Stability of Expectations and Severity of Crises

Pablo Gluzmann
CEDLAS/CONICET/FCE-UNLP
Martin Guzman
Columbia University / UBA / FCE-UNLP
Peter Howitt
Brown University

Arnoldshain Seminar XIV, Córdoba, October 2016

Motivation

- Is the severity of financial crises related to the preceding macroeconomic stability?
  - Question addressed by H. Minsky, who conjectured a Financial Instability Hypothesis (FIH)
    - "Stability leads to instability"

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  1. The longer the period of stability, the larger the probability of a financial crisis
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- Expectations are central for intertemporal plans
- Our question of interest:

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  - Yes for banking and sovereign debt crises
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Literature review

- Endogenous financial fragility (Minsky, Kindleberger)
- Behavioral economics: overconfidence and psychological biases (Thaler (1991), Shiller (2000), etc.)
- Interaction between expectations and leverage (Geanakoplos and coauthors)
- Determinants and measurement of severity of crises (Bordo et al. (2001), Hutchison and Noy (2005), Jonung and Hagberg (2010))
- Leverage and credit growth as predictors of financial instability (Berkman et al. (2012), Reinhart and Rogoff (2009), etc.)

Outline

1. Expectations
   - Definitions
   - Macroeconomic stability and stability of expectations
2. Severity of crises
   - Definitions of crises
   - Measures
3. Results
   - Basic results
   - Robustness
4. Conclusions

Expectations

- Object of interest: expectations on output growth
  - Determines capacity of fulfilling financial contracts
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Stability of expectations

Definition 1

Change in expectations. *$CE_{t-1,t}$ is the change in output growth expectations from period $t-1$ to t,*

$$CE_{t-1,t} = |E_t g^y_{t+1} - E_{t-1} g^y_t|$$

Definition 2

Volatility of expectations. *$VOE(i)$ is an inverse measure of the stability of expectations between crisis $i-1$ and i:*

$$VOE(i) = \frac{1}{t(i) - t(i-1)} \sum_{t=t(i-1)}^{t(i)} CE_{t-1,t}$$

where $t(i)$ is the year in which crisis i occurs

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Macro stability and stability of expectations: General questions

1. What do different assumptions on expectations imply for the relationship between macro stability and stability of expectations?
2. How do agents form expectations?

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- Three different assumptions:
  1. Full information rational expectations (FIRE)
  2. Bayesian learning
  3. Non-Bayesian learning

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Macro stability and stability of expectations I

- Suppose output is described by

$$Y_t = e^{z_t}\Gamma_t$$

with $\Gamma_t = e^{g_t}\Gamma_{t-1}$

- Shocks:

$$z_t = \rho_z z_{t-1} + \epsilon_t^z$$

$$g_t = (1-\rho_g)\mu_g + \rho_g g_{t-1} + \epsilon_t^g$$

with $\rho_z \in (0,1)$, $\rho_g \in (0,1)$, $\epsilon_t^z \sim N(0,\sigma_z^2)$ and $\epsilon_t^g \sim N(0,\sigma_g^2)$

- We can write the output growth rate as

$$g_t^y = g_t + z_t - z_{t-1}$$

Macro stability and stability of expectations: FIRE

Result 1

Under FIRE, forecast errors provide no useful information about the future

Corollary 1

Under FIRE, a stream of consecutive similar signals would not affect the volatility of expectations

Macro stability and stability of expectations: Bayesian learning

- The individual attempts to identify from aggregate growth shocks signals whether changes in output are due to transitory or permanent shocks, using the parameters that govern distributions of shocks
- The goal is to estimate $\alpha_t = \begin{bmatrix} z_t & z_{t-1} & g_t \end{bmatrix}'$ optimally
- Given normality of errors, the optimal estimator $a_t = E(\alpha_t / I_t)$ is linear

Macro stability and stability of expectations: Bayesian learning

- The Kalman coefficients are the parameters of an adaptive rule for the posterior a_t that is a linear combination of previous beliefs and the new signal:

$$a_t = k_1 a_{t/t-1} + k_2 g_t^Y$$

with

$$k_1 = I - PZ'(ZPZ')^{-1}Z;\ k_2 = PZ'(ZPZ');\ a_{t/t-1} = Ta_{t-1} + c$$

being P the estimation errors covariance matrix

Result 2

Under unbiased Bayesian learning, a stream of consecutive similar signals would decrease the volatility of expectations

Macro stability and stability of expectations: Non-Bayesian learning

- Stochastic-Gain Learning (SGL)
- General idea: If forecast errors are small, the individual adjusts her expectations by using a decreasing gain parameter. However, if forecast errors are large, the individual suspects there was a change of regime, hence she assigns more importance to information of the present and the gain parameter becomes constant

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Macro stability and stability of expectations: Non-Bayesian learning

$$E_t g^y_{t+1} = E_{t-1} g^y_t + \kappa_t (g^y_t - E_{t-1} g^y_t)$$

$$\kappa_t = \begin{cases} 1/t \quad if \quad \frac{1}{S} \sum_{s=0}^{S} (\mid g^y_{t-s} - E_{t-s-1} g^y_{t-s} \mid) < v^y_t \\ \\ \kappa \quad if \quad \frac{1}{S} \sum_{s=0}^{S} (\mid g^y_{t-s} - E_{t-s-1} g^y_{t-s} \mid) \geq v^y_t \end{cases}$$

- v^y_t is the mean absolute deviation of historical forecast errors, which is recursively updated
- When the agent switches back to a decreasing-gain parameter, the parameter is reset to $\frac{1}{\kappa^{-1}+t}$ (t starts from one after the switch)

Macro stability and stability of expectations: Non-Bayesian learning

Result 3

Under Stochastic-Gain learning, a stream of consecutive similar signals would decrease the volatility of expectations

Data on expectations

- Insufficient survey data on expectations
- What algorithm has a better match with available survey data on GDP growth expectations?
- Answer:
  - For low-volatility economies, FIRE, Bayesian learning, and SGL have approximately similar performances
  - For high-volatility economies, SGL performs better than the others!

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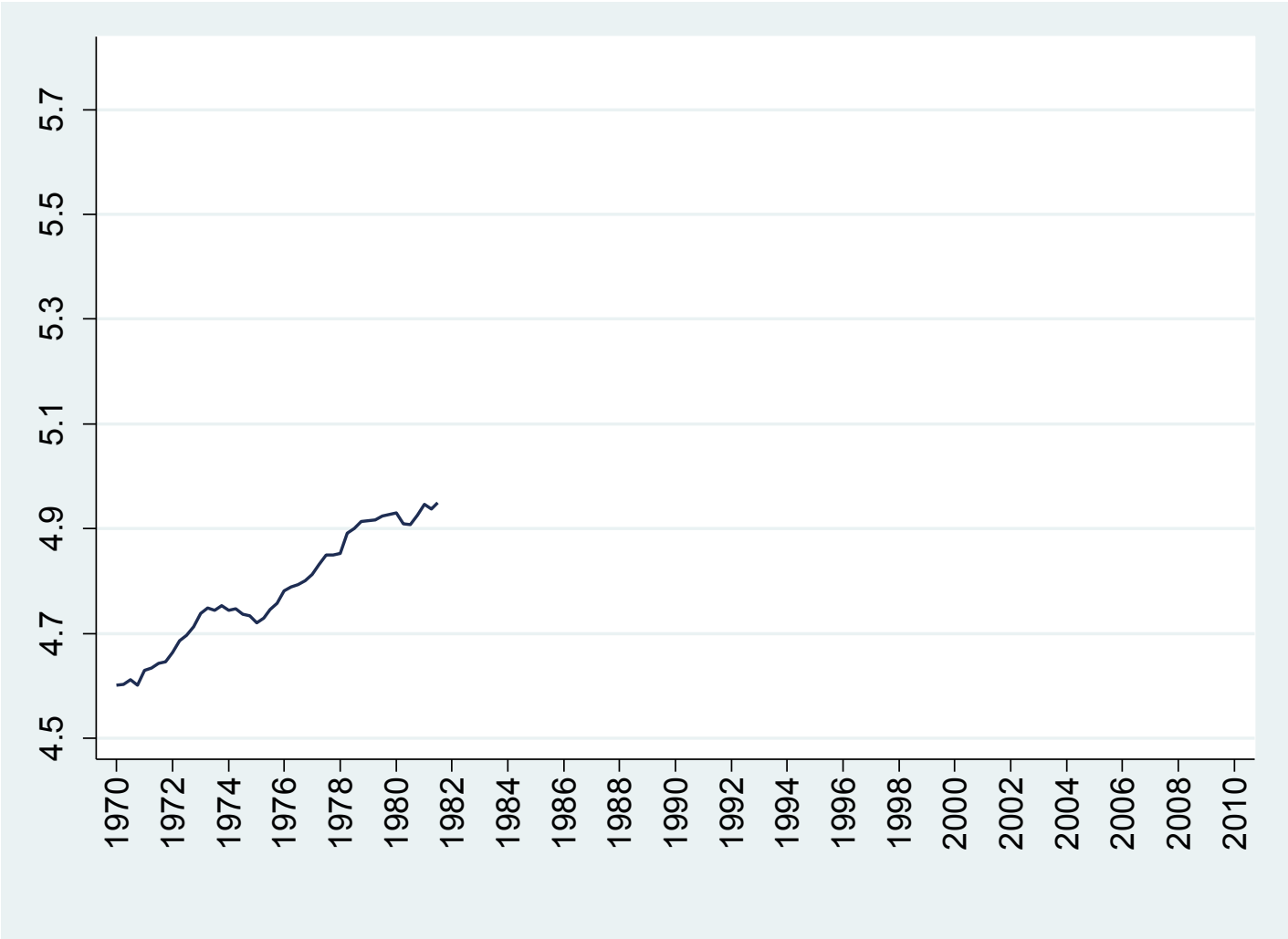

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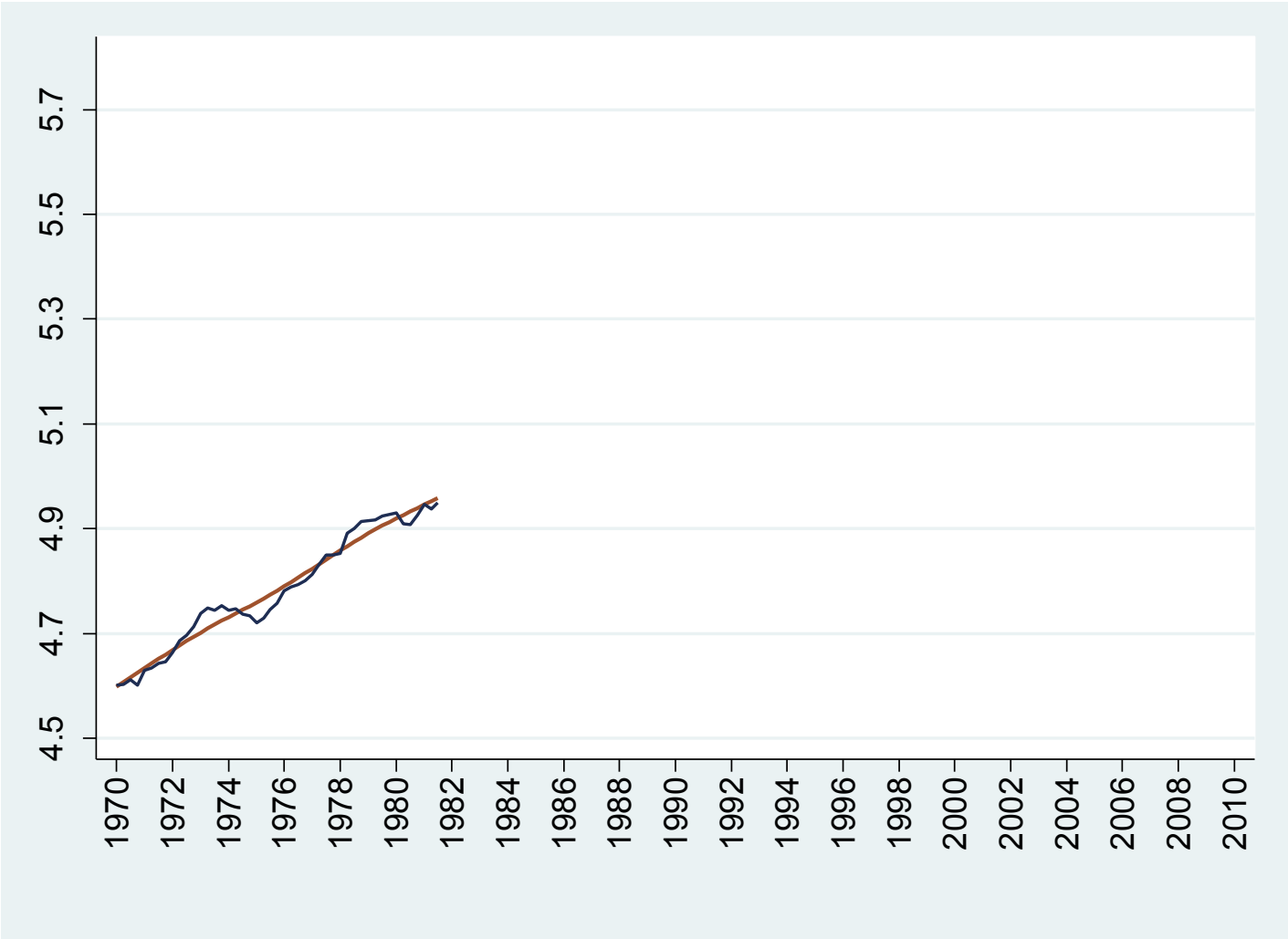

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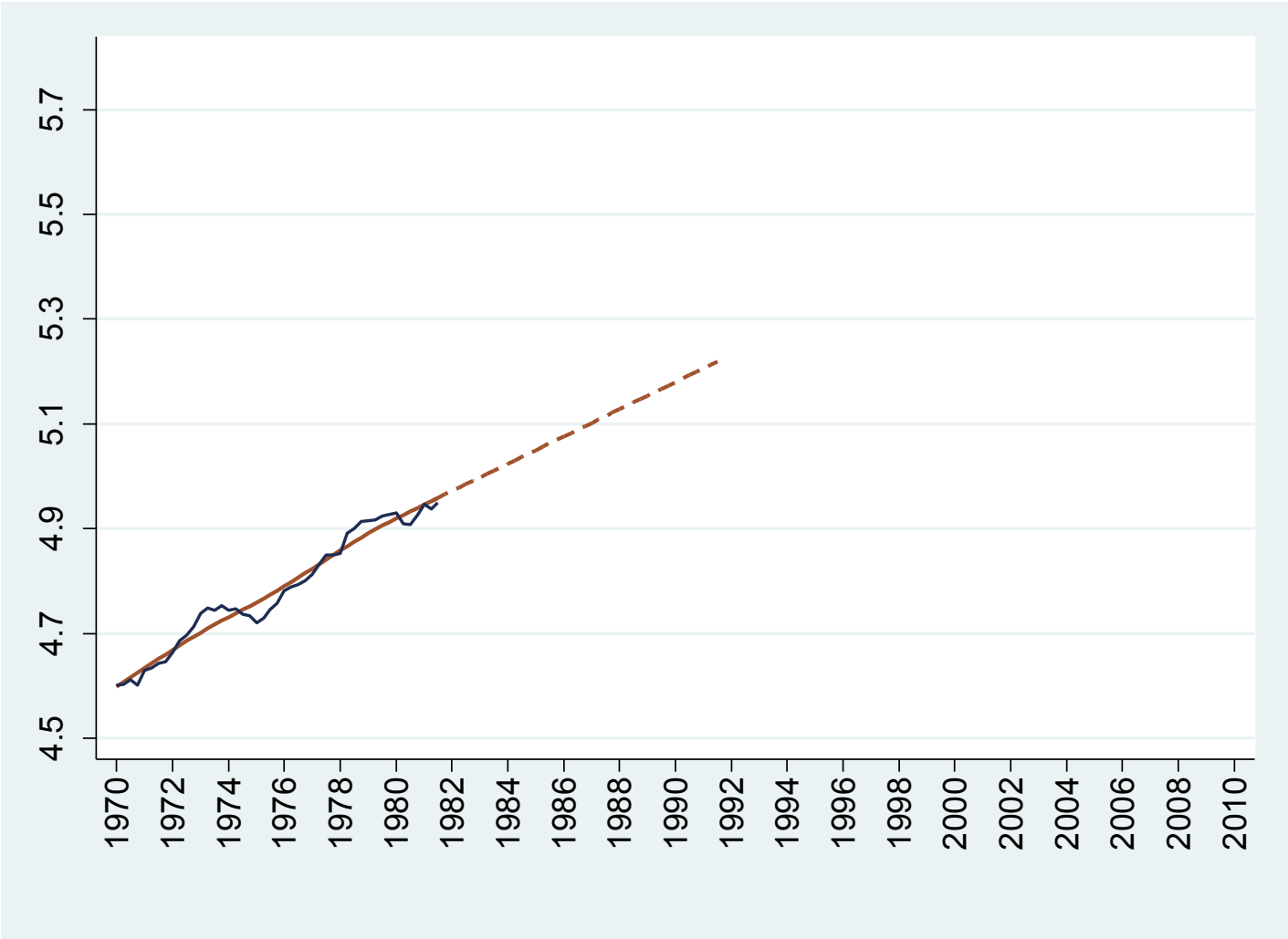

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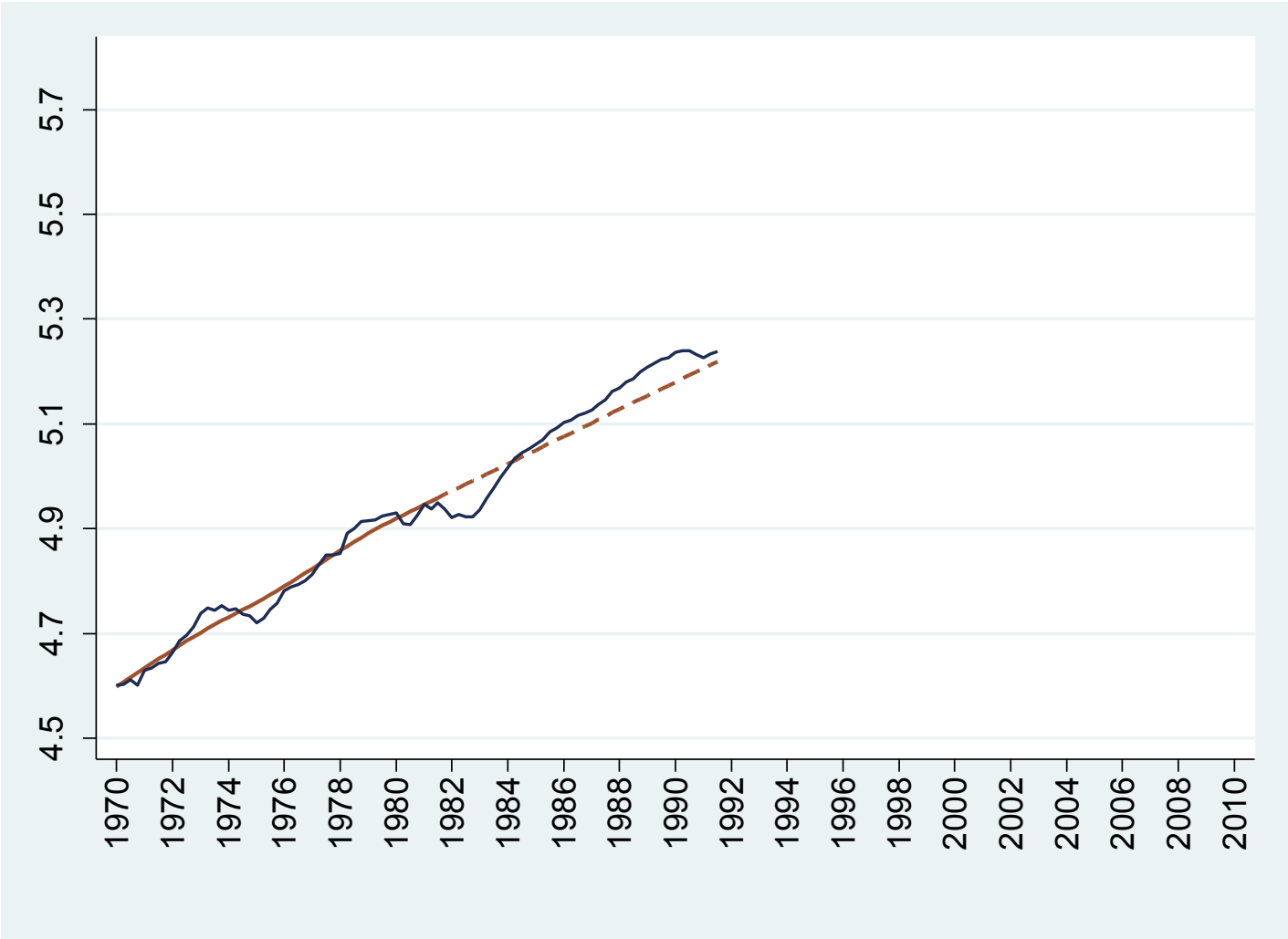

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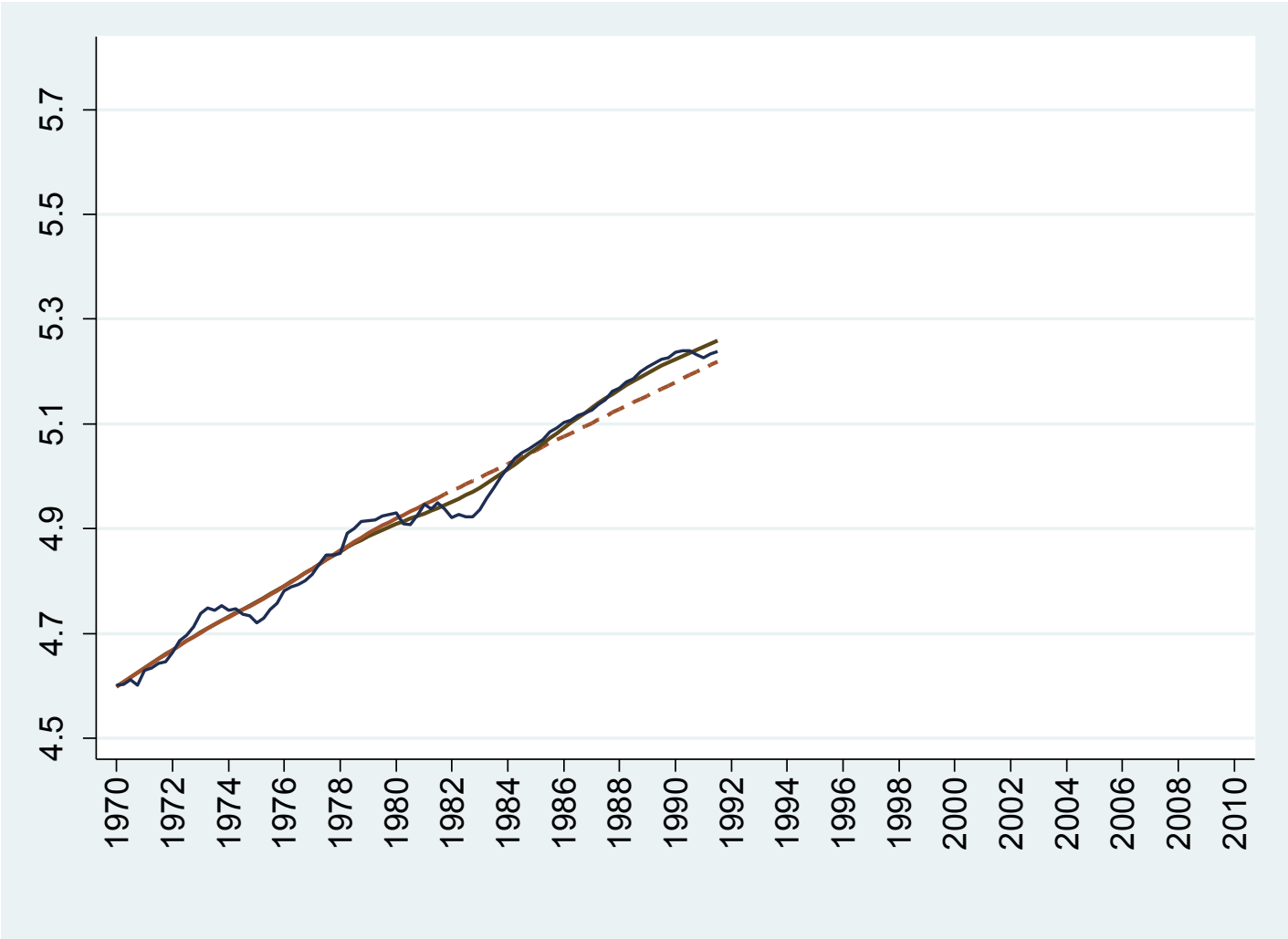

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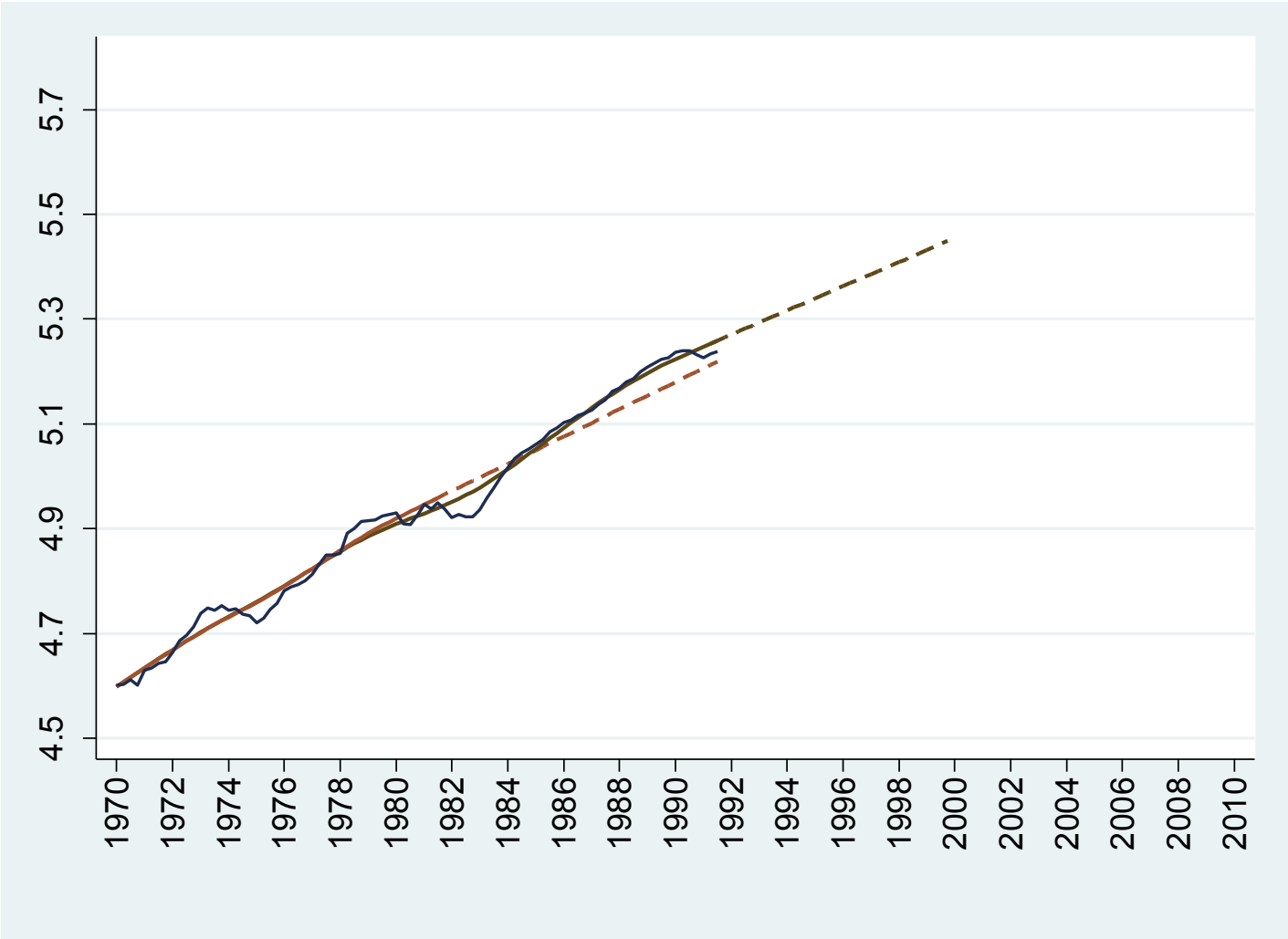

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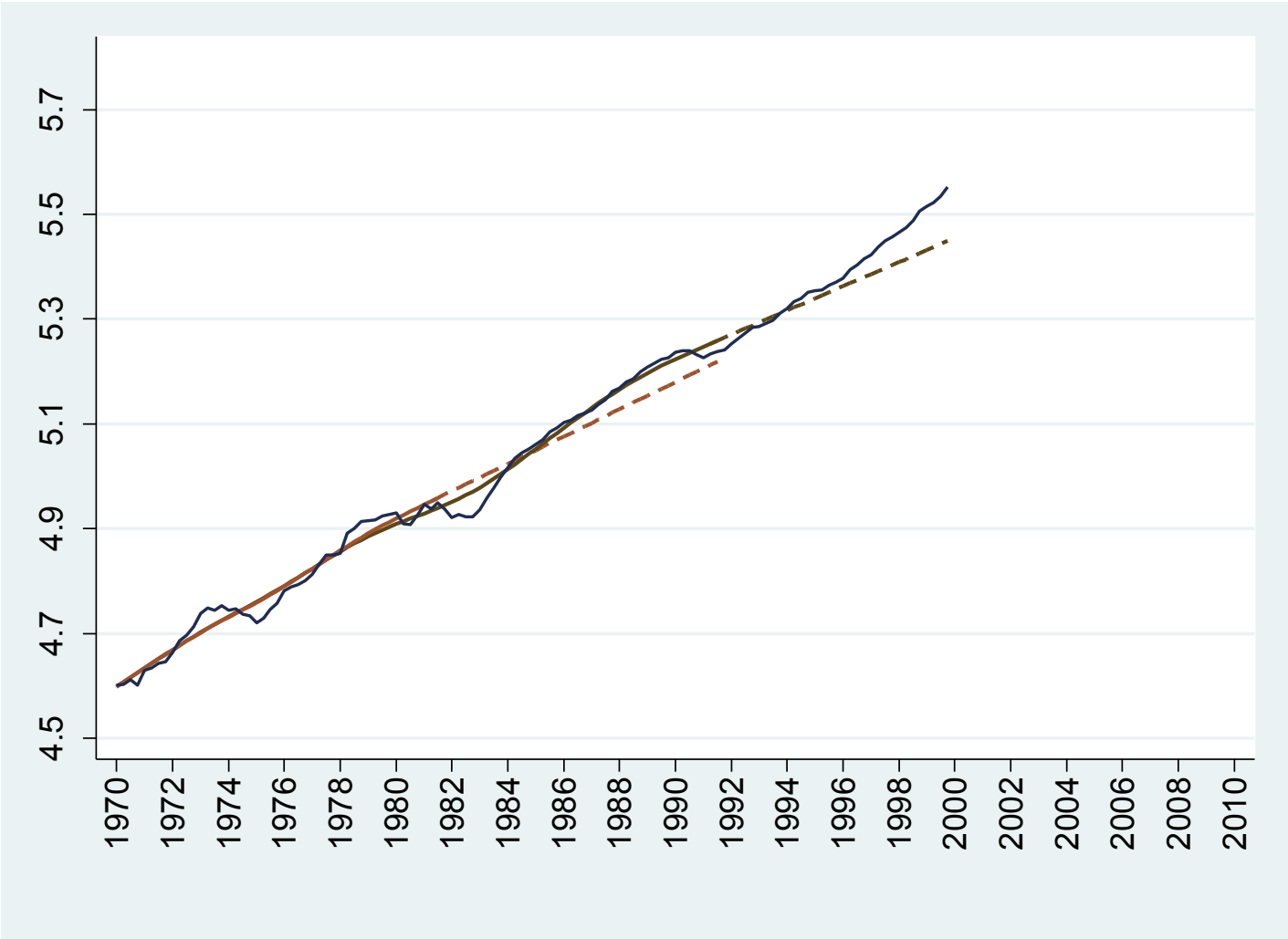

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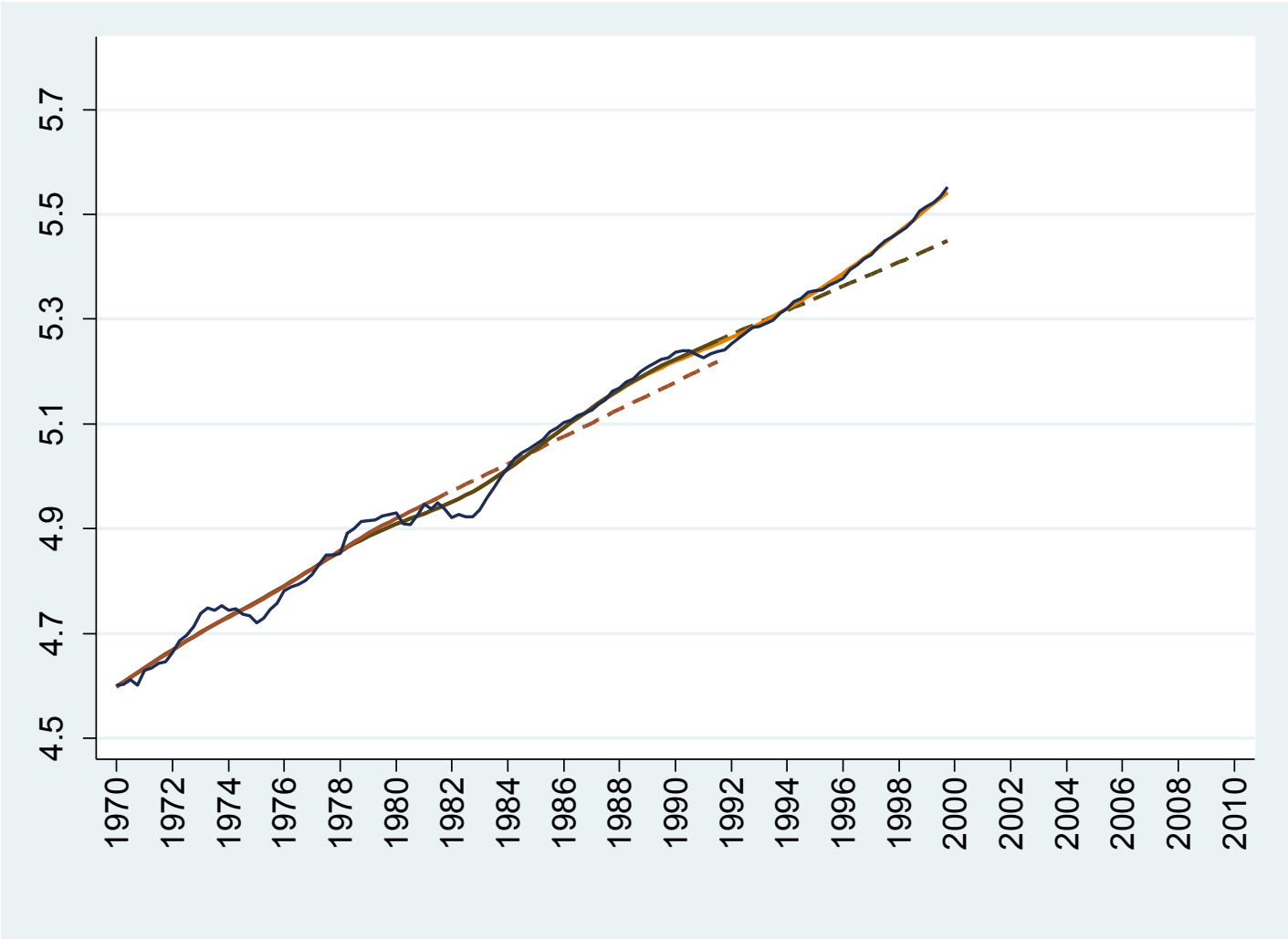

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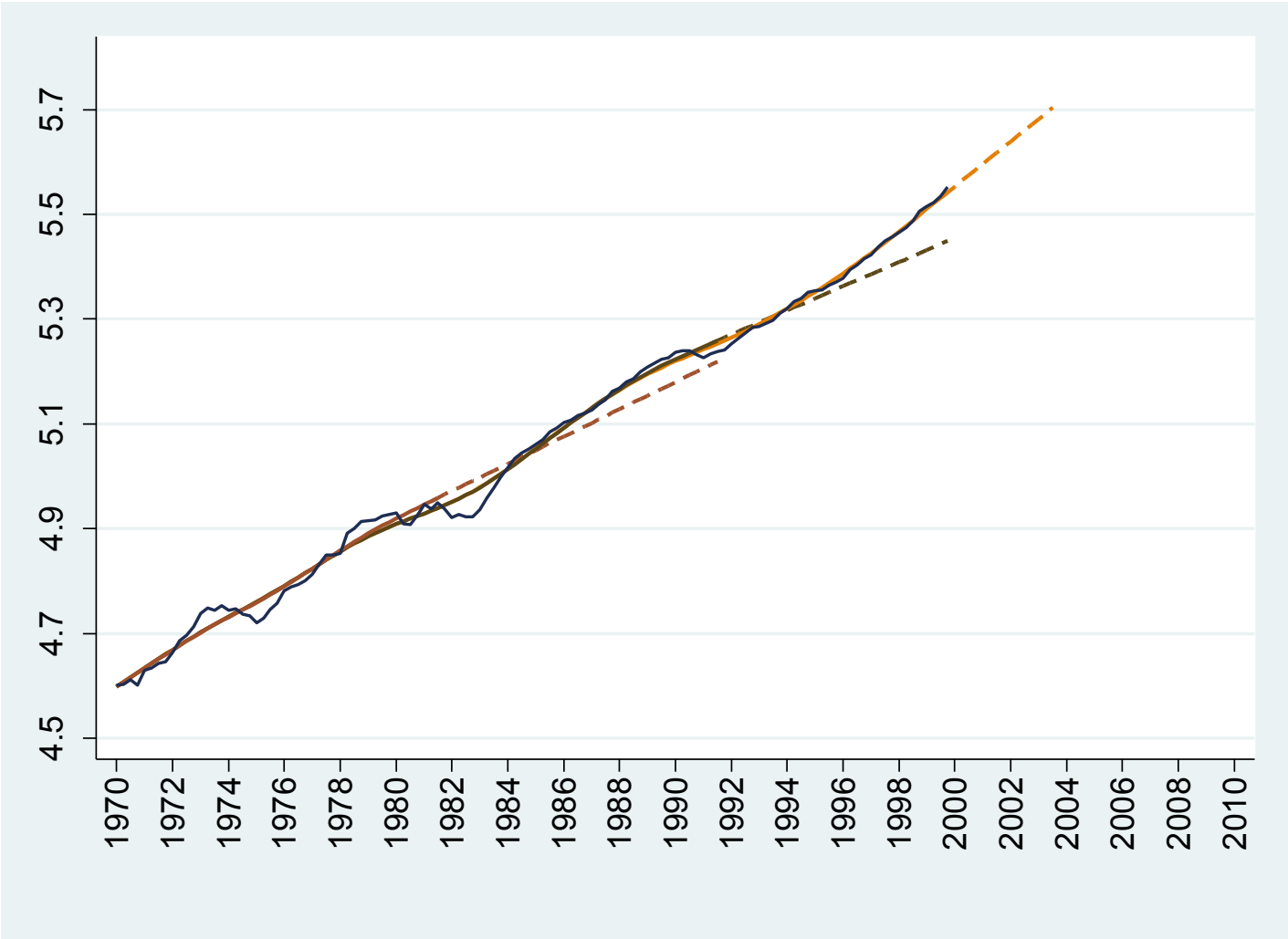

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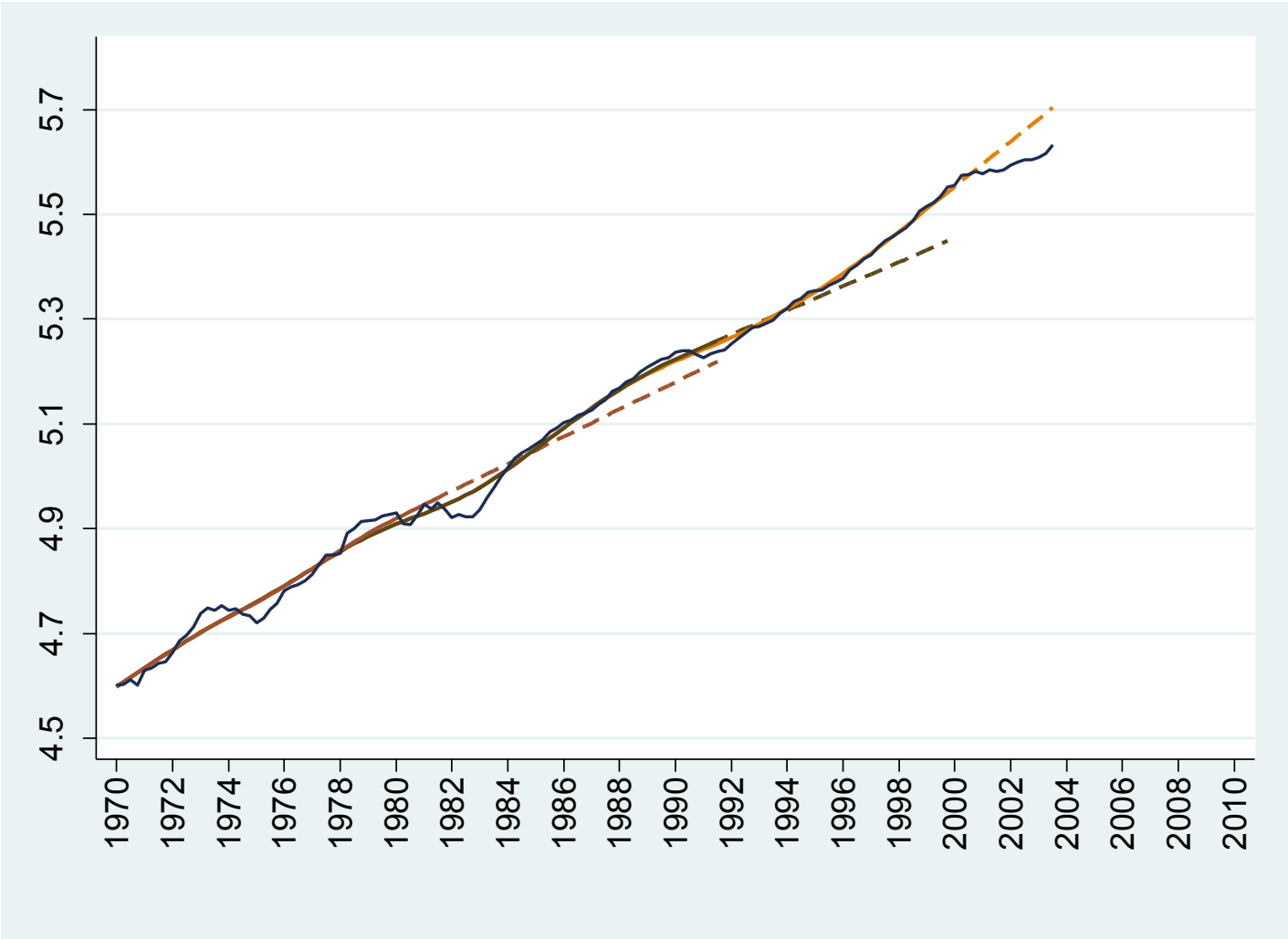

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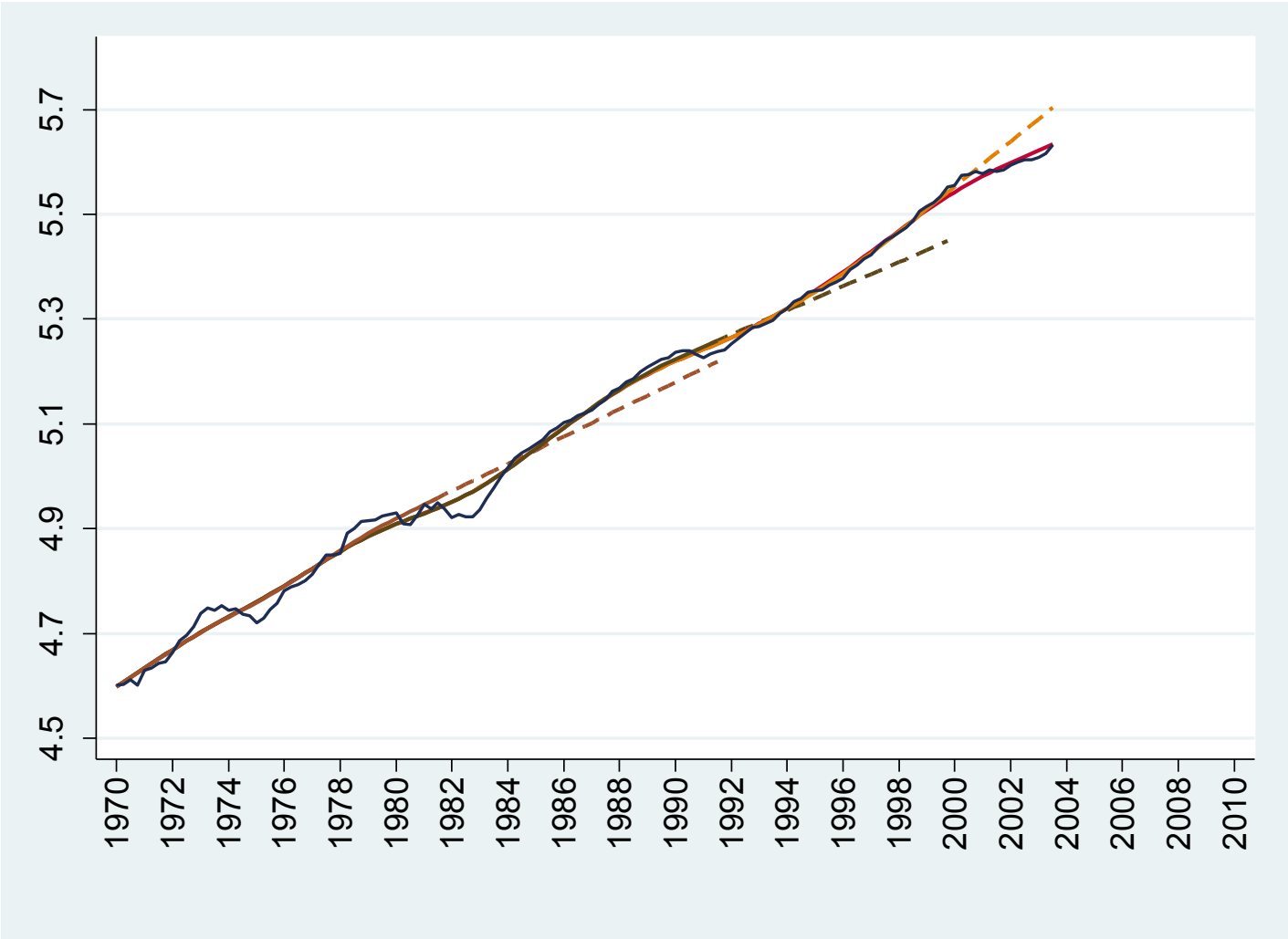

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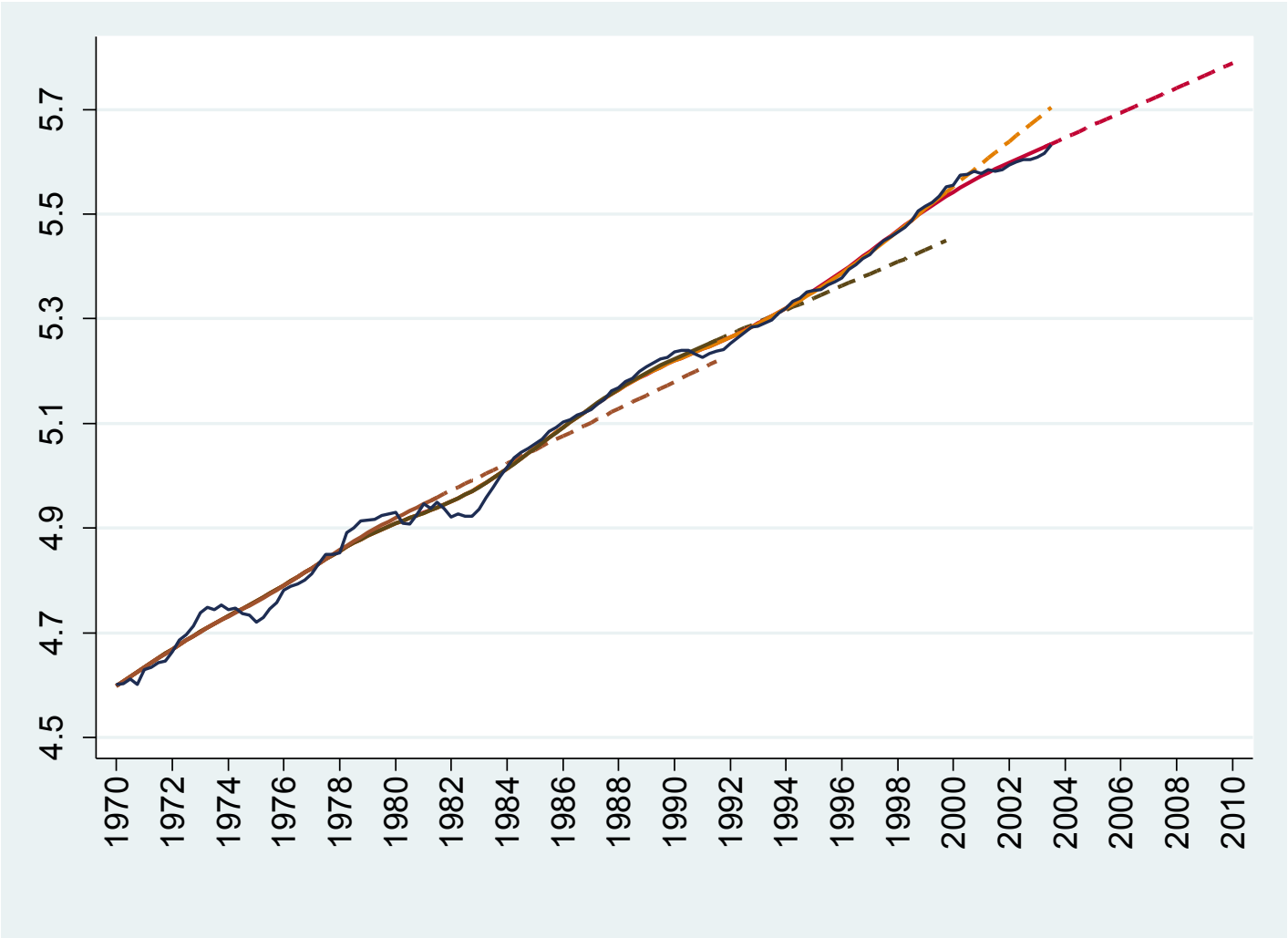

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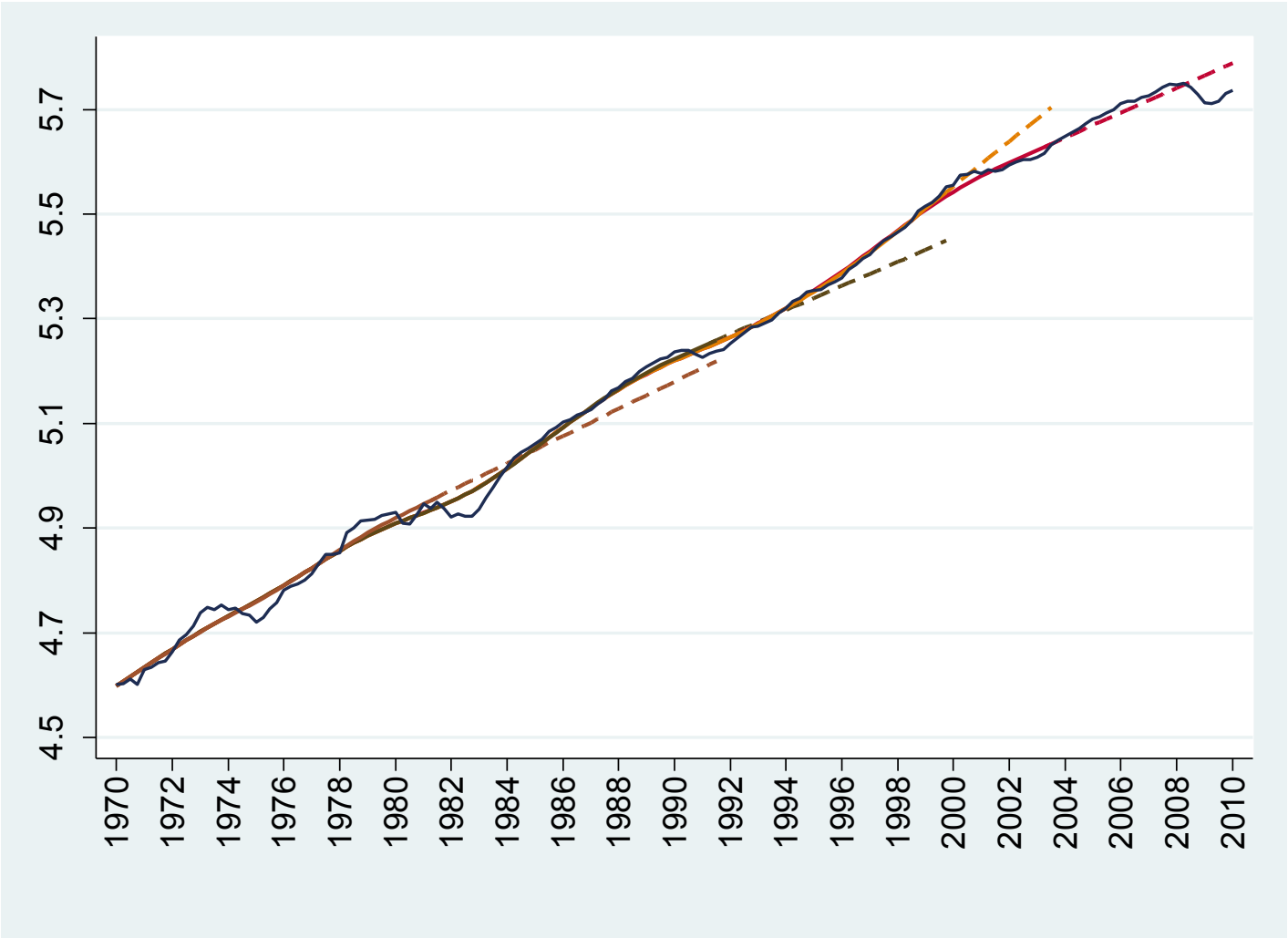

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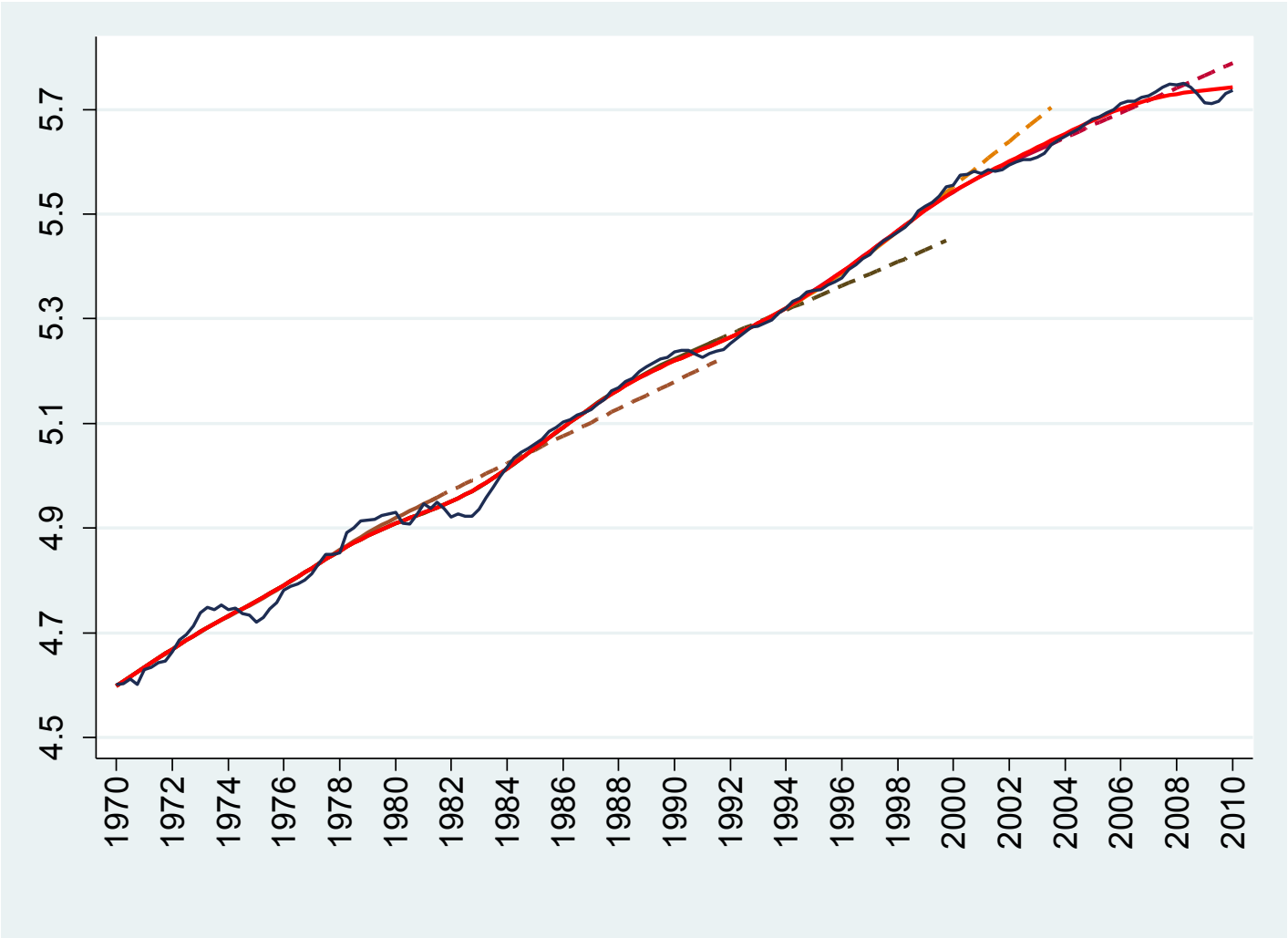

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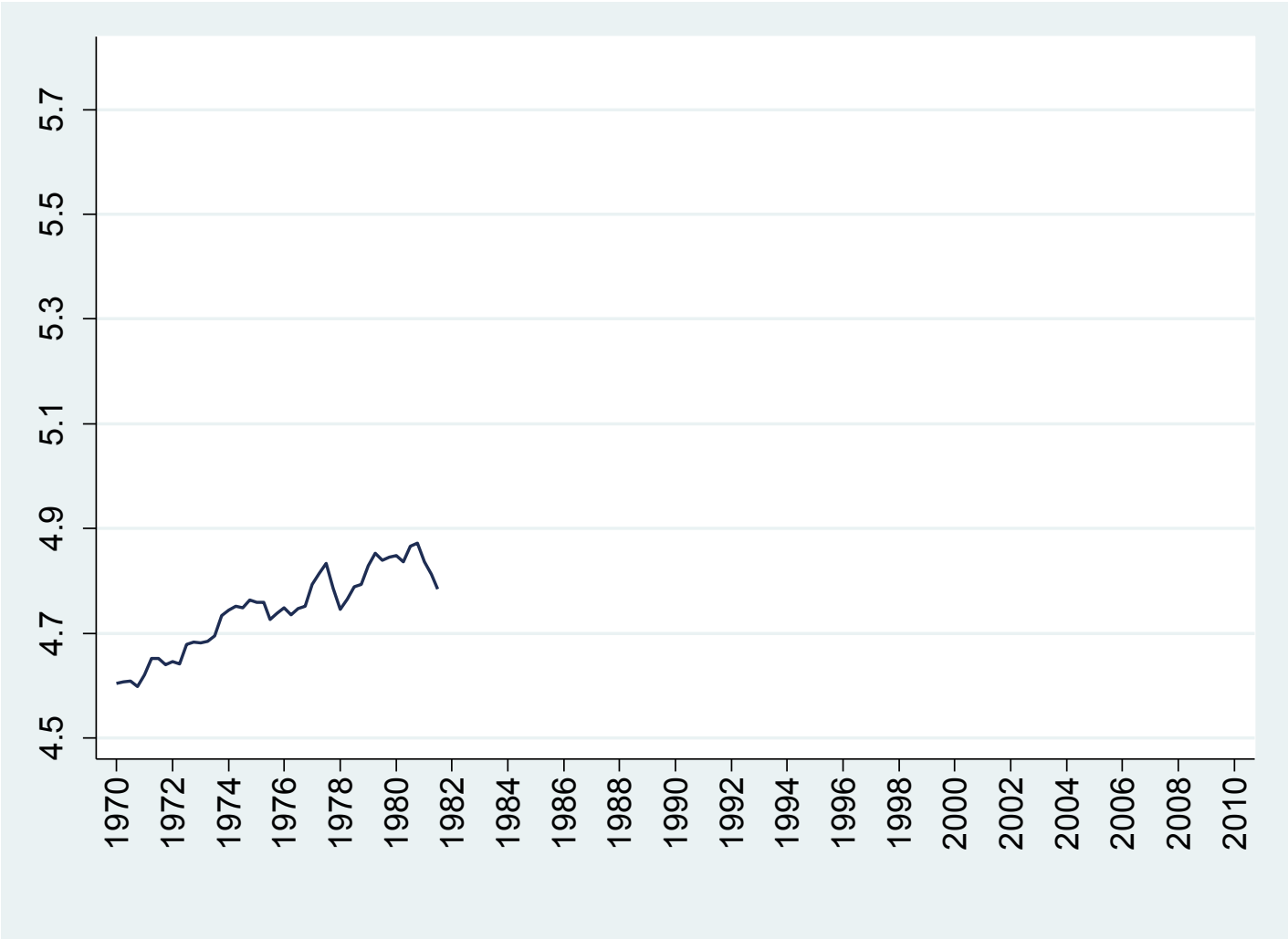

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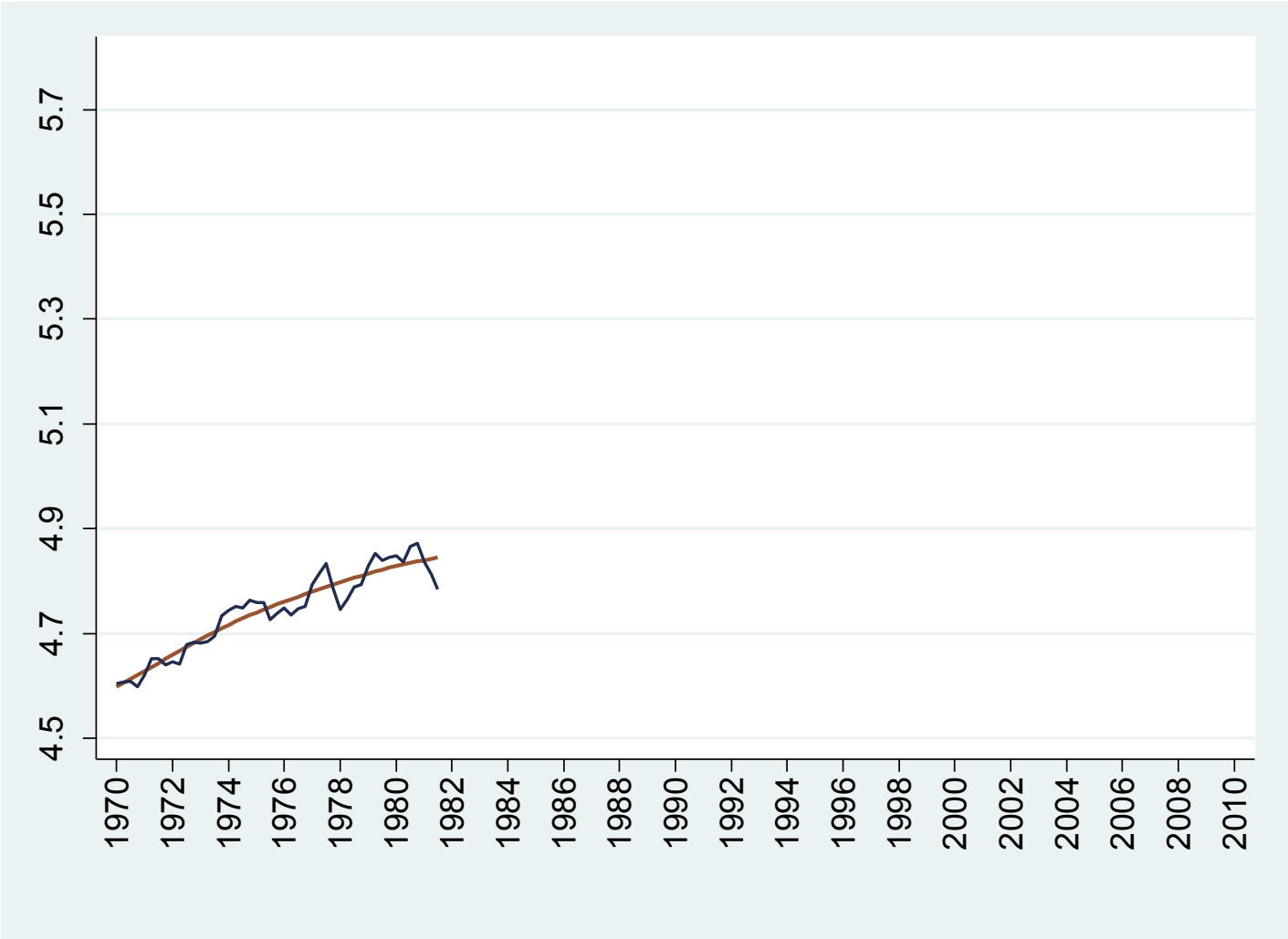

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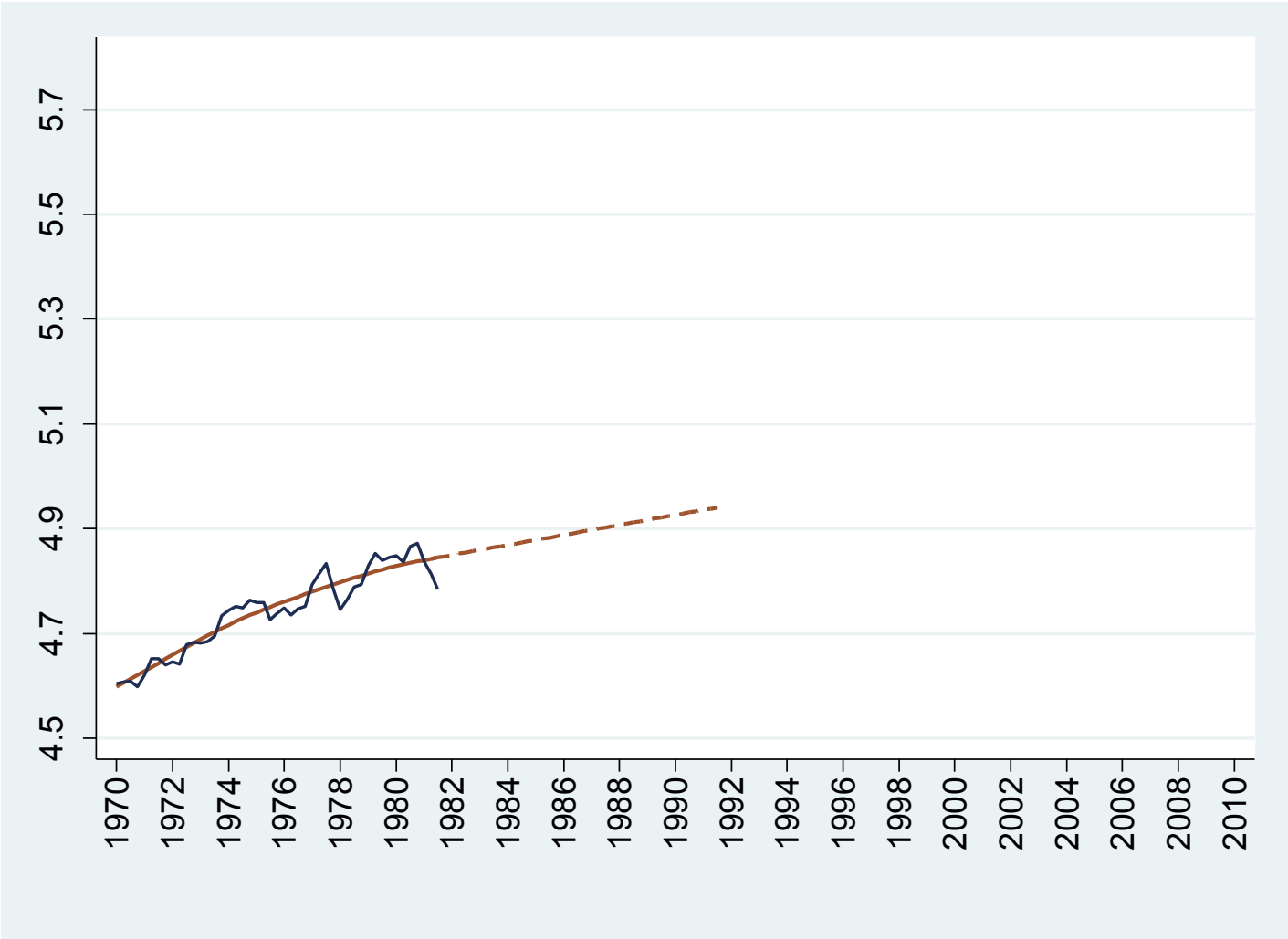

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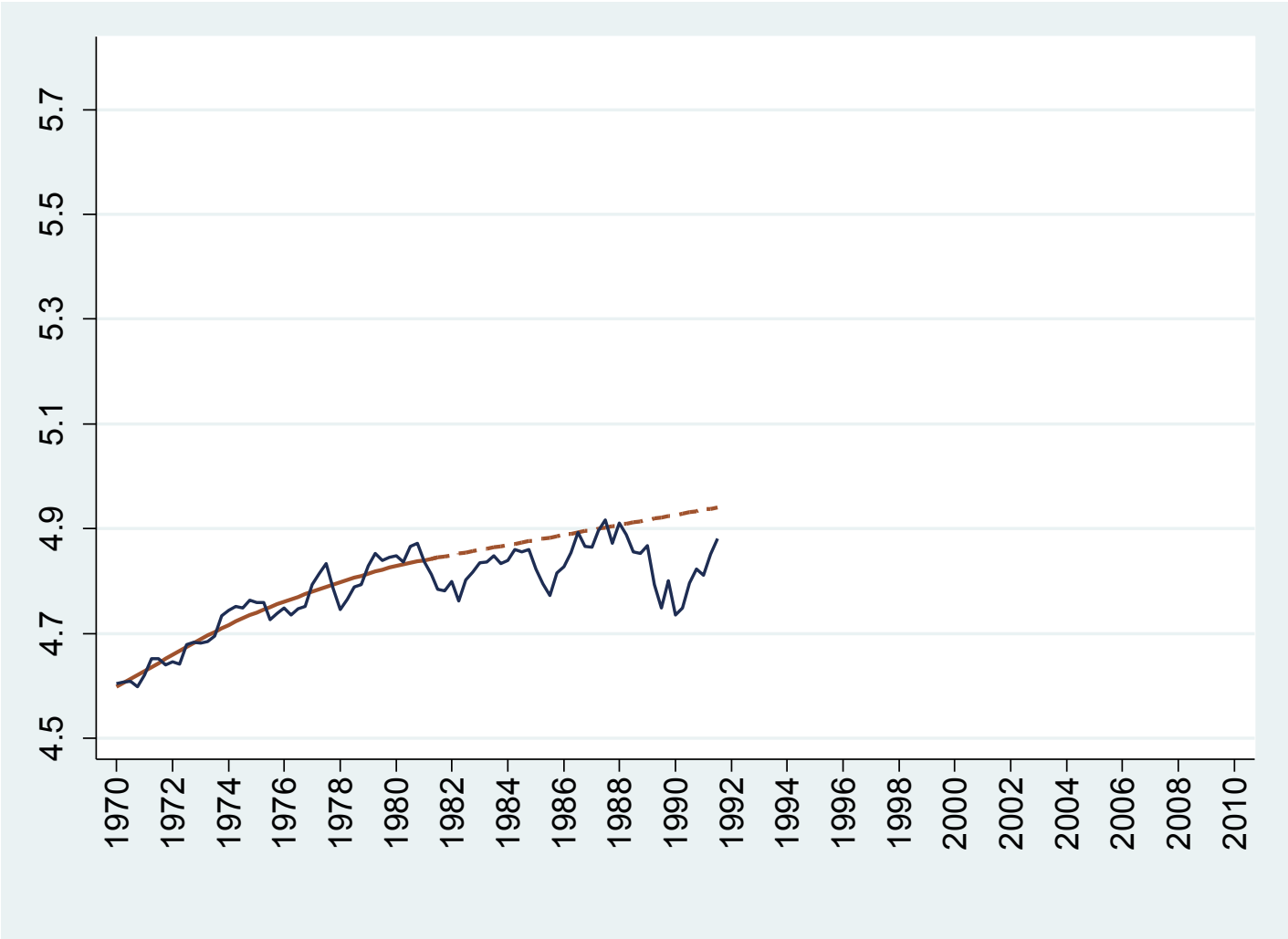

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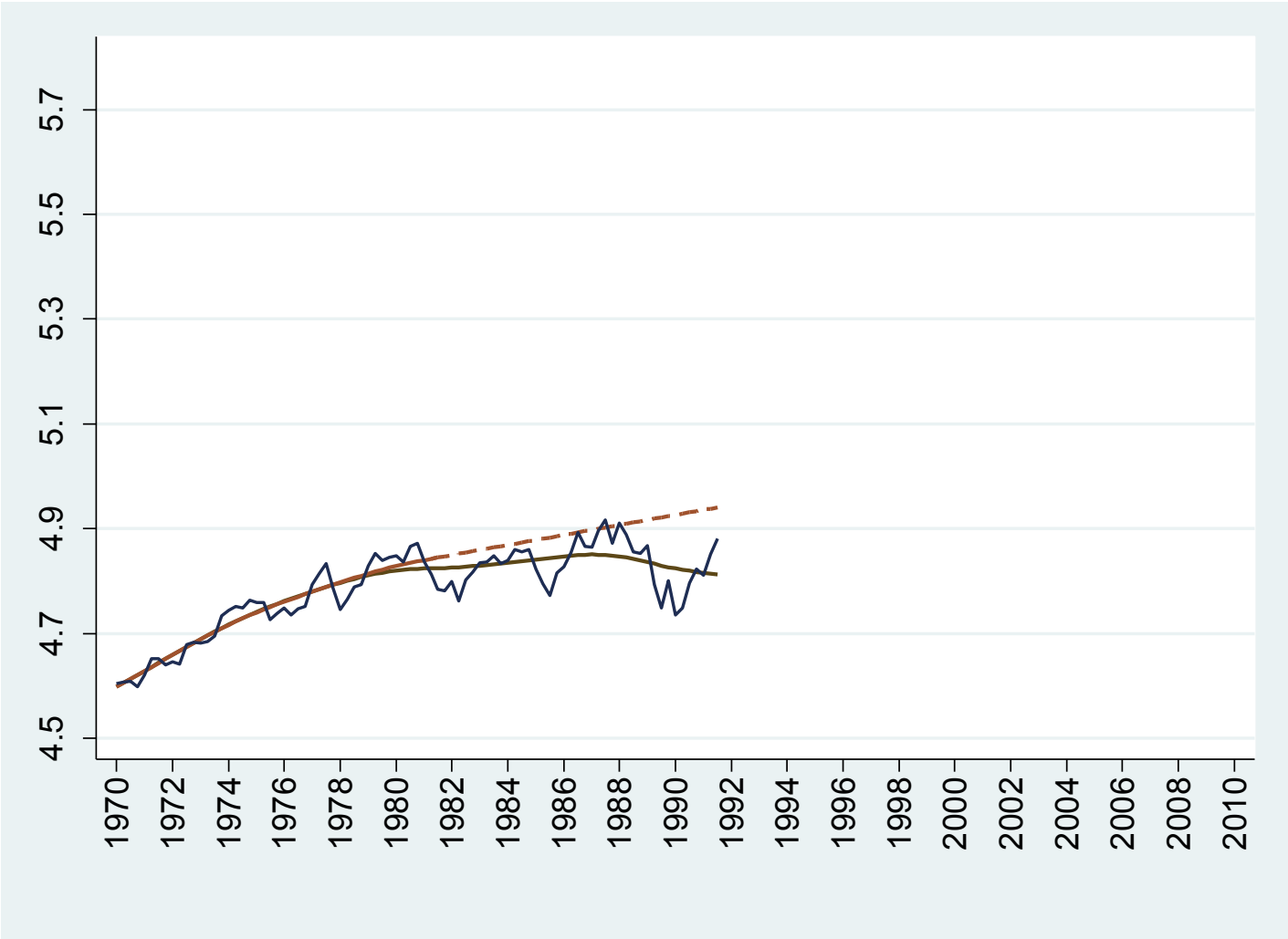

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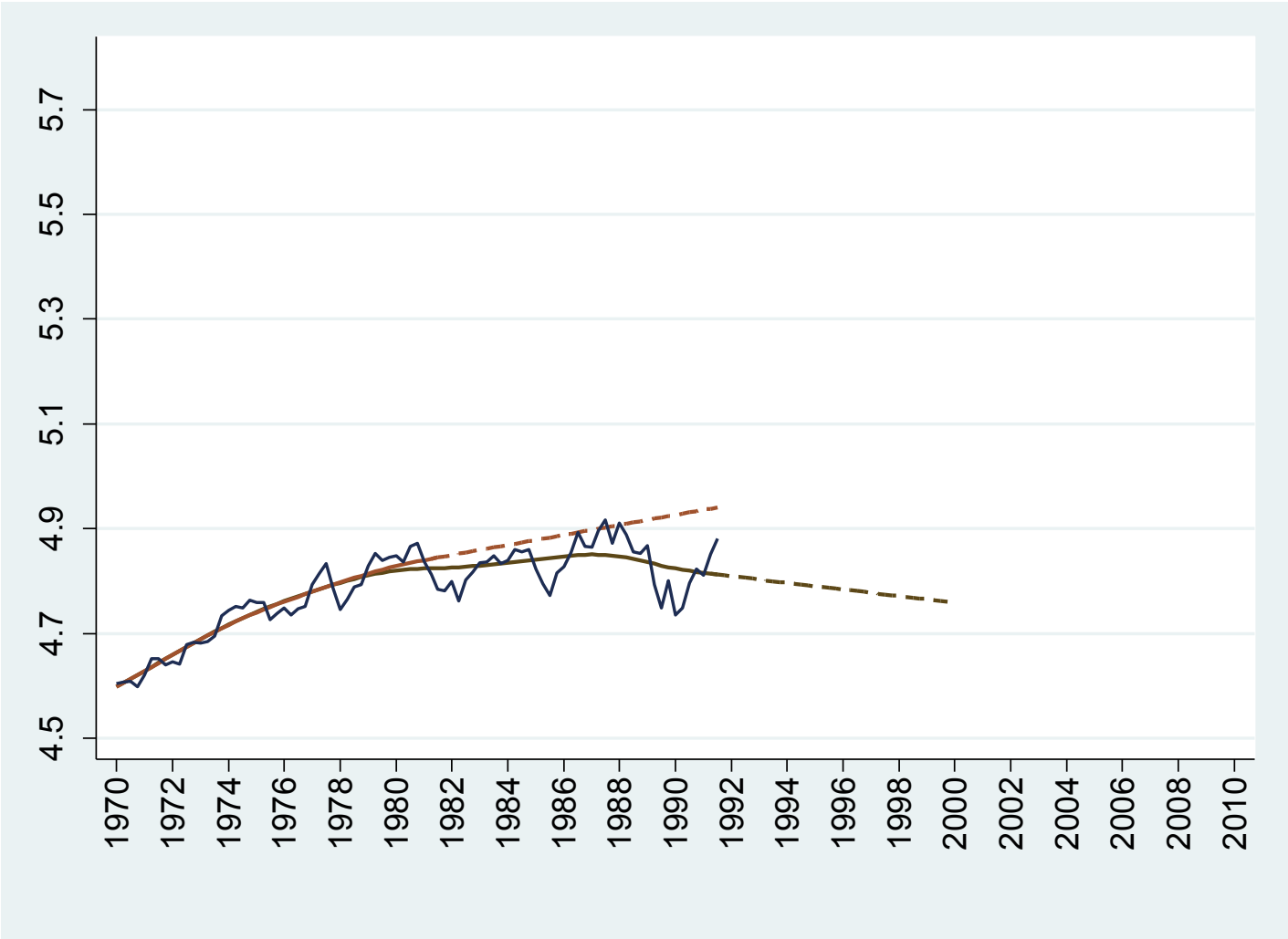

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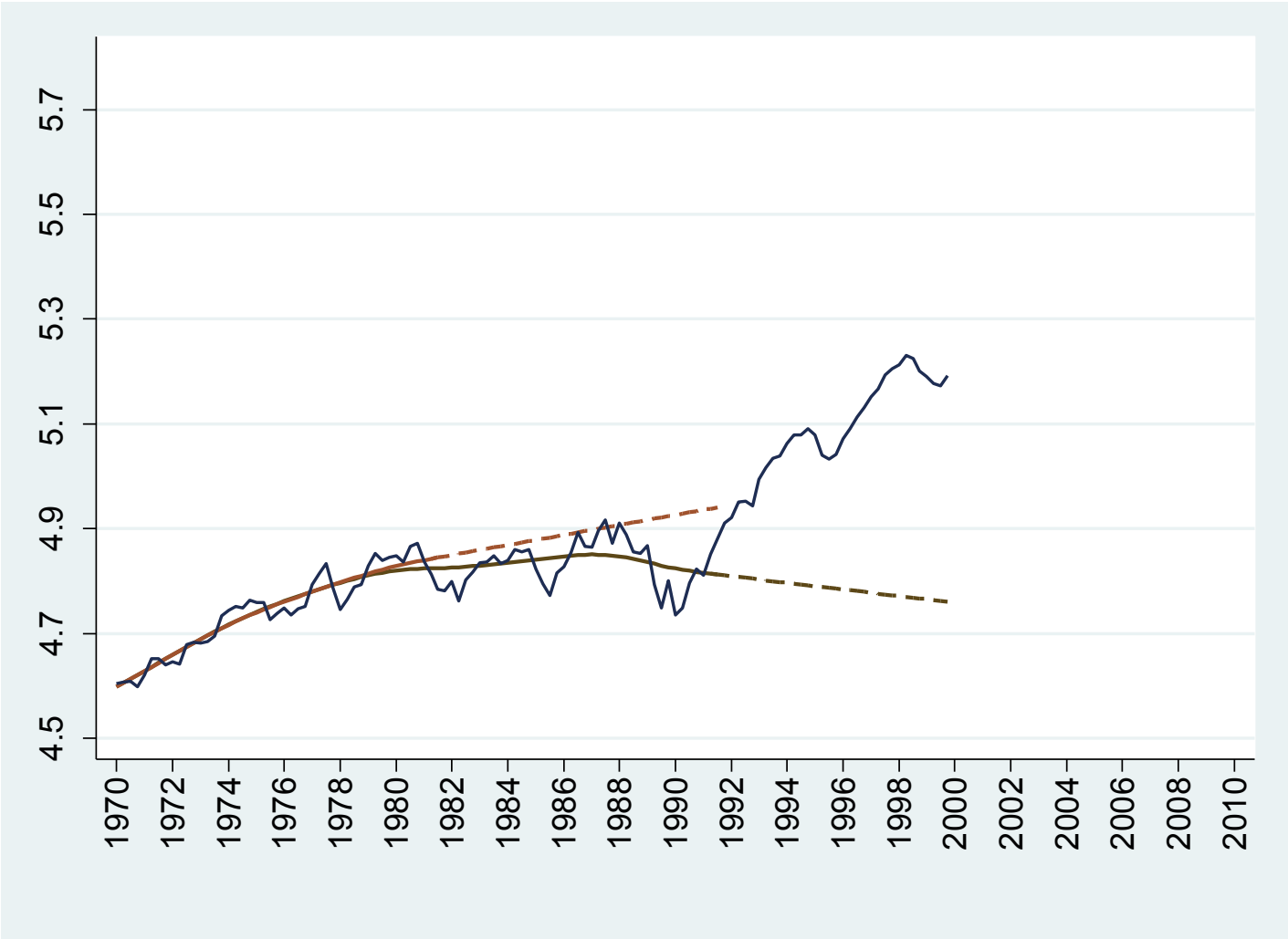

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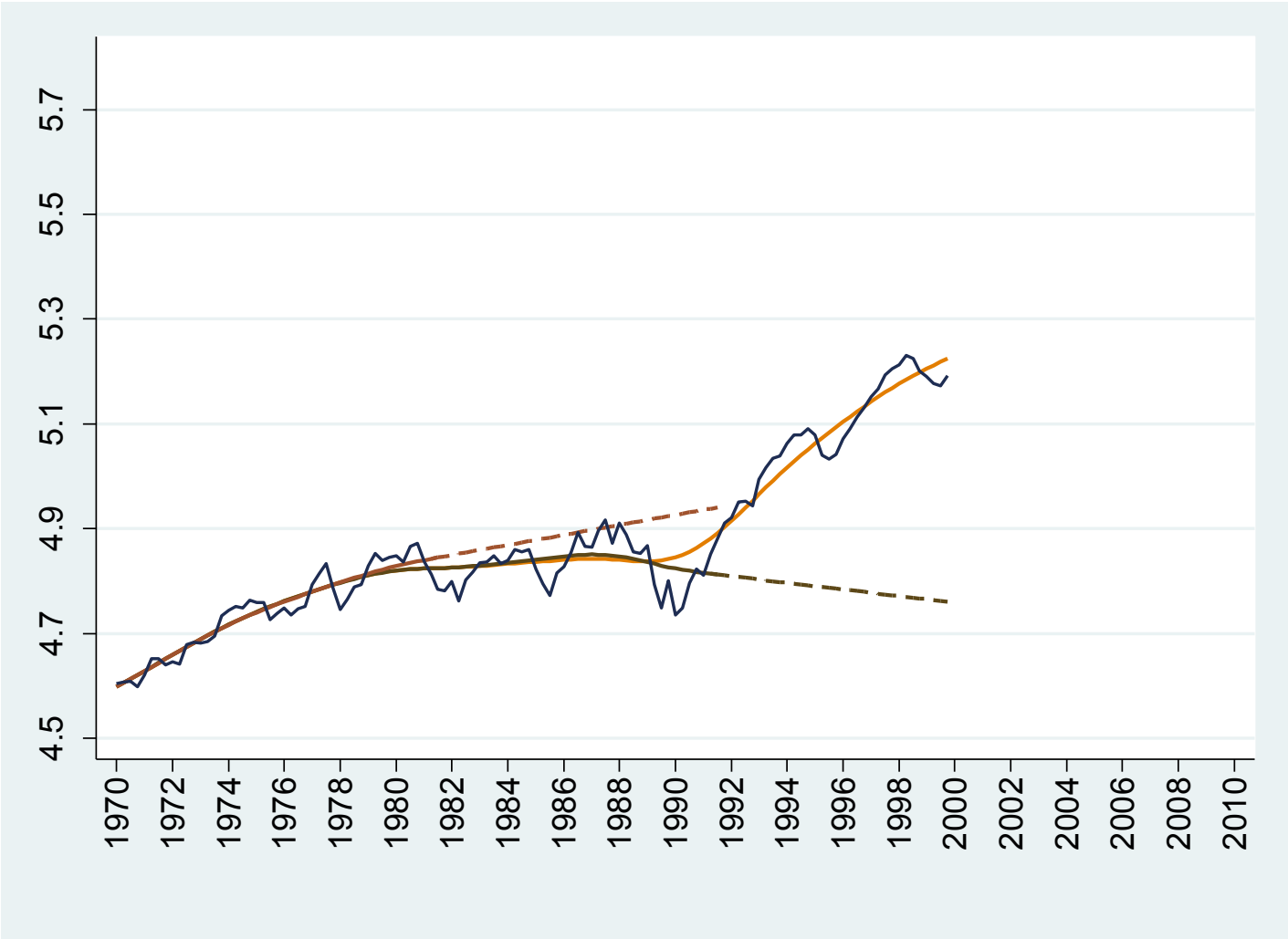

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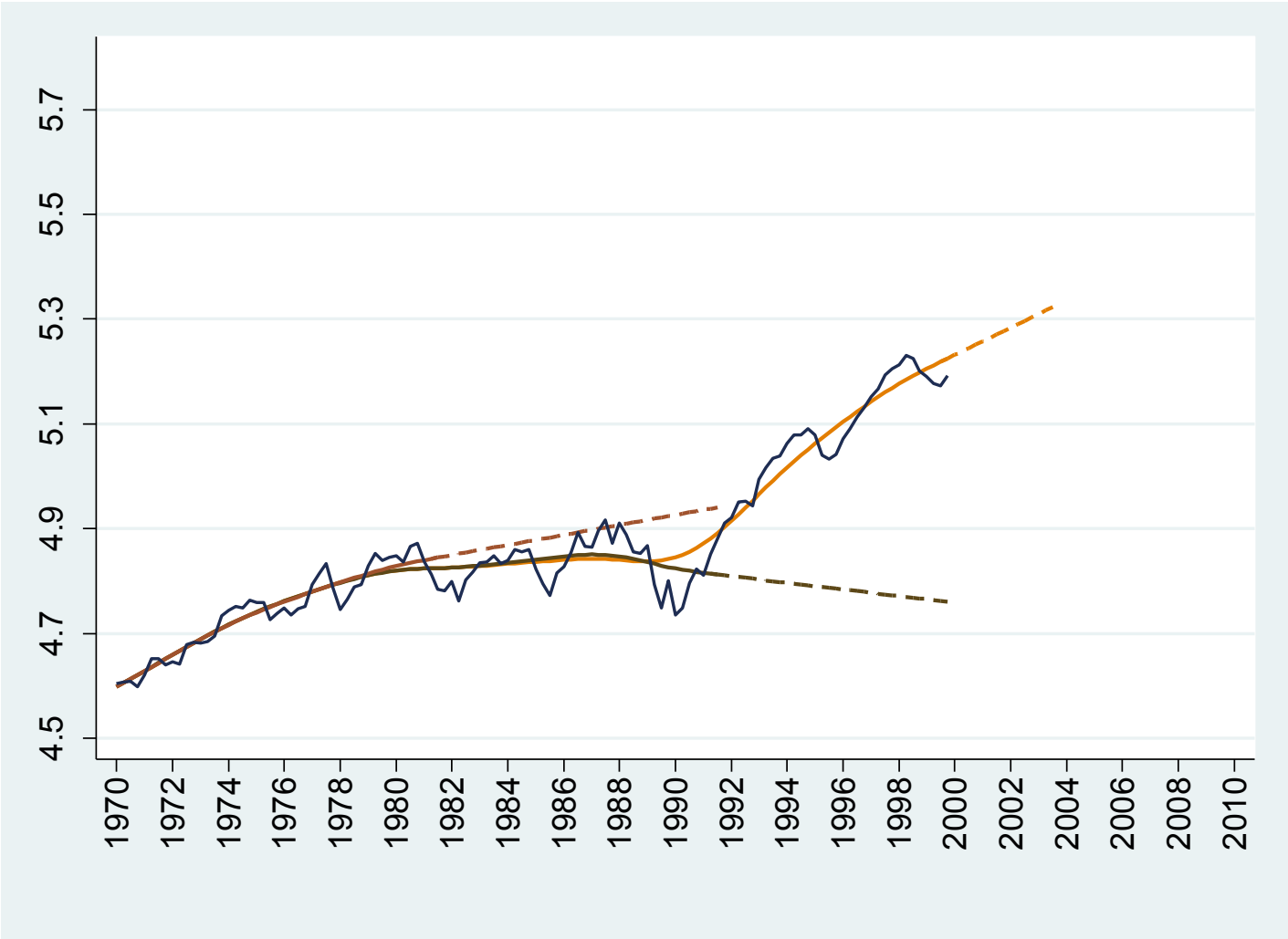

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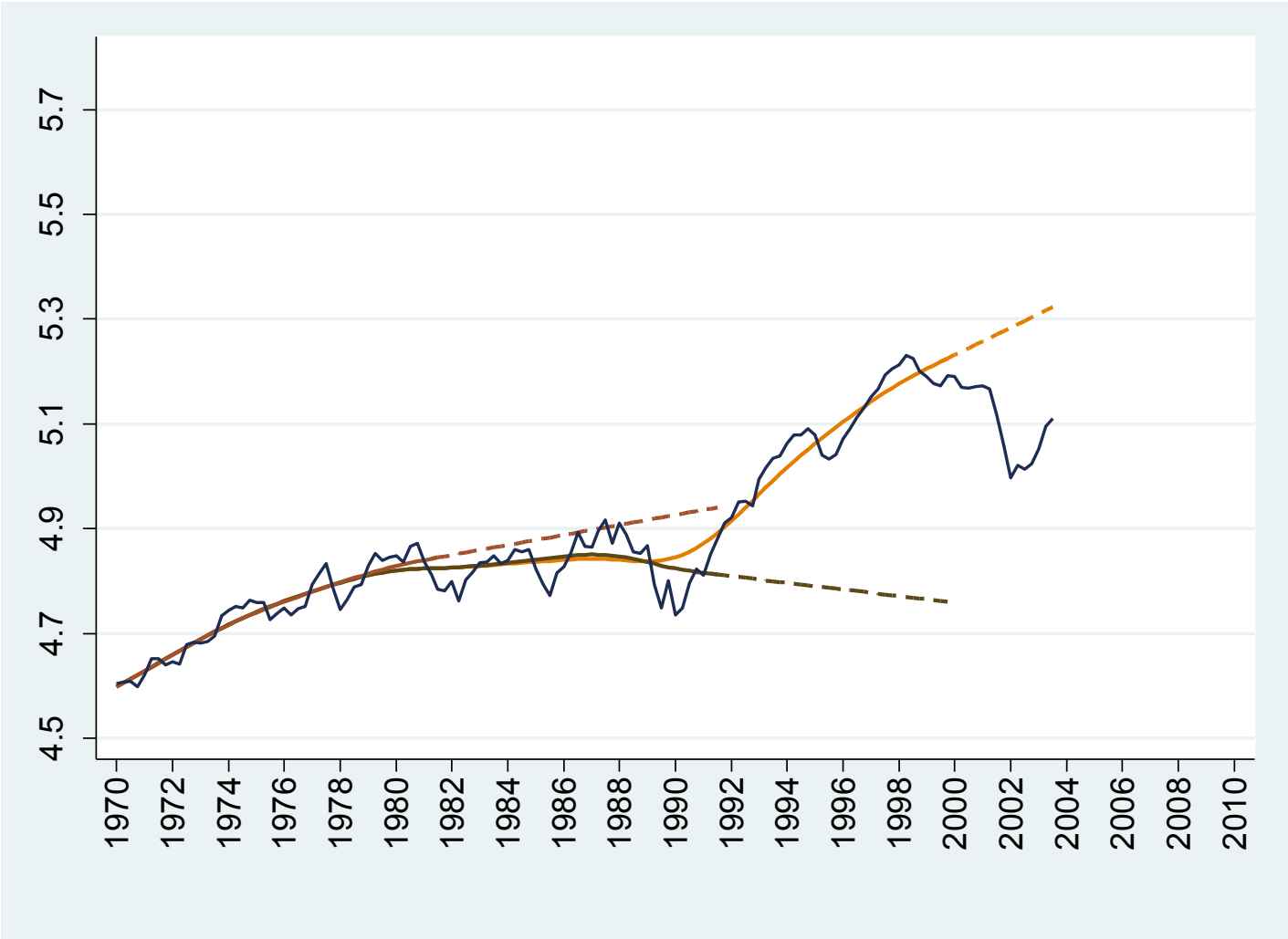

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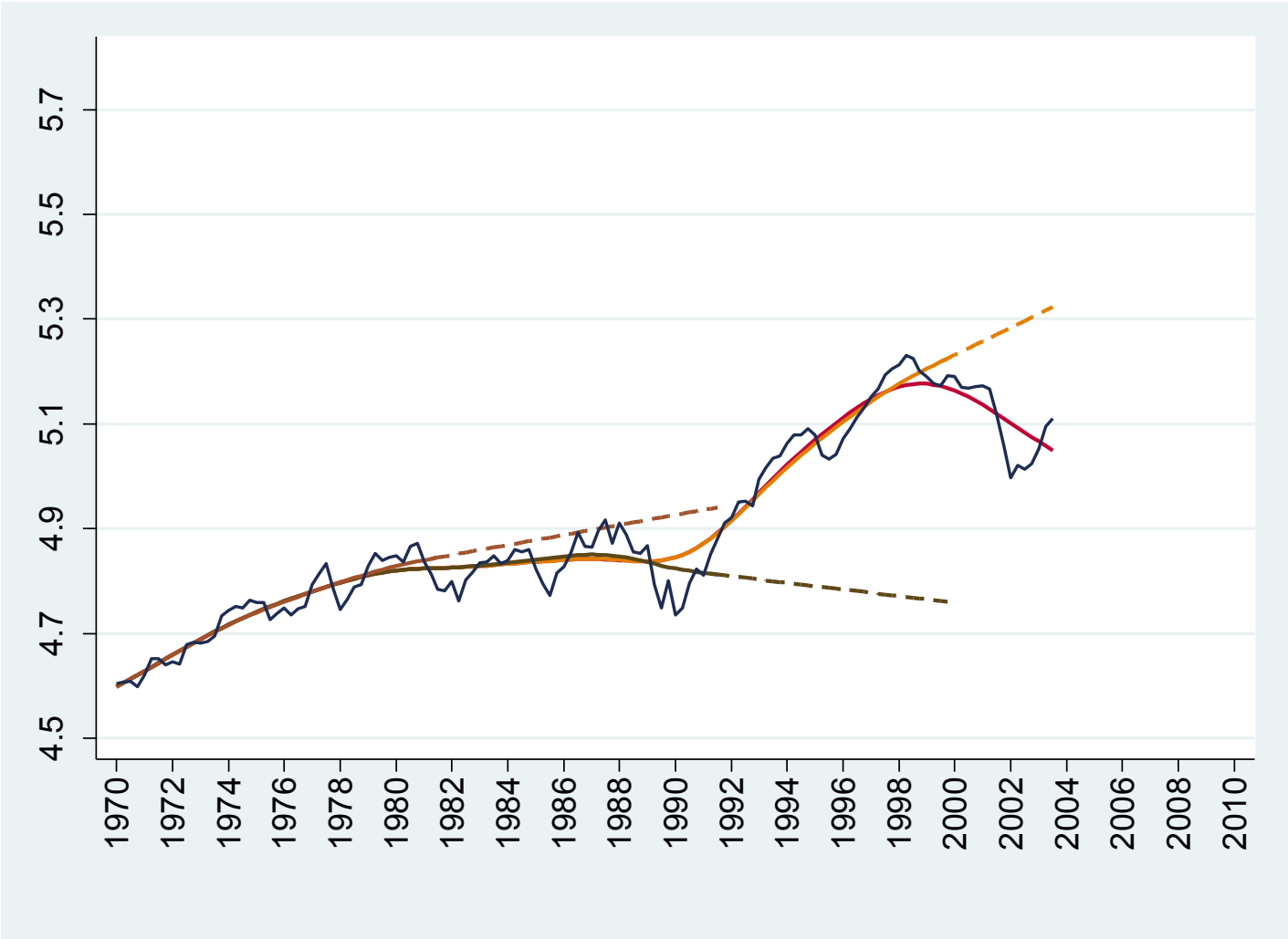

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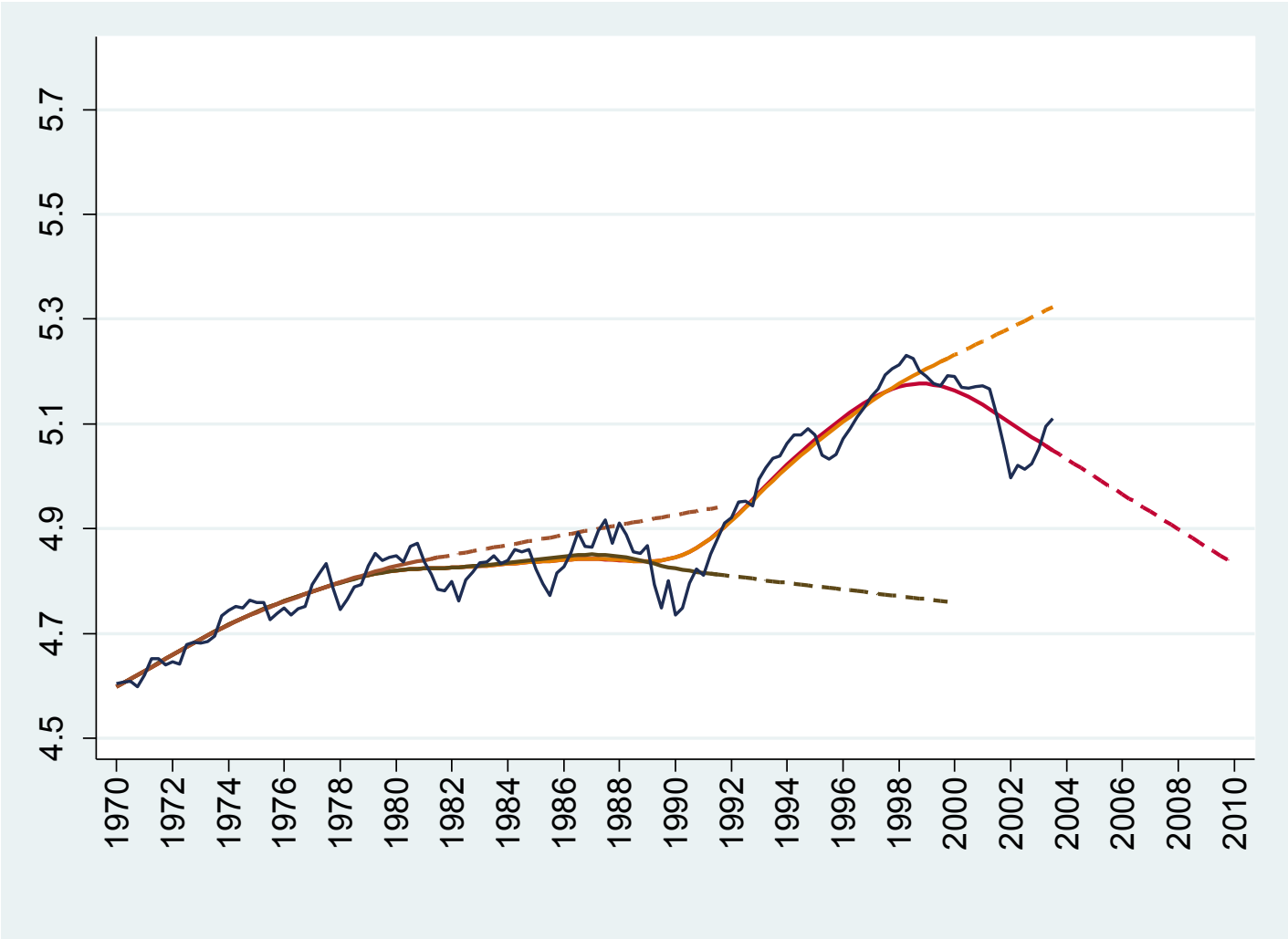

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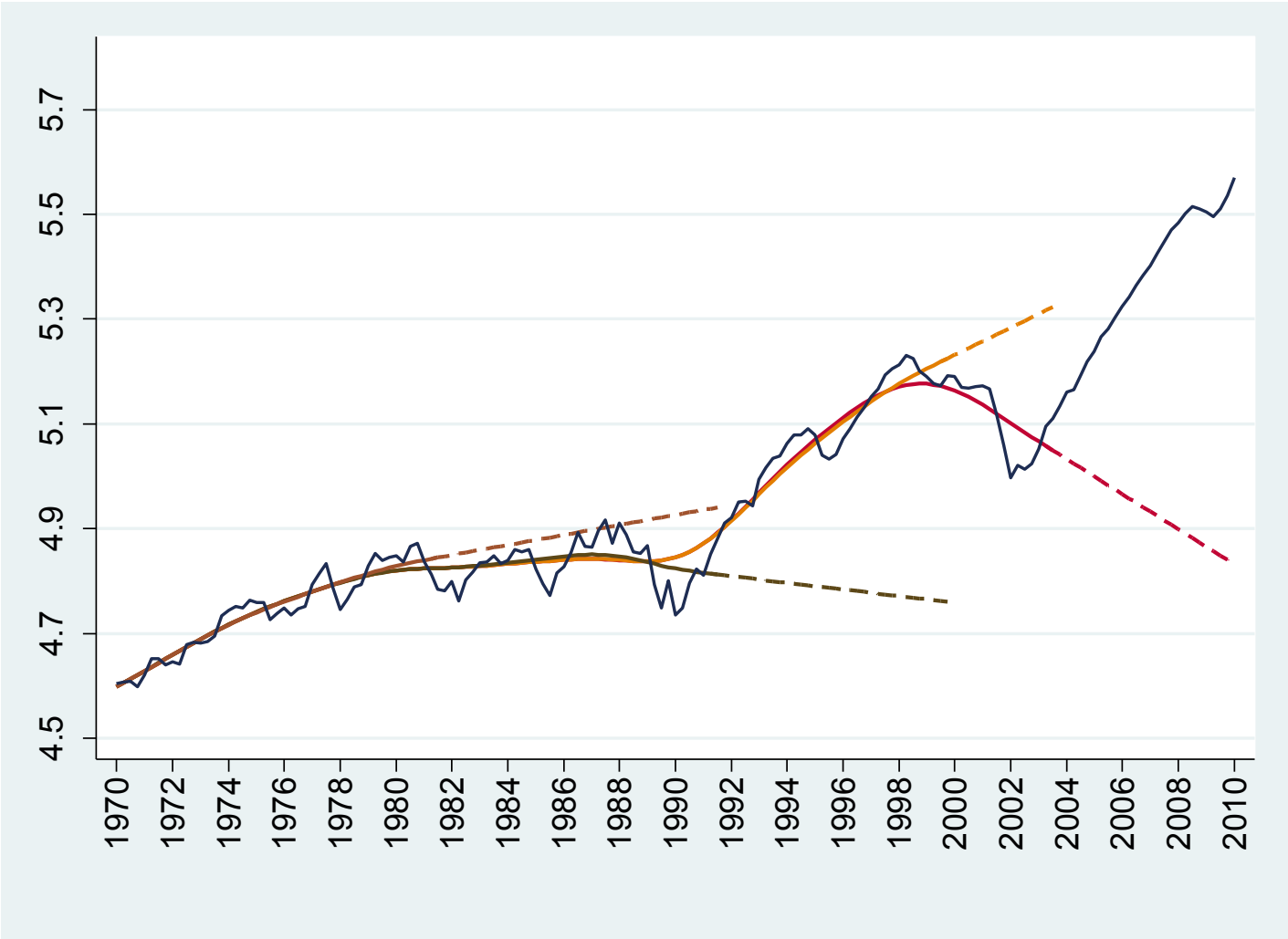

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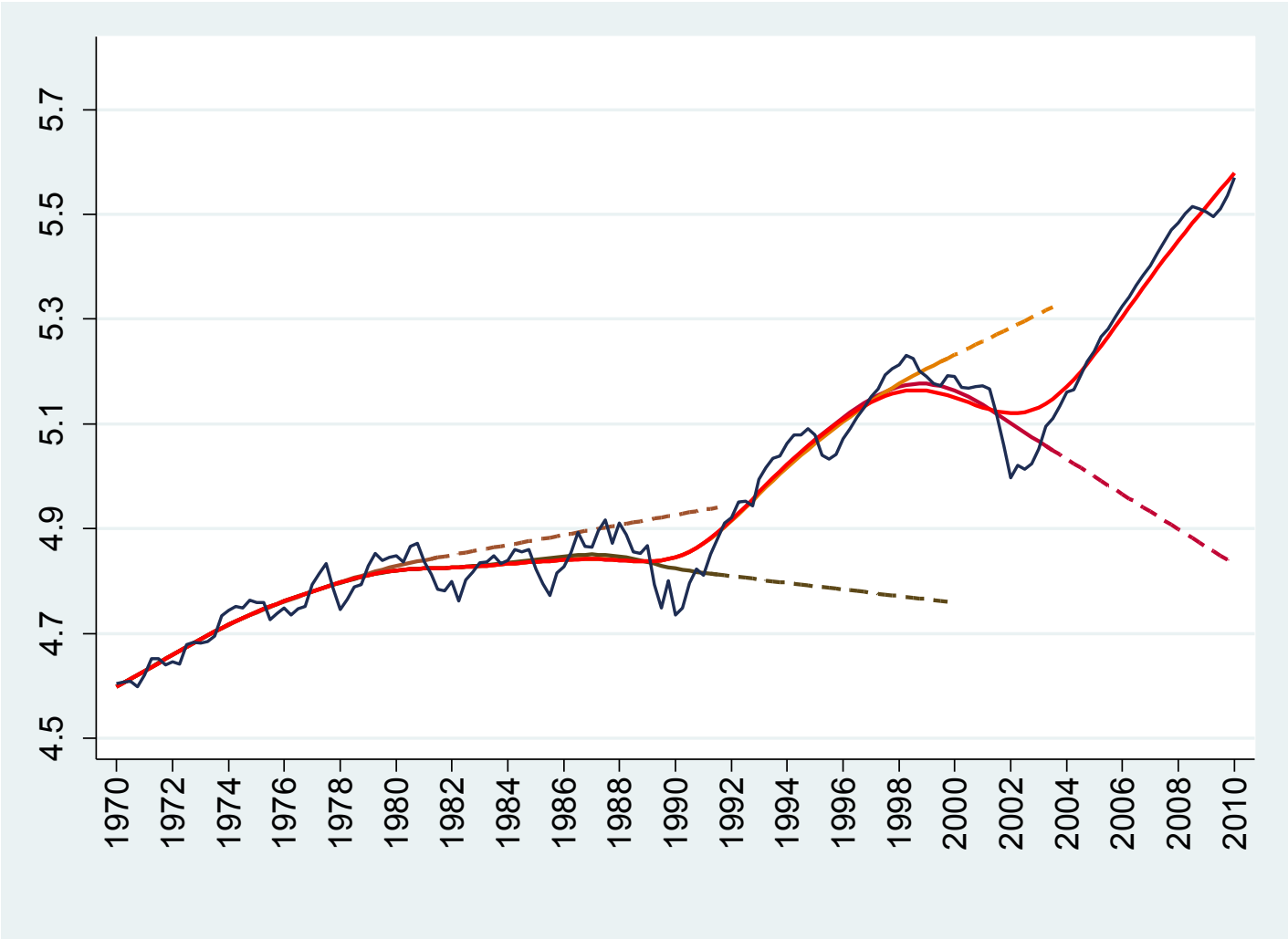

Data on expectations

- Then, we build series of expectations by using forecasting algorithm (SGL) that has best fit with survey data from Survey of Professional Forecasters

Note 1

The volatility of expectations is negatively correlated with leverage (for a variety of measures, see literature review)

Data on crises

- Object of interest: financial crises
- Types of financial crises:
  - Sovereign debt crises
    - There is an external or domestic sovereign default
  - Banking crises
    - A country's corporate and financial sectors experience a large number of defaults and if financial institutions and corporations face great difficulties repaying contracts on time
  - Currency crises
    - Nominal depreciation of the currency vis-à-vis the U.S. dollar of at least 30 percent and that is also at least 10 percentage points higher than the rate of depreciation in the year before
  - Inflation crises
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    - There is an external or domestic sovereign default
  - Banking crises
    - A country's corporate and financial sectors experience a large number of defaults and if financial institutions and corporations face great difficulties repaying contracts on time
  - Currency crises
    - Nominal depreciation of the currency vis-à-vis the U.S. dollar of at least 30 percent and that is also at least 10 percentage points higher than the rate of depreciation in the year before
  - Inflation crises
    - Annual rate of inflation exceeds x percent

Severity of crises

- Severity of a crisis measured as output growth loss

$$Sev(t_0) = \sum_{t=t_0}^{t_n} (\tilde{g}^y_{t_0} - g^y_t)$$

- No consensus on right measures, we use different alternatives:
  1. IMF methodology (slightly modified): t_n for the first t such that $g^y_t = \tilde{g}^y_{t_0}$, and $\tilde{g}^y_{t_0}$ is a five-years trend
  2. t_n: date of resolution assigned by either Reinhart and Rogoff (2009) or Laeven and Valencia (2012)
  3. Change in GDP between the year before and the year after the crisis
  4. Difference between the GDP growth five-year trend before the crisis and the GDP after the crisis

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Severity of Crises

Note 2

The IMF measure for severity of a crisis is the least correlated with all the others

Tables

Volatility of expectations and severity of crises: Empirical analysis

- We firstly estimate the following model with pooled data

$$Sev_i = \alpha + \beta VOE_i + \gamma X_i + \epsilon_i$$

- Then, inclusion of country-fixed effects
- If more stable expectations are associated with more severe crises, β should be negative

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Results

- For sovereign debt and banking crises, $\beta < 0 \rightarrow$ more stability of expectations associated with more severe crisis

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  Robustness

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Conclusions

- This paper highlighted the importance of evolution of expectations for financial instability
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End

Thanks!!

gluzmann@yahoo.com

Correlations among measures of severity of crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
IMF	1			
RR dating	0.2549	1		
ΔGDP	0.2147	0.3712	1	
Δ(HP_GDP)	0.3048	0.4059	0.8813	1

Back

Pooled data, only banking and debt crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	53.421	-43.115	-17.137	-16.692
	(1.60)	(2.35)**	(2.72)***	(3.61)***
Constant	0.131	0.117	0.042	0.045
	(3.54)***	(4.91)***	(4.44)***	(5.54)***
Observations	61	100	100	100
R-squared	0.020	0.050	0.050	0.070

Back

Panel data, country fixed effects, only banking and debt crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	-1.762	-94.002	-32.855	-32.831
	(0.03)	(3.25)***	(3.03)***	(3.47)***
Constant	0.195	0.184	0.063	0.066
	(2.26)**	(4.19)***	(4.03)***	(4.36)***
Observations	61	100	100	100
R-squared	0.780	0.370	0.440	0.430

Back

Pooled data, all financial crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	141.147	-21.748	4.358	1.989
	(2.02)**	(1.48)	(0.89)	(0.53)
Constant	0.030	0.069	0.012	0.015
	(0.48)	(3.95)***	(1.95)*	(2.97)***
Observations	129	221	221	221
R-squared	0.080	0.020	0.010	0.000

Back

Panel data, country fixed effects, all financial crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	127.816	-57.548	-3.180	-5.731
	(1.30)	(2.59)**	(0.45)	(1.07)
Constant	0.045	0.113	0.021	0.024
	(0.43)	(4.03)***	(2.33)**	(3.33)***
Observations	129	221	221	221
R-squared	0.320	0.210	0.200	0.140

Back

Pooled data, only currency and inflation crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	175.051	-2.582	9.787	6.255
	(2.05)**	(0.36)	(2.13)**	(1.71)*
Constant	-0.030	0.032	0.003	0.005
	(0.40)	(3.25)***	(0.58)	(1.09)
Observations	87	156	156	156
R-squared	0.110	0.000	0.040	0.020

Back

Panel data, country fixed effects, only currency and inflation crises

	IMF	RR dating	ΔGDP	Δ(HP_GDP)
VOE	181.225	-14.194	8.783	1.928
	(1.50)	(1.04)	(1.14)	(0.33)
Constant	-0.037	0.047	0.005	0.010
	(0.25)	(2.62)***	(0.45)	(1.32)
Observations	87	156	156	156
R-squared	0.430	0.190	0.250	0.190

Back

Pooled data, only banking and debt crises, with controls (emerging and advanced economies)

	IMF	LV dating	ΔGDP	Δ(HP_GDP)
VOE	-37.356	-39.092	-7.875	-21.210
	(1.27)	(3.02)***	(1.27)	(2.46)**
ToT (Terms of Trade)	-0.018	-0.016	-0.013	-0.005
	(0.70)	(0.69)	(1.14)	(0.69)
Gross Domestic Product at PPP 2005	-0.289	-0.187	-0.115	-0.039
	(0.86)	(0.75)	(0.96)	(0.53)
Openness ((X+M)/GDP)	0.094	0.307	0.025	-0.001
	(0.12)	(0.88)	(0.12)	(0.01)
ToT * GDP	0.002	0.002	0.001	0.000
	(0.67)	(0.72)	(1.05)	(0.61)
ToT * Openness	0.000	-0.002	0.000	0.000
	(0.03)	(0.66)	(0.04)	(0.18)
Constant	2.794	1.681	1.125	0.453
	(0.96)	(0.77)	(1.08)	(0.69)
Observations	57	83	83	83
R-squared	0.060	0.099	0.216	0.205

Back