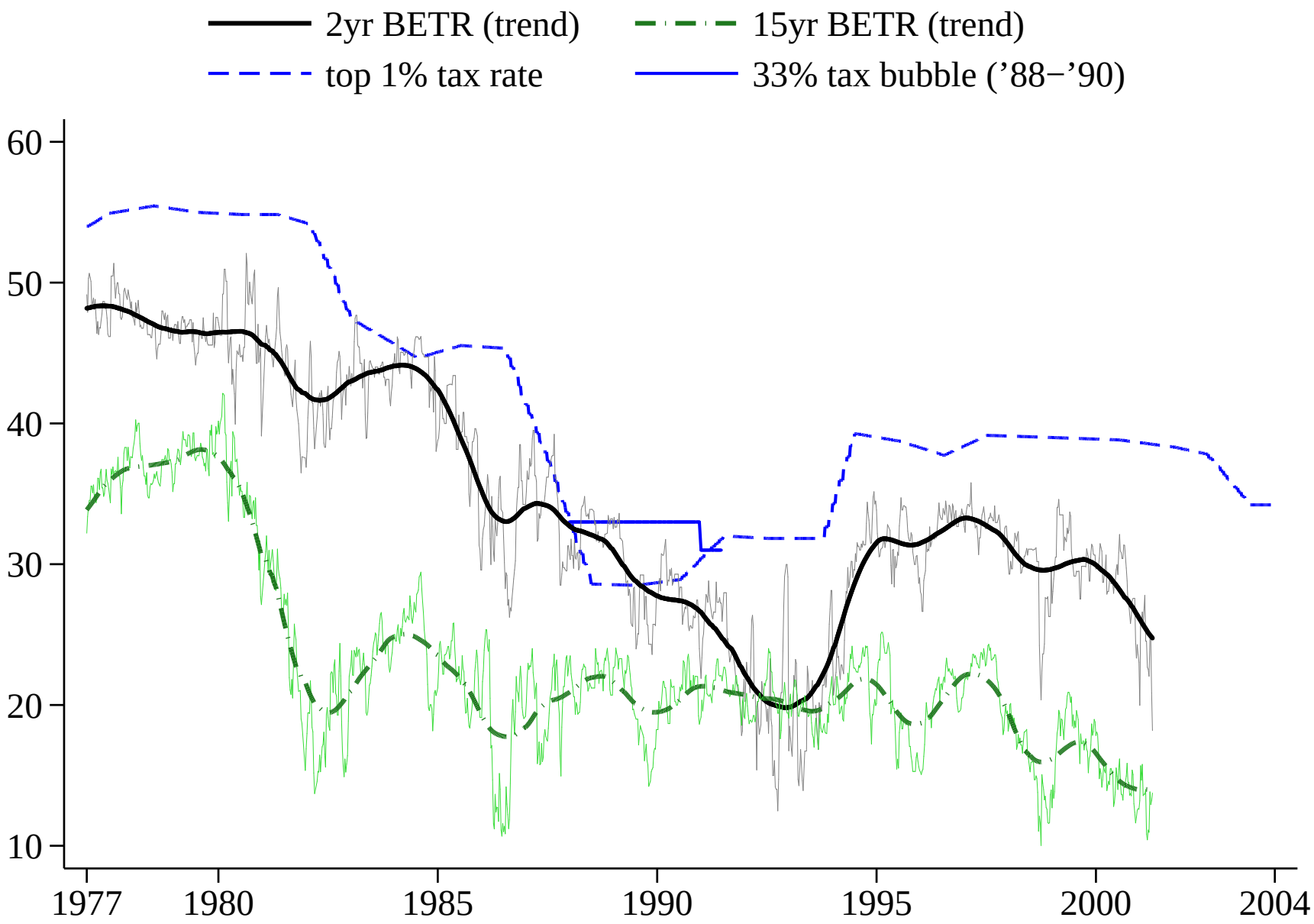
2yr BETR (trend)
15yr BETR (trend)
top 1% tax rate
33% tax bubble (’88−’90)
60
50
40
30
20
10
1977
1980
1985
1990
1995
2000
2004

Further evidence that news drives response of high-income HHs

Sample		Response	
news vs. "noise" matters :	no filter	-0.049	(0.101)
	one-sided	-0.789**	(0.309)
	two-sided	-0.985**	(0.318)
early 90s have no info :	1980-88	-1.274*	(0.101)
	1989-92	0.227	(1.347)
	1993-97	-0.990	(0.960)
	1998-01	-0.749	(0.466)

Conclusion 1 – Bond Results

- **Financial markets anticipate income taxes well**,
  - not only the **timing** but also
  - the **expected persistence** (magnitude of shock in present-value terms)

- Why is this finding important?

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- **Financial markets anticipate income taxes well**,
  - not only the **timing** but also
  - the **expected persistence** (magnitude of shock in present-value terms)

- Why is this finding important?
  - There might be a **dynamic anticipation effect** in addition to the traditional **tax multiplier**
  - Shows that expectations can be important, for instance if **transmission of news shocks is through asset prices**, which is not the case here, but...
  - ... consumption results show that **transmission** can also be **through annuity-value (or present-value) effects**

Conclusion 2 – Consumption Results

- I **cannot reject** the **basic rational expectation** life-cycle model (RE-LCH) for high income households
- I **can reject RE-LCH** model for lower-income HHs
  - either liquidity and myopia
  - or break-down of identification
  - In new paper I'm analyzing which of the two it is...
- Why are these results important?

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  - or break-down of identification
  - In new paper I'm analyzing which of the two it is...
- Why are these results important?
  - **First direct test** of *individual* consumption response to news shocks
  - **Optimal policy** might be **trickier** than you think.
  - Might be first step in **reconciling excess sensitivity** literature **with rational expectations** theory...

– Thank you for your attention –

Looking forward to discussing with you!

The likes of PIMCO are out there trying to figure out [future policy], and investing accordingly; how many families do you know deciding on holiday purchases based on expectations of tax policy in 2014? [...] So yes, expectations can matter; but some expectational arguments are more equal than others.

– **Paul Krugman**, NYT 11/30/2011

I have plenty of suspicions but little evidence. I think people are concerned about high tax rates, [...]. But none of this has happened yet. You can't look at evidence. The taxes haven't really been raised yet.

– **Robert Lucas**, WSJ 9/25/2011

Appendix

Consumption Research Agenda

1. **Complementary work to tax news:** News about Alaska Permanent Fund Dividend
2. **Reconcile excess sensitivity with rational expectations** by estimating adjustment bands (utility costs δ)
3. **Modeling excess sensitivity**
   - strong evidence for asymmetric response to shocks:
     - positive response to small positive tax shocks
     - no response to small negative tax shocks
   - myopia + cash constraints might explain this
   - loss aversion is another candidate