Accounting for the slowdown in output growth after the Great Recession: A wealth preference approach

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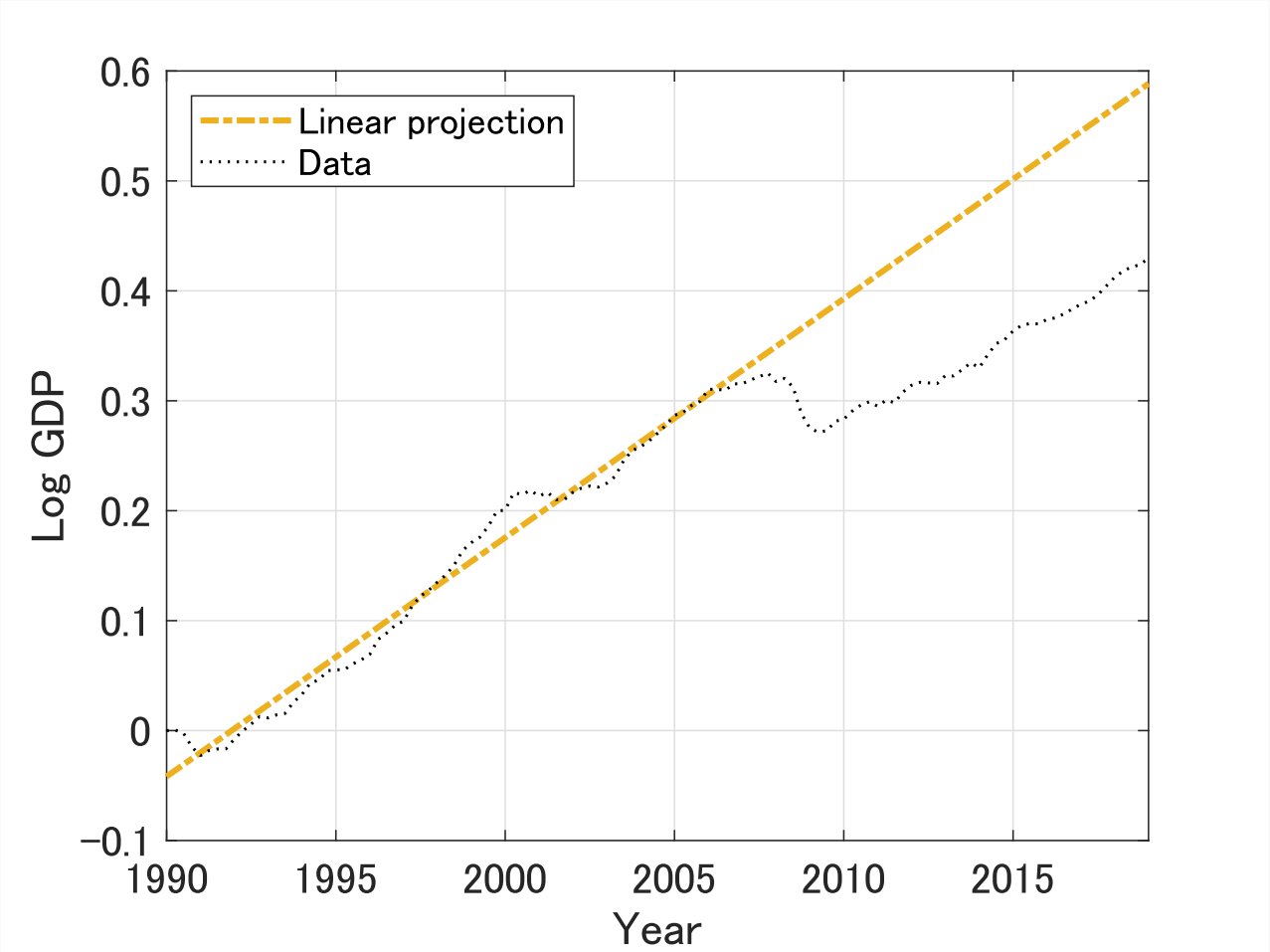
Research questions: US

- Slowdown in output growth
- Linear projection (based on 1990-2007)



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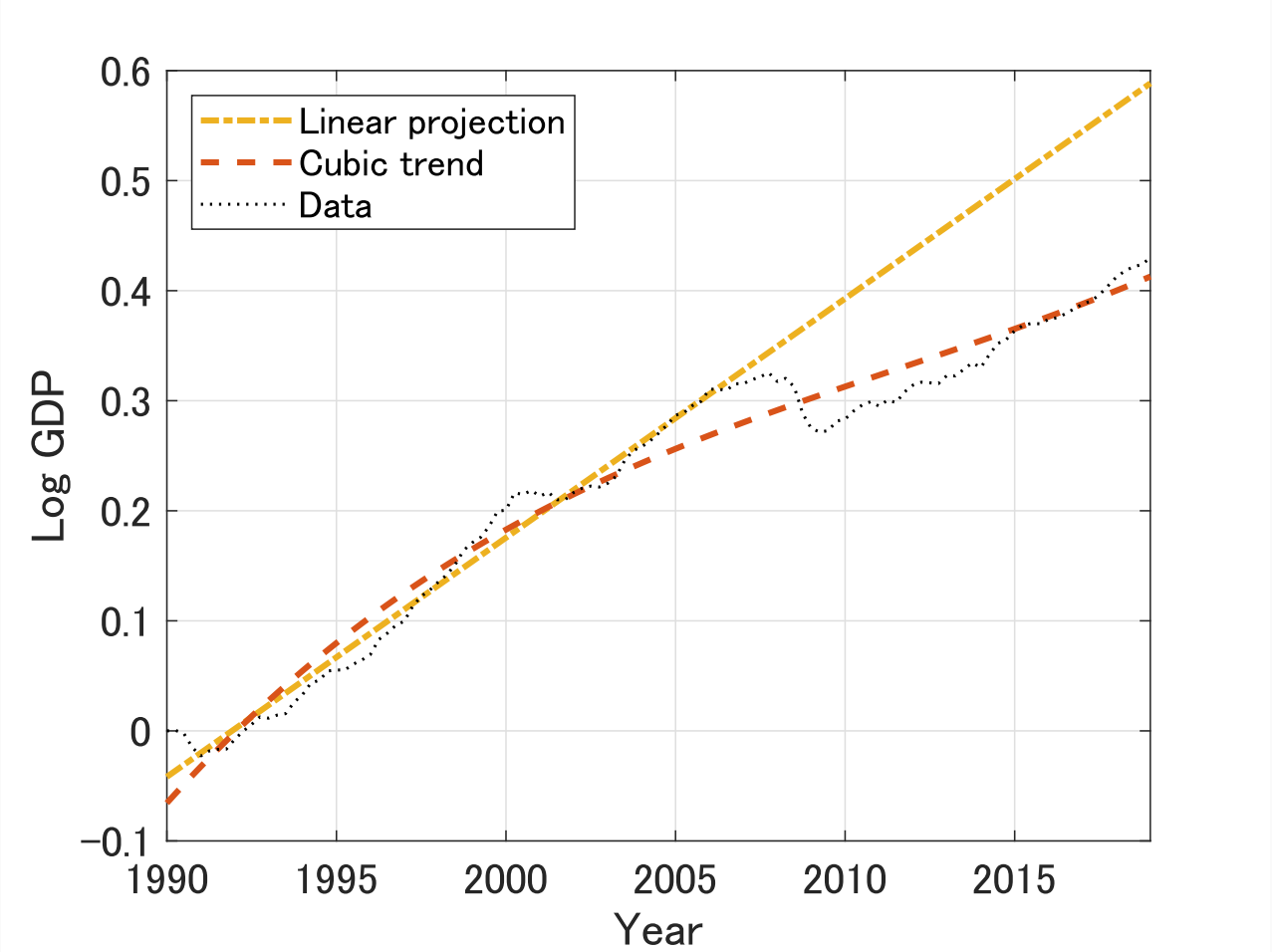
- Slowdown in output growth
- Cubic trend (based on 1990-2019)



Secular stagnation

- Secular stagnation hypothesis
  - Prior to the Great Recession, the output growth is expected to be high
  - But actual output after the Great Recession failed to catch up with the expected output trend
  - e.g., Summers (2014)
  - A similar observation can be made in the case of Japan, where the stagnation started in the middle of the 1990s ▸ Japan

This paper

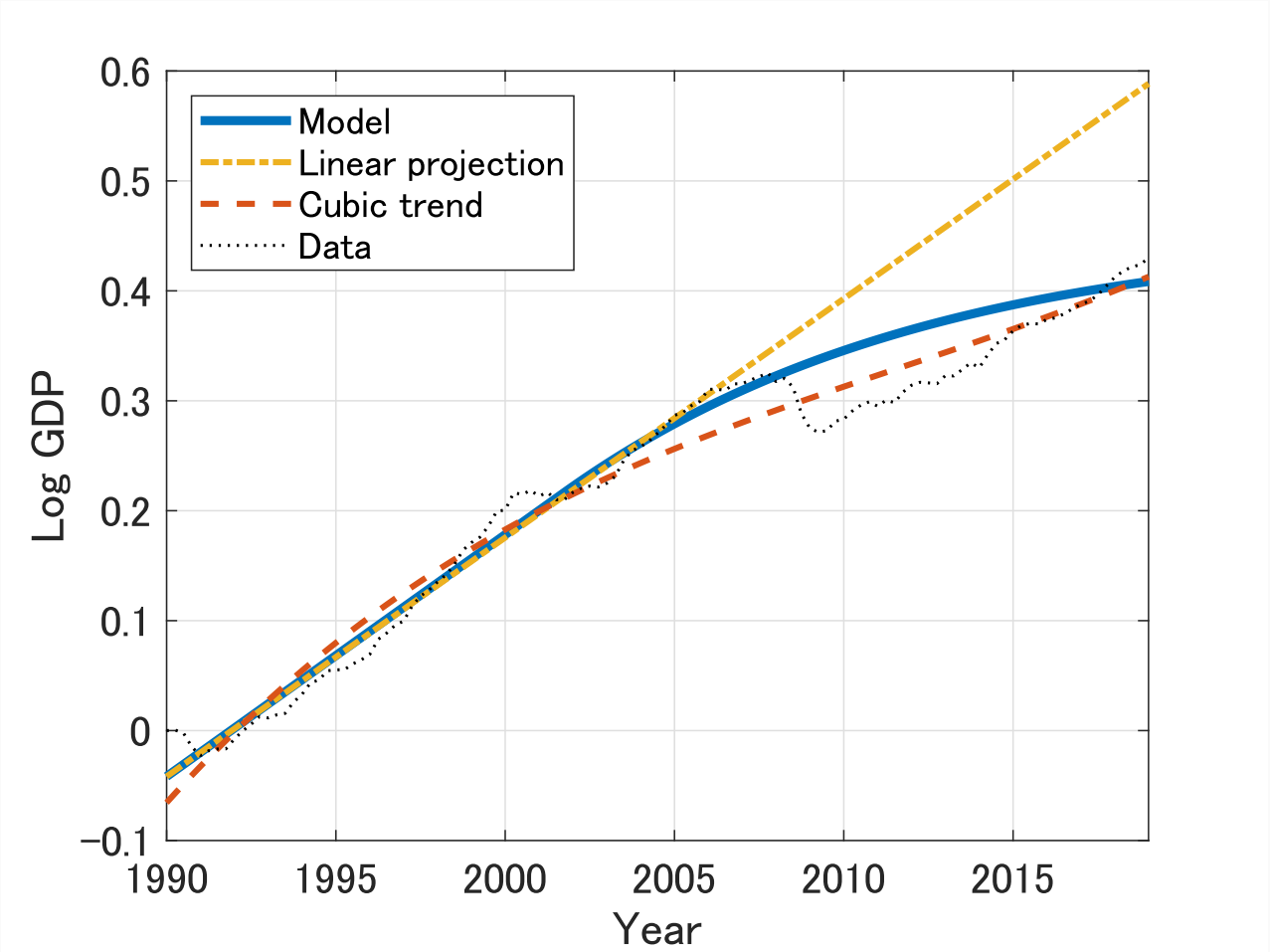
- Aims to account for the long-run trend in output,
  - We start with a standard monetary growth model
    - Productivity grows at a constant rate
  - We introduce wealth preferences into this growth model
- Why wealth preferences?
  - Households receive benefits from holding wealth in addition to market interests
  - The benefits incentivize households to save more and consume less to enjoy holding wealth
- For the aggregate demand to play a role in output growth...
  - We add the downward nominal wage rigidity (DNWR) into the model

What we find

- Endogenous slowdown in output growth
    - Output initially grows at the same constant rate as productivity
    - Output growth starts declining even though productivity continues to grow
- Aggregate demand shortage matter for slowdown in output growth
- Our model also explains the real interest rate and low inflation remarkably well

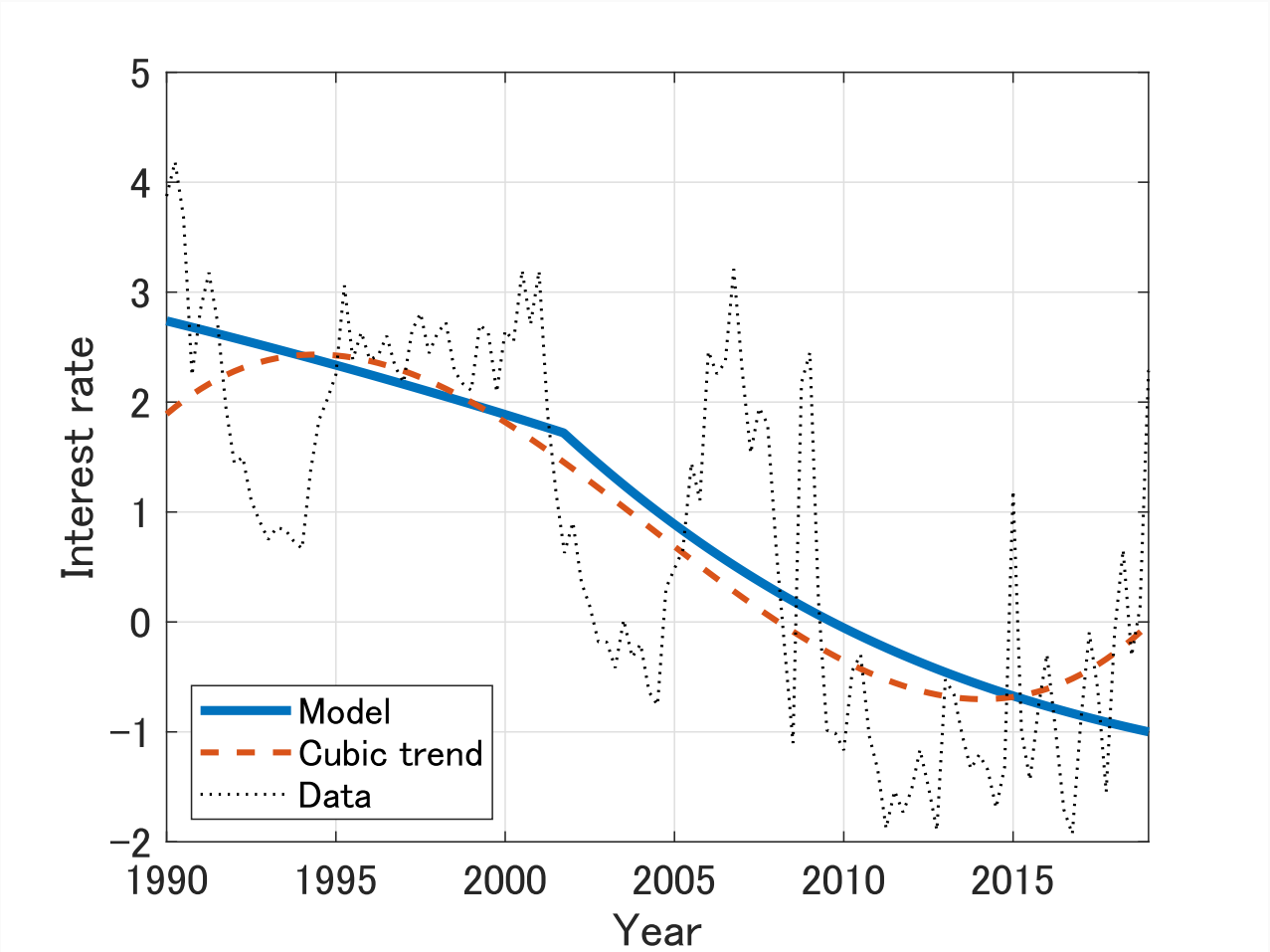
Slowdown in output growth: US

- Predicted output closely follow the long-run trend of output



Real interest rate: US

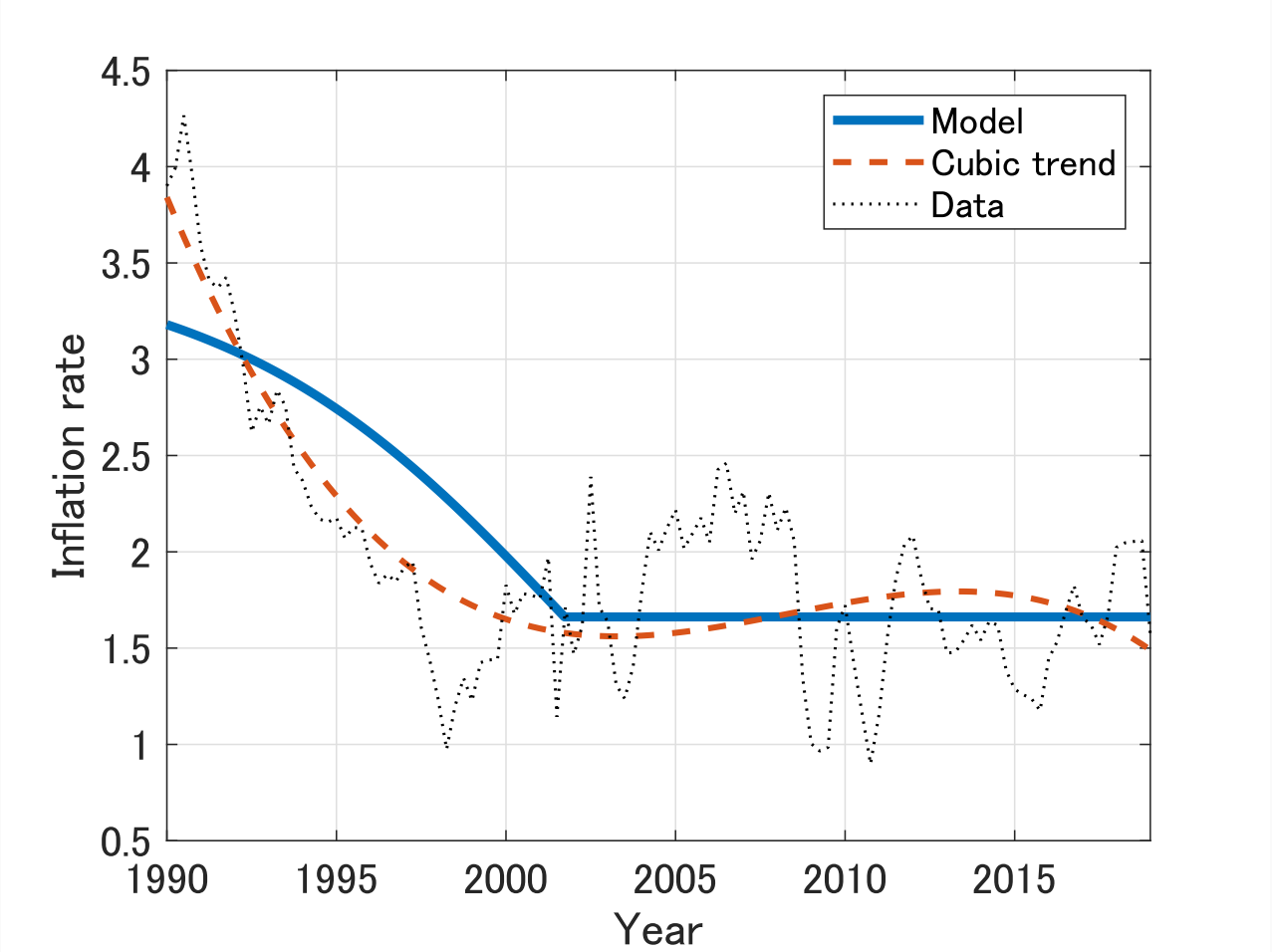
- Predicted real interest rate closely follow the data



- In the standard growth model, real interest rate is constant

Inflation: US

- Predicted inflation closely follow the data



- In the standard growth model, inflation is constant

Intuition: Standard monetary growth model

- The demand for money on the balanced growth path (BGP)

$$\underbrace{\frac{v'(m_t)}{u'(c_t)}}_{\text{MRS of money for consumption}} = \underbrace{r_t + \pi_t}_{\text{nominal interest rate}}$$

$$= \rho + \frac{\dot{c}_t}{c_t} + \pi_t$$

  - In the standard monetary growth model
    - Consumption growth is constant
    - Inflation is constant
    - MRS is constant
  - On BGP, $v'(m_t)$ and $u'(c_t)$ decrease at the same rate

Intuition: Our model

- In our model, $v'(m_t)$ decreases faster than $u'(c_t)$ b/c of wealth (money) preferences
- e.g., The economy where m_t grows much faster than c_t

$$\frac{v'(m_t)}{u'(c_t)}(\downarrow) = \rho + \frac{\dot{c}_t}{c_t}(\downarrow) + \pi_t(\downarrow)$$

  - The LHS $(v'(m_t)/u'(c_t))$ declines over time
  - The RHS $\rho + \dot{c}_t/c_t + \pi_t$ must decline
  - As long as π_t decreases, $\dot{c}_t/c_t$ remains high
  - When the DNWR is binding, π_t cannot decrease and $\dot{c}_t/c_t$ must decrease

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The model

- The model is a standard monetary growth model with wealth preferences
- The representative HH solves

$$\max \int_0^\infty e^{-\rho t}[u(c_t) + v(m_t) + \beta(a_t)]\,dt,$$
$$\dot{a}_t = r_t(a_t - m_t) - \pi_t m_t + w_t n_t + \tau_t - c_t$$
$$n_t \leq 1$$

- c_t: consumption, m_t: real money balances, a_t: wealth, n_t: labor
- π_t: inflation, τ: transfers from gov't

Assumptions on preferences

- Preferences:

$$\begin{aligned} u(c) &= \ln c \\ v(m) &= \frac{m^{1-\eta}}{1-\eta} \end{aligned}$$

- Preferences for wealth are non-standard

$$\beta(a) = \beta \times a, \text{ where } \beta > 0$$

  - We follow Michau (2018) and Ono (1994, 2001)
  - The linearity is an assumption for simplicity ▸ jump

FOC

- First-order conditions

$$\begin{aligned} \frac{v'(m_t)}{u'(c_t)} &= r_t + \pi_t \\ \frac{\dot{c}_t}{c_t} &= r_t - \rho + \frac{\beta'(a_t)}{u'(c_t)} \end{aligned}$$

- The term in red is the additional benefit of holding wealth

Aggregate demand

- FOCs imply

$$\Omega(m_t, y_t) = \rho + \frac{\dot{c}_t}{c_t} + \pi_t \tag{1}$$

  - LHS = MB of holding money:

$$\Omega(m_t, y_t) \equiv \frac{v'(m_t) + \beta'(m_t)}{u'(y_t)}$$

  - RHS = opportunity cost of holding money

Firm & Gov't

- Firms
  - Representative firm's technology has a linear technology in labor
  - Productivity grows at an exogenous rate g
  - When output equals the potential level, output growth is g
- Government
  - Constant money growth

Downward nominal wage rigidity

- Another important assumption is downward nominal wage rigidity (DNWR)

$$\frac{\dot{W}_t}{W_t} \geq \text{ constant} \tag{2}$$

  - Uribe and Schmitt-Grohé (2016)
- DNWR is translated into the lower bound in price inflation

$$\pi_t \geq \gamma$$

Goods market with DNWR

- DNWR is translated into the complementary slackness condition in goods market

$$\underbrace{(\pi_t - \gamma)}_{\text{(A)}}\underbrace{(y_t^f - y_t)}_{\text{(B)}} = 0$$

  where y_t^f: the first-best allocation of output

- Two regimes
  1. High inflation regime: $\pi_t > \gamma$ and $y_t = y_t^f$
  2. Low inflation regime: $\pi_t = \gamma$ and $y_t < y_t^f$
- The economy experiences a regime change
  - from high to low inflation regime

1. High inflation regime

- Characterized by high inflation $\pi_t > \gamma$ and the 1st-best allocation $y_t = y_t^f$
- Output growth = productivity growth

$$\frac{\dot{y}_t}{y_t} = g$$

- Low inflation due to weakened aggregate demand (due to strong desire to hold wealth)

$$\pi_t = \gamma + [\Omega(m_t, y_t) - \Omega^*]$$

- Low interest rate due to strong desire to hold wealth

$$r_t = \rho + g - \beta y_t$$

- As y_t increases, r_t decreases over time

2. Low inflation regime

- Characterized by the binding DNWR $\pi_t = \gamma$ and the 2nd-best allocation $y_t < y_t^f$
- Output growth is declining over time due to weakened aggregate demand

$$\frac{\dot{y}_t}{y_t} = g + \underbrace{[\Omega(m_t, y_t) - \Omega^*]}_{(-)}$$

- Inflation hits the lower bound

$$\pi_t = \gamma$$

- Low interest rate due to further stronger desire to hold wealth

$$r_t = \rho + g - \beta y_t + \underbrace{[\Omega(m_t, y_t) - \Omega^*]}_{(-)}$$

Transition path to the “stagnation” steady state

- There is the steady state characterized by
  - Constant output

$$y^{ss} = \frac{\rho + \gamma}{\beta} \tag{3}$$

  - Real money balances grow at a constant rate $\mu - \gamma$
  - Inflation hits the lower bound γ
- The “stagnation” steady state

Lemma 1: Uniqueness

Lemma 1

- *There exists a unique transition path to the stagnation steady state under reasonable parameter assumptions* ▸ jump
- *The economy experiences a regime change from a high inflation regime to low inflation regime at* $t = t^*$

Proposition 1: Slowdown in output growth

Proposition 1

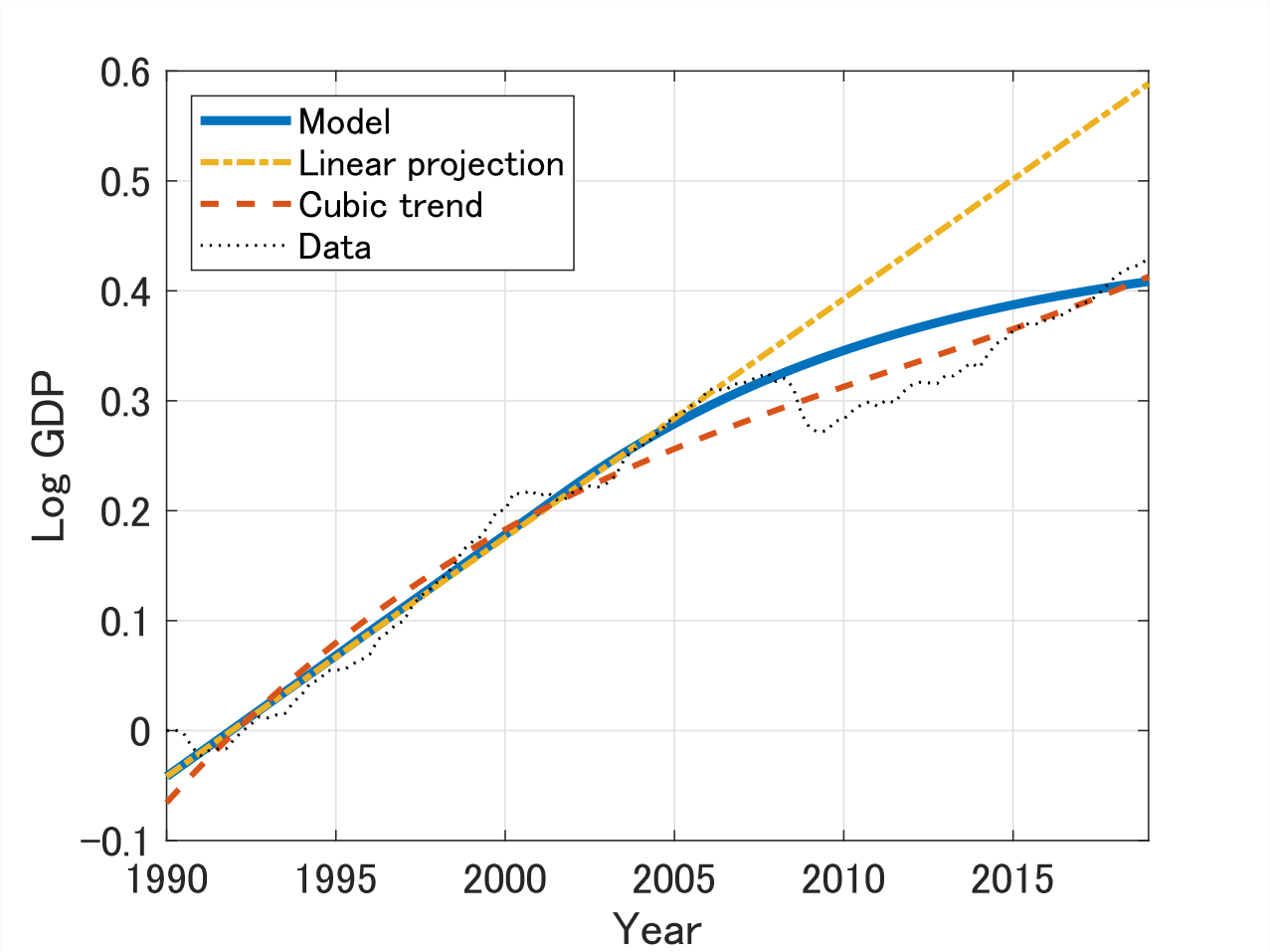
- Under the high inflation regime ($0 < t \leq t^*$), the output growth is g
- Under the low inflation regime ($t > t^*$), the output growth is lower than g

$$\frac{\dot{y}_t}{y_t} = g + \underbrace{[\Omega(m_t, y_t) - \Omega^*]}_{<0}$$

- Slowdown in output growth starting from $t = t^*$
  - The slowdown in output growth is not temporary

Slowdown in output growth: US

- Predicted output closely follow the long-run trend of output



Real interest rate: US

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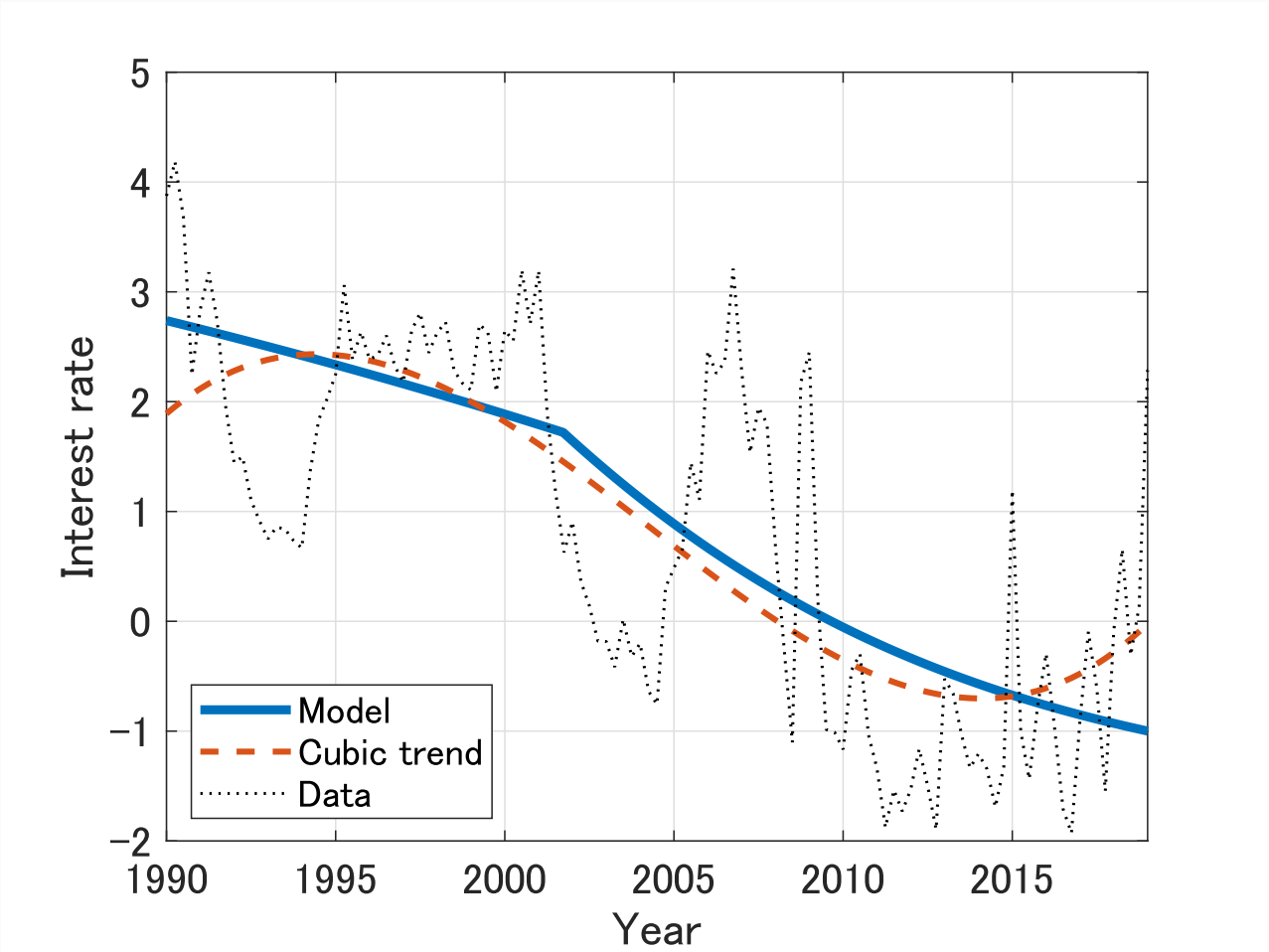

- In the standard growth model, real interest rate is constant

Inflation: US

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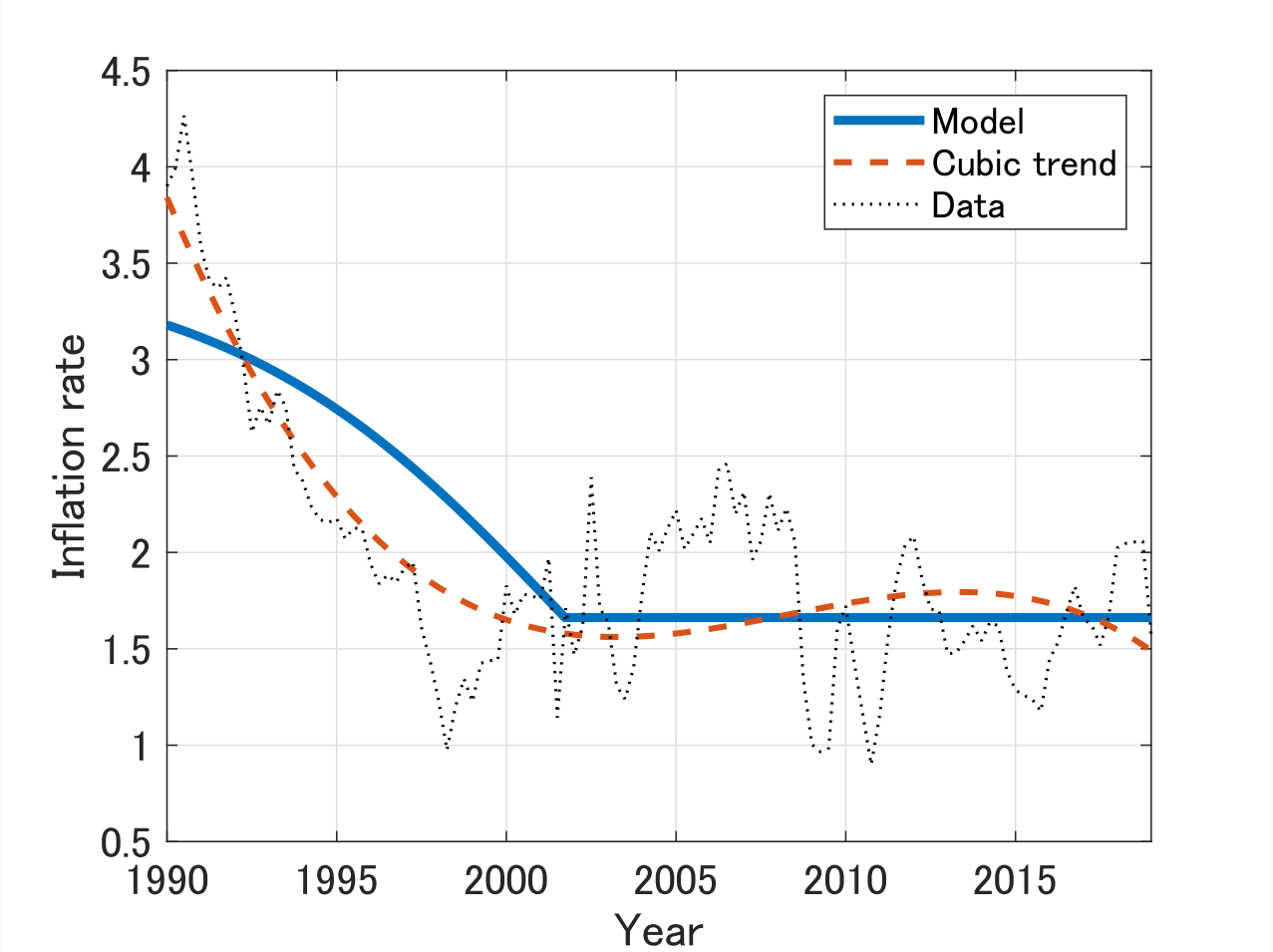


- In the standard growth model, inflation is constant

Conclusion

- US output growth was persistently low after the Great Recession
- Extending a standard monetary growth model with wealth preferences explains the observed slowdown in output growth remarkably well
- The model can also explain the real interest rate and inflation

Literature

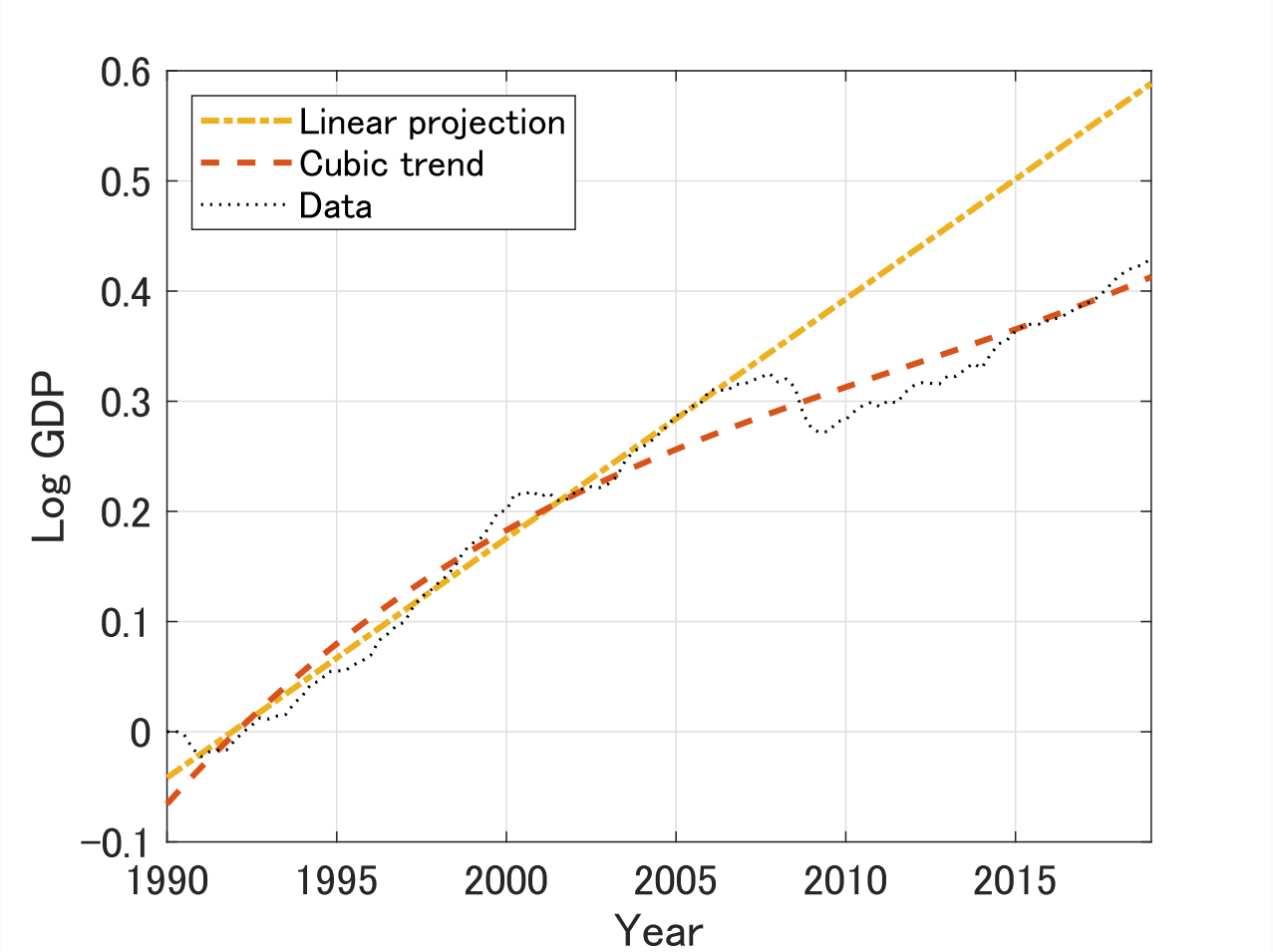
- Previous studies fall into one of four groups in explaining secular stagnation
    1. Productivity slowdown: Fernald (2015), Gordon (2015), Takahashi and Takayama (2022)
    2. Demographic changes: Carvalho et al. (2016), Gagnon et al. (2021), Jones (2022)
    3. Debt deleveraging: Hall (2011), Eggertsson and Krugman (2012), Mian and Sufi (2014), Guerrieri and Lorenzoni (2017), Eggertsson et al. (2019)
    4. **Wealth preferences**: Michau (2018), Illing et al. (2018)
- The study closest to ours is Michau (2018)
- We explain endogenous slowdown in output growth and implement simulations to test the model

Simulating the model

- Timing of regime change from high inflation to low inflation regime (t^*)
    - We determine t^* from the data
- The time in which the cubic trend falls below the linear trend
    - 2001:Q3 for the US
    - 1989:Q1 for Japan

Timing of regime change: US

- The cubic trend falls below the linear trend from 2001:Q3



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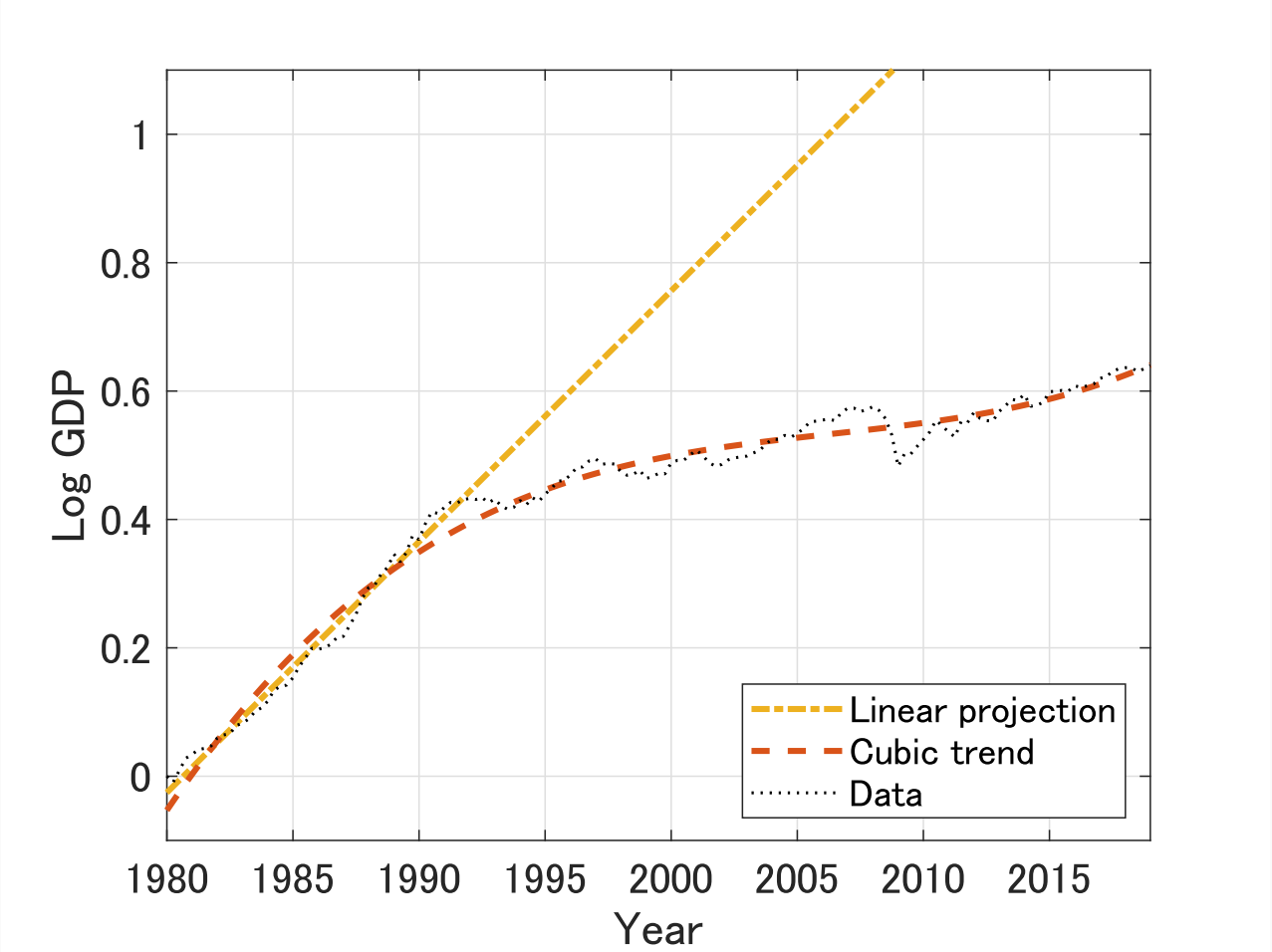
Other parameters

	US	Japan	Description
t^*	2001:Q3	1989:Q1	Time of regime change
η	4.75	4.96	Degree of relative risk aversion for m
g	0.022	0.039	Productivity growth
μ	0.043	0.041	Money growth rate
γ	0.017	0.003	Lower bound for W growth
v	0.072	0.048	Parameter for money demand
β	0.015	0.031	Parameter for wealth pref.

- v, η, and β are calibrated from the mean squared error of output prediction from the cubic trend, the real interest rate and M2 velocity

Output growth: Japan

- Slowdown in output growth



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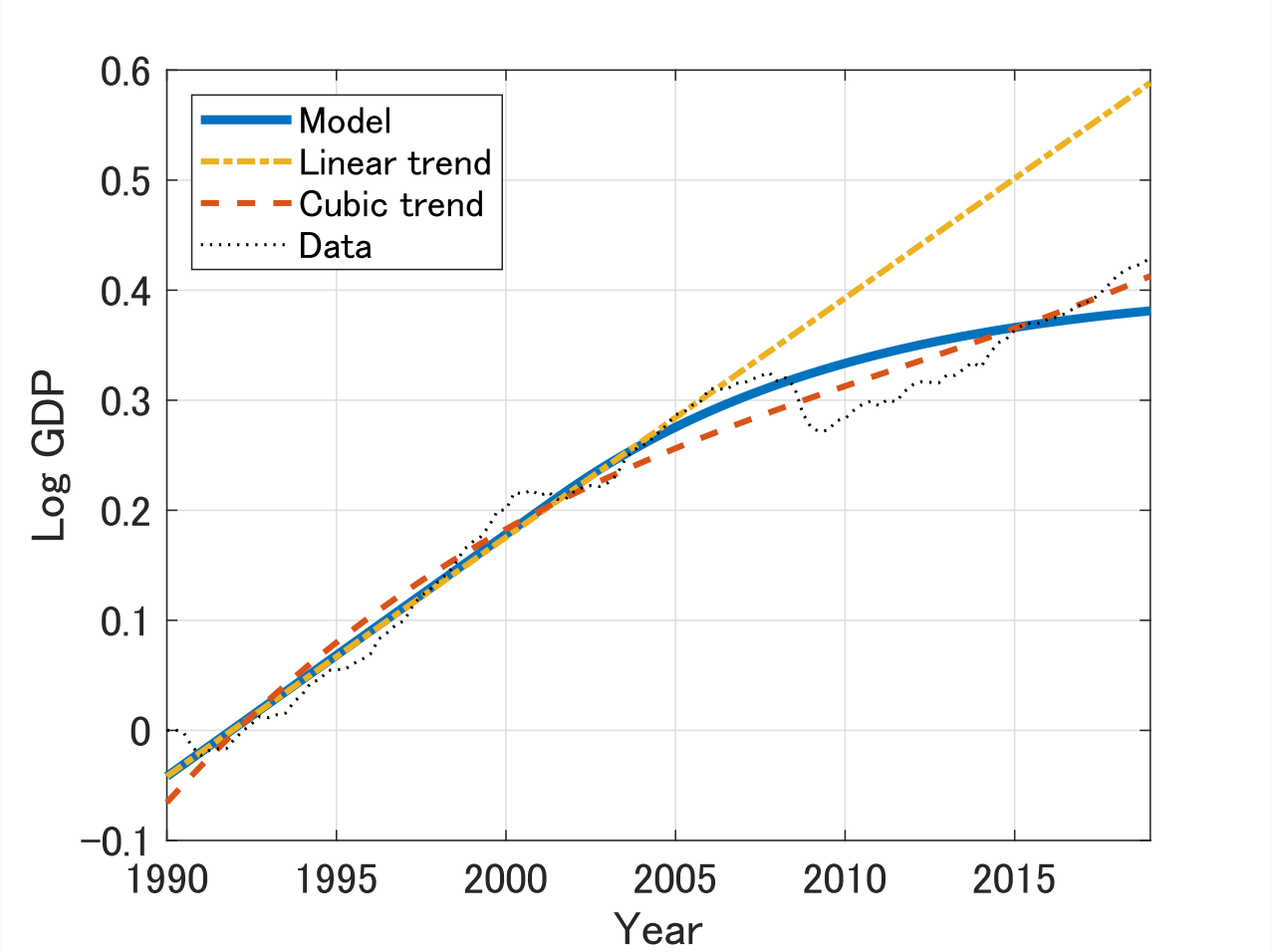

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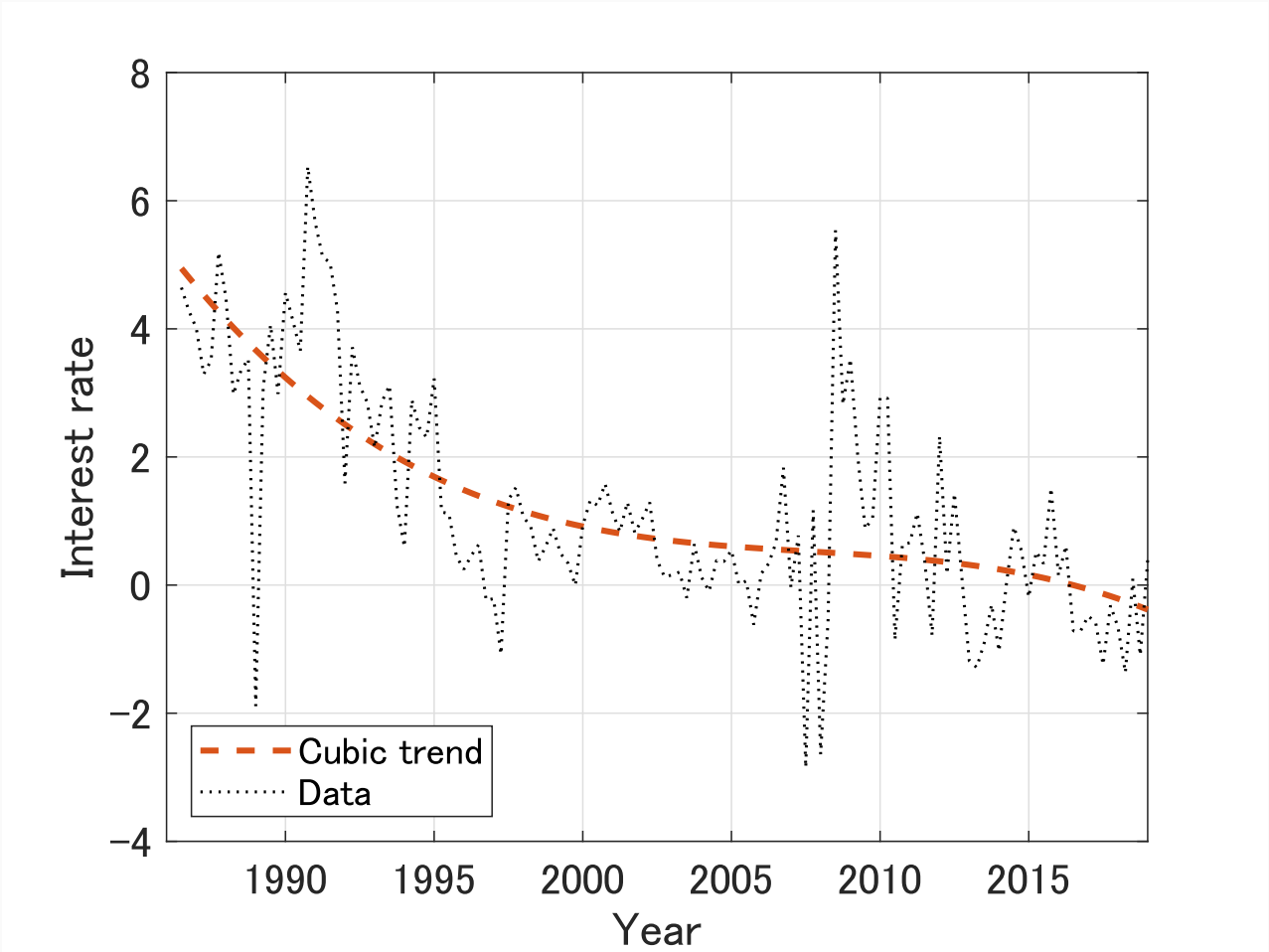

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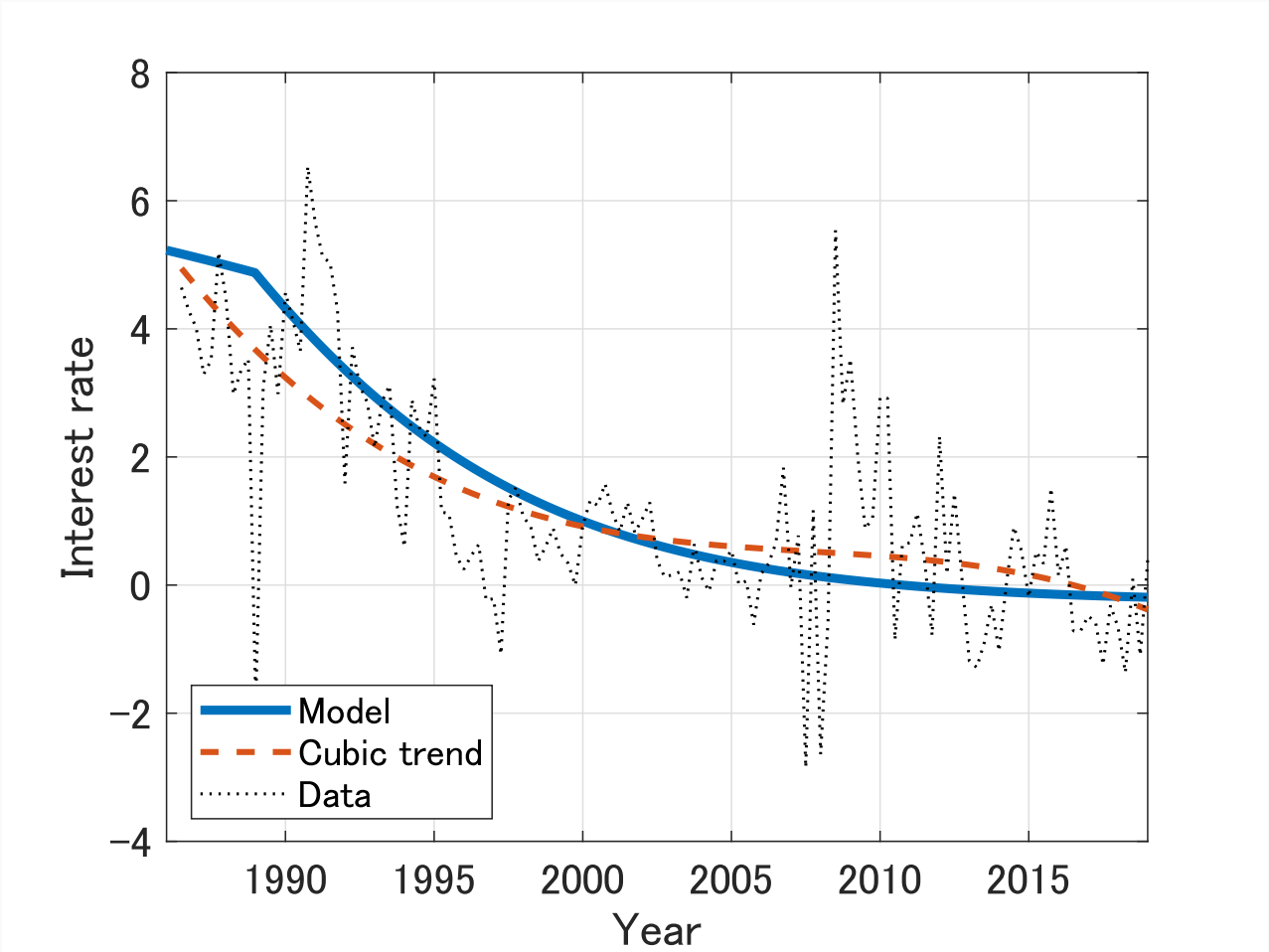
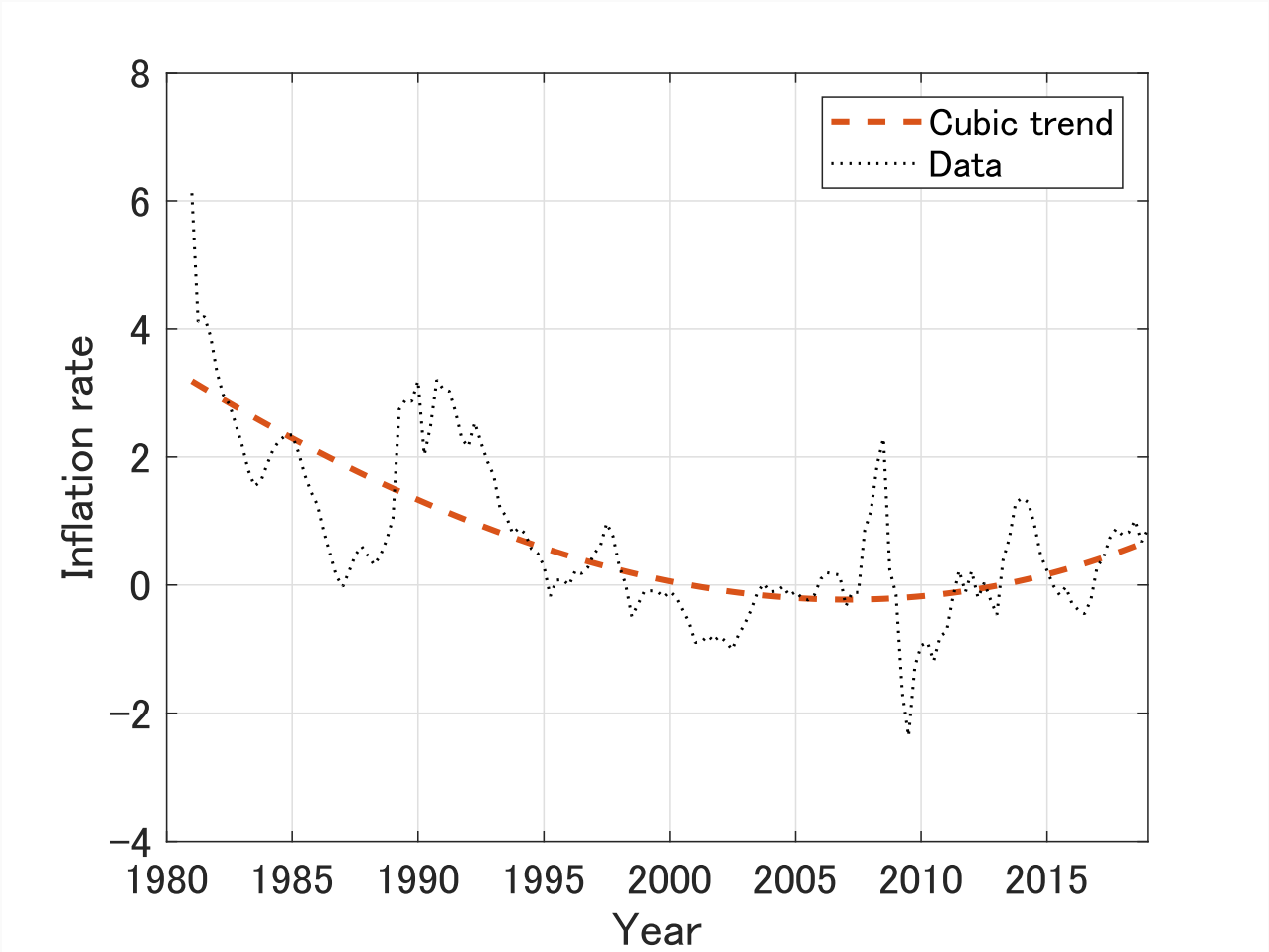


Inflation: Japan



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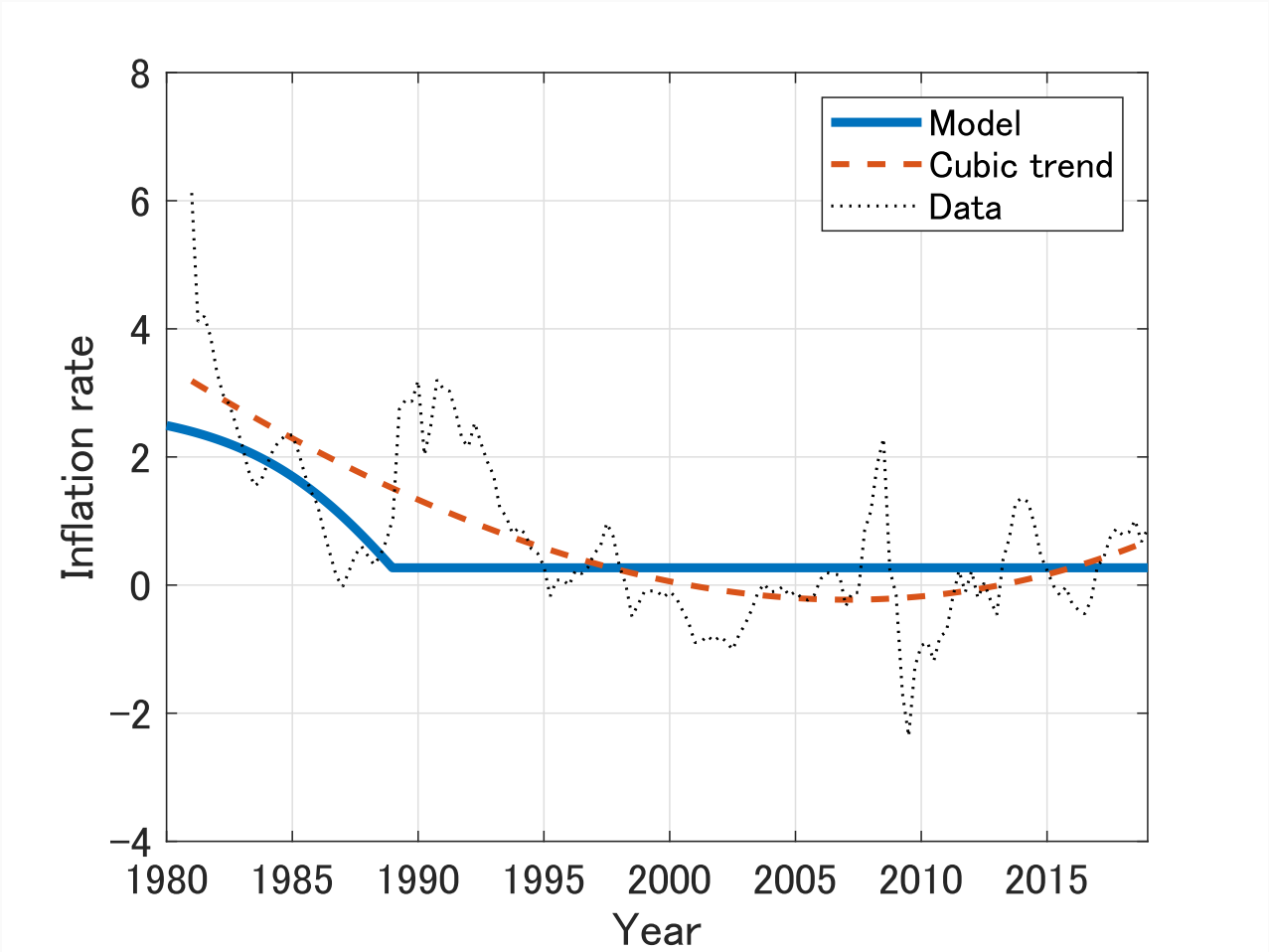


Monetary policy

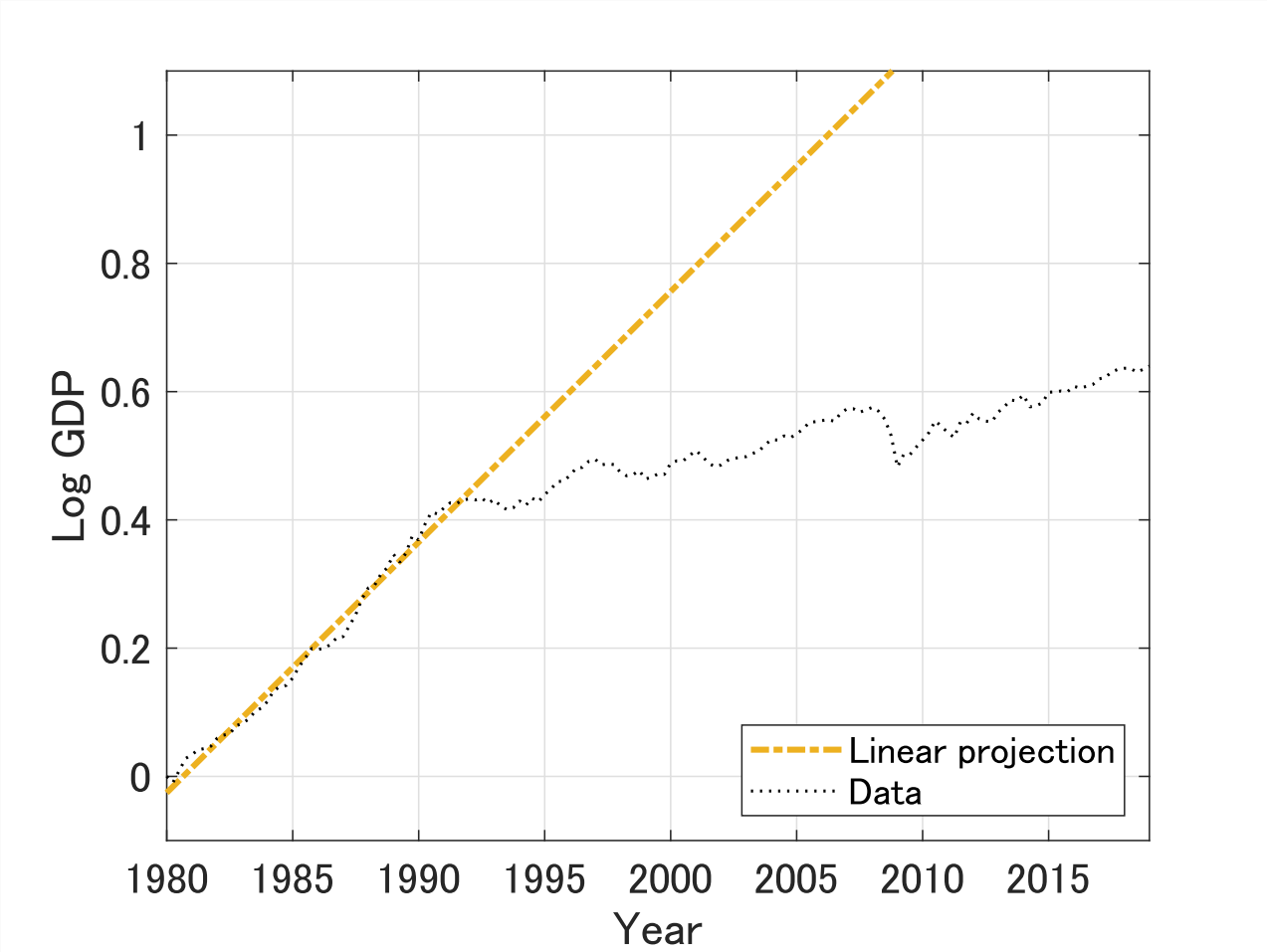
- Aggregate demand

$$\Omega\left(m_t^s, y_t\right) = \rho + \frac{\dot{y}_t}{y_t} + \pi_t$$

- Effect of $\uparrow$ in μ (growth rate of M_t^s) on equilibrium allocation
  - When DNWR is not binding (prices are flexible), money is super-neutral
    - y_t(-) , $\dot{y}_t/y_t$(-), r_t(-), $\pi_t(\uparrow)$
  - When DNWR is binding, money is not super-neutral
    - $y_t(\uparrow)$, $\dot{y}_t/y_t(\downarrow)$, $r_t(\downarrow)$, $\pi_t(-)$

Research questions: Japan

- Slowdown in output growth
- Linear projection (based on 1980-1991)



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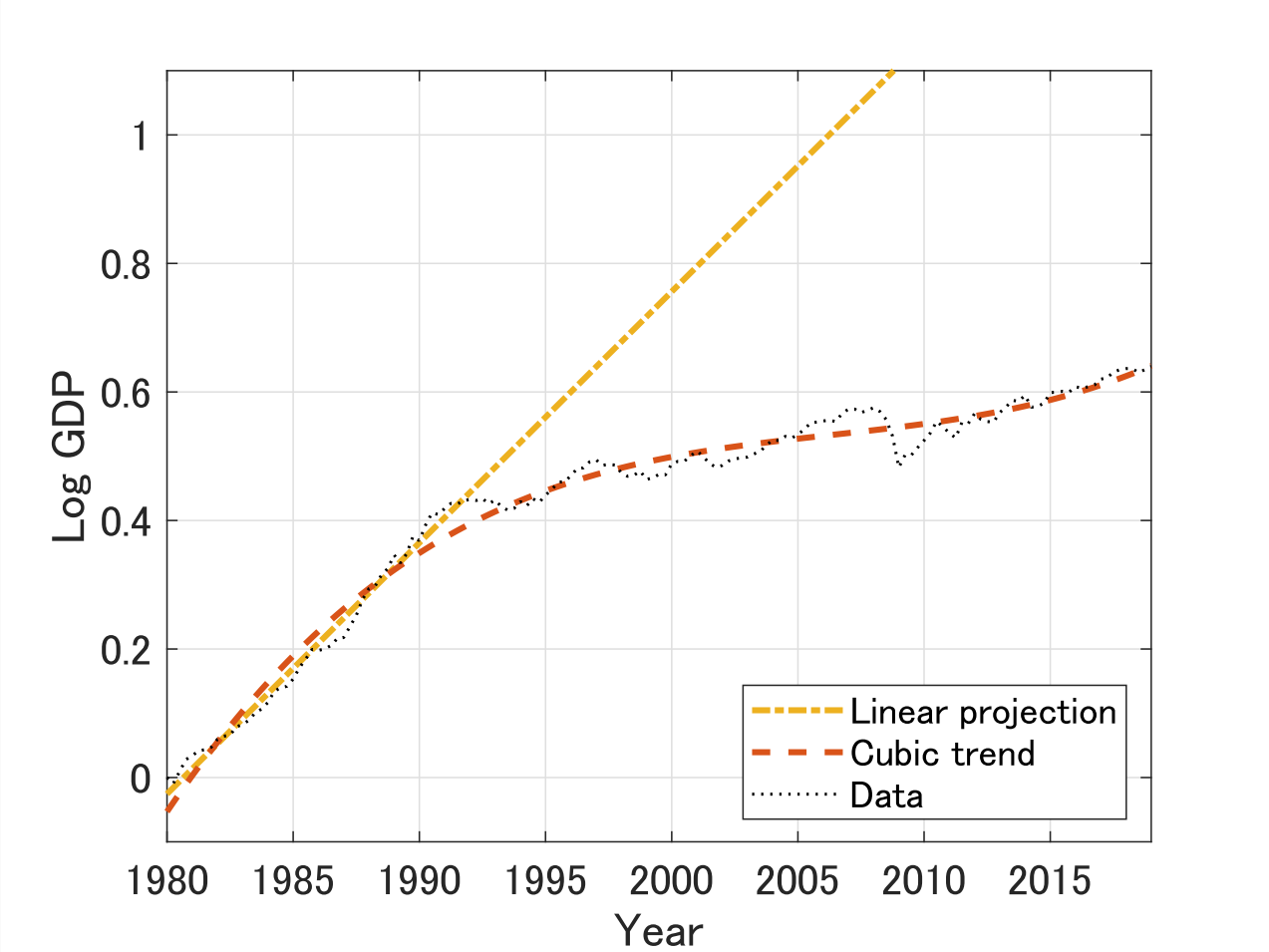

▸ US

Slowdown in output growth: Japan

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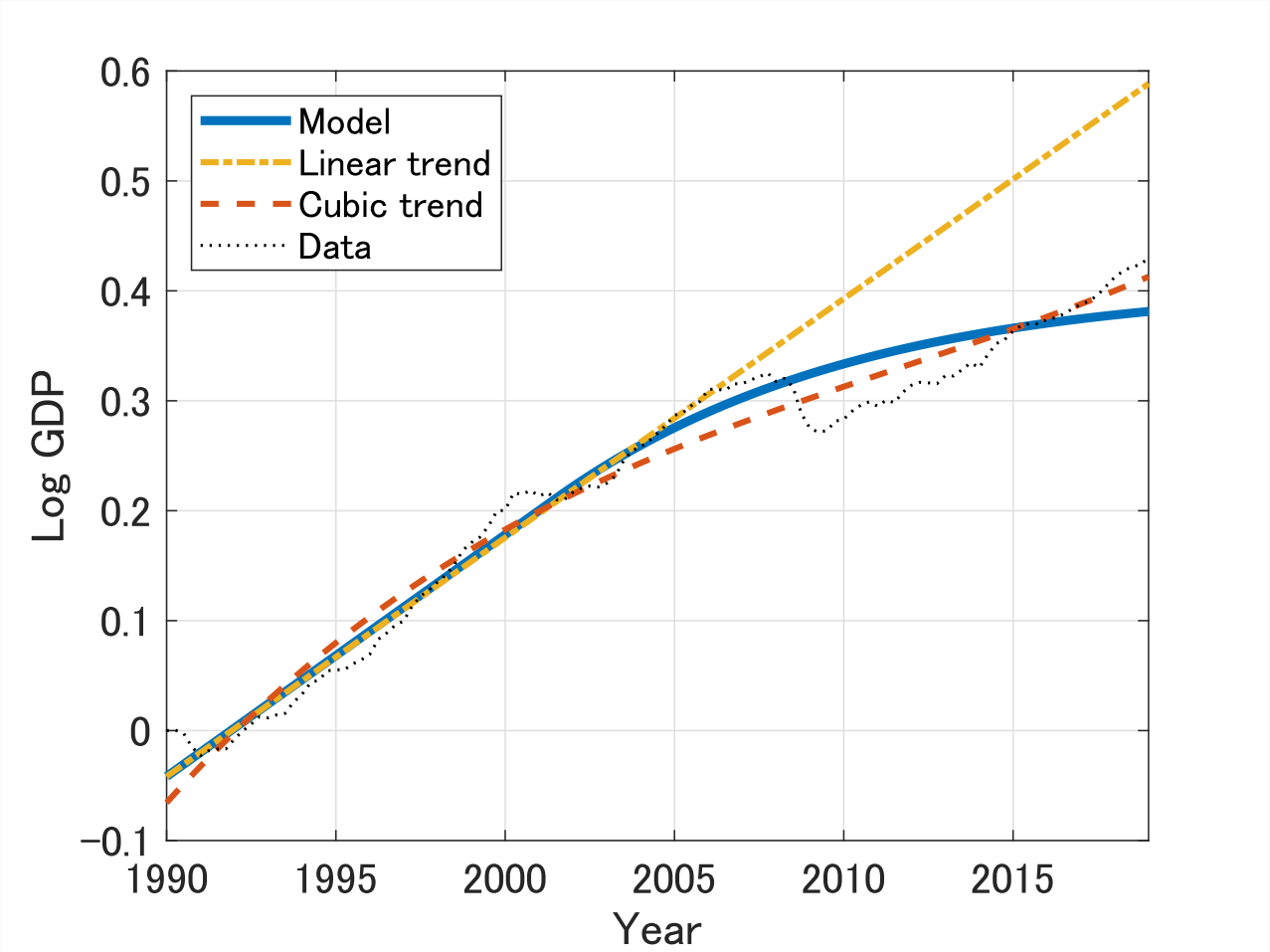

Wealth preferences

- A necessary condition is a strictly positive marginal utility in the steady state
- Alternative specification I (Michaillat and Saez 2021)
  - Utility is given by $\beta(a(i), \bar{a}) = \beta(a(i) - \bar{a})$ where $\bar{a}$ is real asset holding and taken as give by individual HH
  - The Inada conditions hold:

$$\beta'(a(i)-\bar{a}) > 0, \quad \beta''(a(i)-\bar{a}) < 0, \quad \lim_{a(i)\to\infty} \beta'(a(i)-\bar{a}) = 0$$

  - However, in equilibrium where $a(i) = \bar{a}$

$$\beta'(0) > 0$$

Wealth preferences

- A necessary condition is a strictly positive marginal utility in the steady state
- Alternative specification II (Michau 2018, Hashimoto et al. 2021)
  - Utility is given by $\beta(b_t)$ where $b_t = a_t - m_t^s$ and m_t^s is real money supply and taken as give by HH
  - The Inada conditions hold:

$$\beta'(b) > 0, \quad \beta''(b) < 0, \quad \lim_{b \to \infty} \beta'(b) = 0$$

  - However, in equilibrium

$$\beta'(\bar{b}) > 0$$

where $\bar{b}$ is bond holding in equilibrium back