De-industrialization of the Riches and the Rise of China

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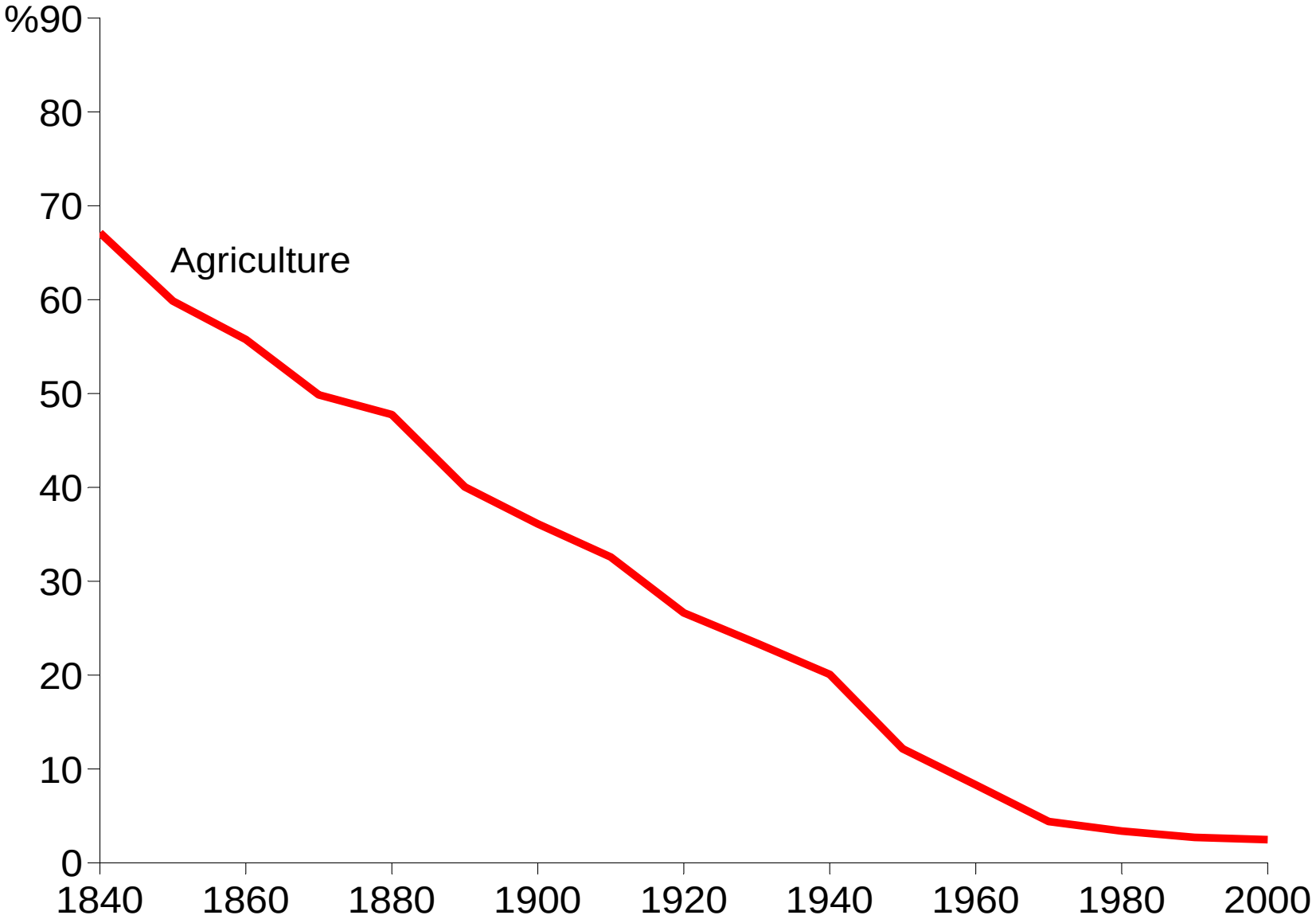
Employment Shares by Sector, U.S. 1840-2000



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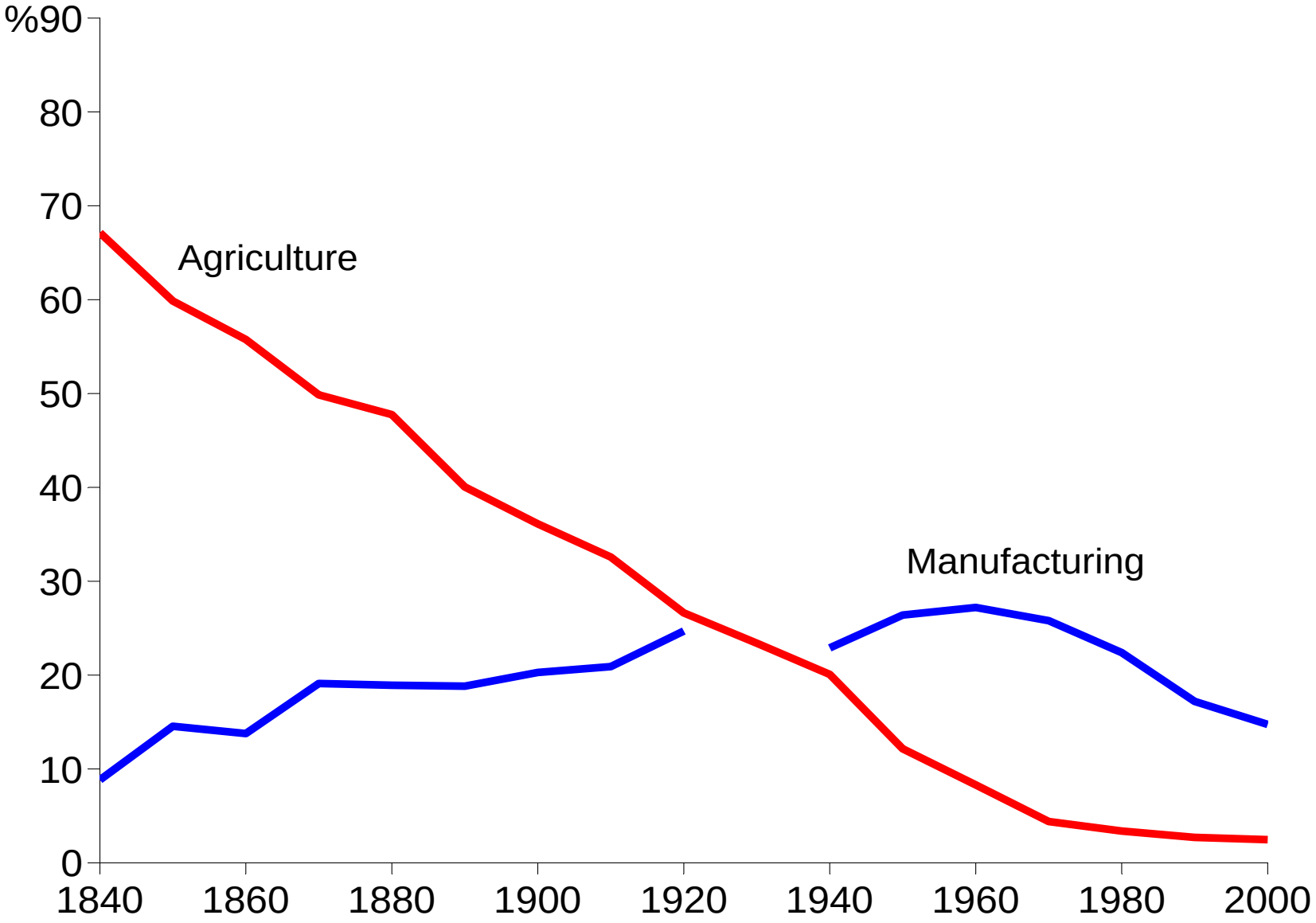

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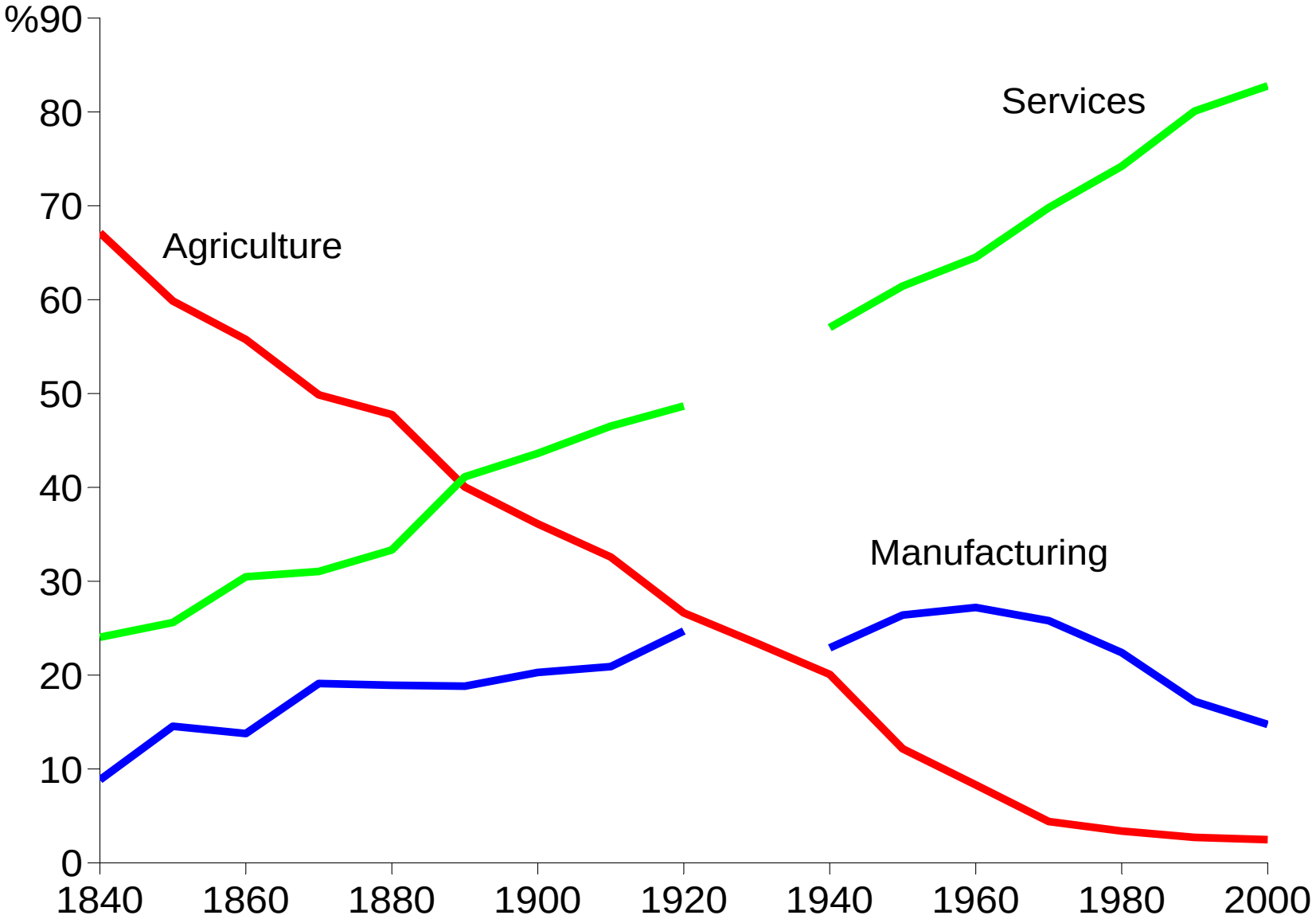

Sources of Structural Change

- Two channels that can account for structural change
  - Sectoral differences in productivity growth (Baumol 1967; Ngai and Pissarides 2007)
  - Sectoral differences in income elasticities of demand (Kongsamut, Rebelo, and Xie 2001)
- The majority of the existing studies on structural change examine the experience of a country in isolation
- Critics of Closed Economy Models
  - Buera and Kaboski (2009), Matsuyama (2009)
- Some Recent Attempts
  - Yi and Zhang (2011), Teignier (2011), Stefanski (2011)

Contribution

- Important questions
  - How does structural change in one country will slow down or speed up structural change in other countries?
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  - A closed economy model accounts for 32.8 percent of the de-industrialization while an open economy model accounts for 62.6 percent of it.
  - Open economy model has more explanatory power to explain the de-industrialization in the post-1990 period accounting for more than 80 percent of it.

Structural Change in a Closed Economy

Households and preferences

$$U(\bar{\mathtt{A}}, C) = \bar{\mathtt{A}} + \log(C) \tag{1}$$

The instantaneous utility is defined over the agricultural good ($\bar{\mathtt{A}}$) and the composite consumption good (C):

$$C = (\gamma^{1-\eta} I^{\eta} + (1-\gamma)^{1-\eta} S^{\eta})^{1/\eta} \tag{2}$$

At each date, and given prices, the household chooses consumption of each good to maximize his lifetime utility subject to the budget constraint:

$$p_A \bar{\mathtt{A}} + p_I I + p_S S = \omega \tag{3}$$

Firms and technologies

The production function for sector j is given by

$$Y_j = \theta_j L_j \tag{4}$$

Firm j problem is given by

$$max \quad p_j Y_j - \omega L_j \qquad s.t. \qquad Y_j = \theta_j L_j, \qquad L_j > 0 \tag{5}$$

Equilibrium

Given a set of prices $\{p_{\mathtt{A}}, p_I, p_S, \omega\}$, a competitive equilibrium consists of consumption decisions that are the household's allocations $\{\bar{\mathtt{A}}, I, S\}$, and factor allocations for the firms $\{L_A, L_I, L_S\}$ such that given prices, the firm's allocations solve its profit maximization problem, the household's allocations solve the household's utility maximization problem, and factor and product markets clear:

$$L_A + L_I + L_S = 1 \tag{6}$$

$$\bar{\mathtt{A}} = Y_A, \quad I = Y_I, \quad S = Y_S \tag{7}$$

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$$L_I = \frac{\Delta(1 - (\bar{\mathtt{A}}/\theta_A))}{1 + \Delta}, \tag{9}$$

where

$$\Delta \equiv (\gamma/(1-\gamma))(\theta_I/\theta_S)^{-\eta/(\eta-1)}.$$

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Proposition

When $1/(1-\eta) < 1$ (gross complementarity), faster productivity growth in industry leads to Baumol's prediction: labor goes to the slow-growing service sector.

$$\frac{\partial L_I}{\partial \theta_I} > 0, \quad \textit{if} \;\; 1/(1-\eta) > 1; \qquad\qquad \frac{\partial L_I}{\partial \theta_I} < 0, \quad \textit{if} \;\; 1/(1-\eta) < 1.$$

Calibration for the U.S., 1950-2005

- Normalize productivity levels across sectors to 1 in 1950:

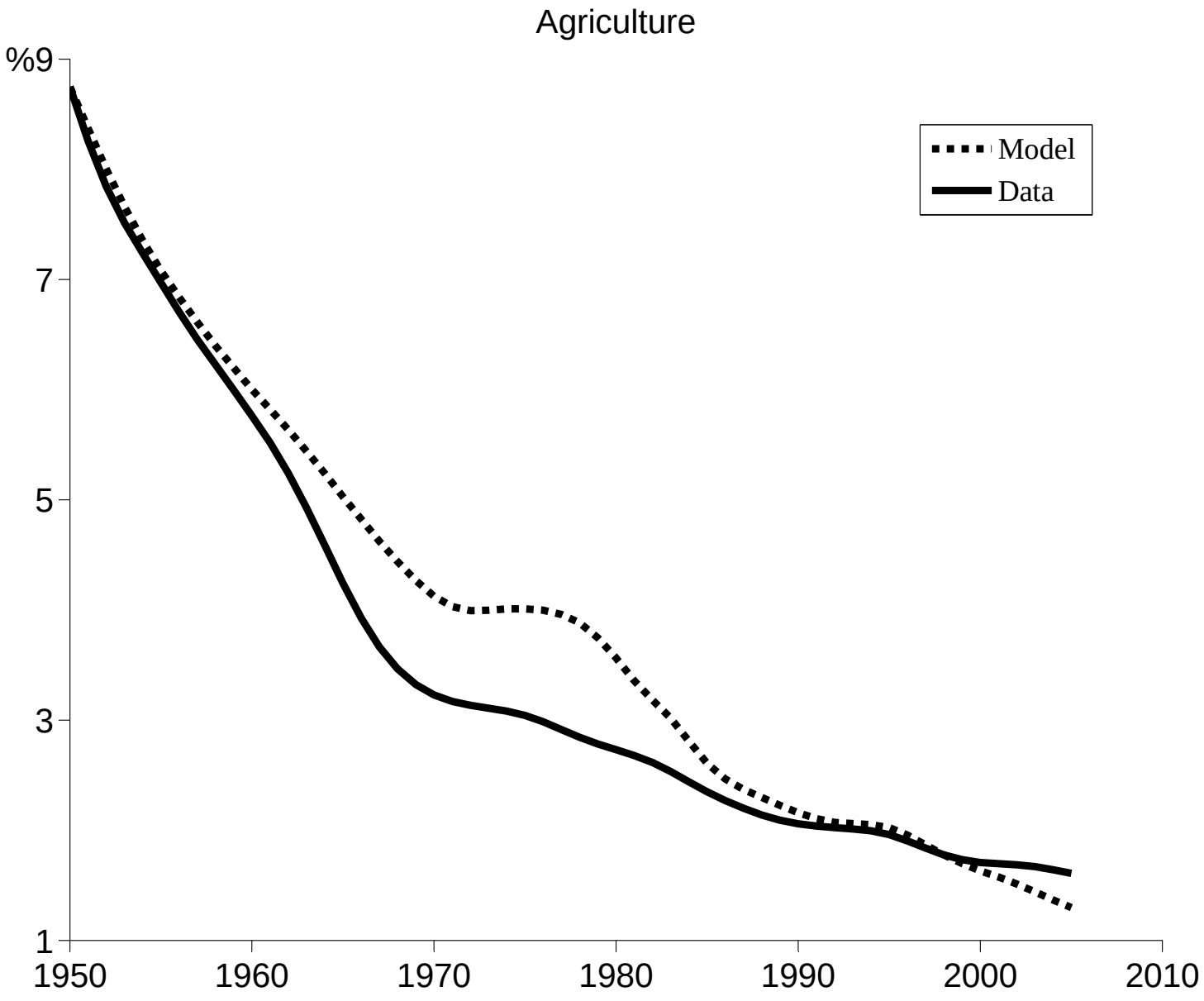
$$\theta^j_{1950} = 1$$

- Use data on sectoral productivity growth to get time paths:

$$\theta^j_{t+1} = (1 + g^j_t)\theta^j_t$$

- Calibrate the preference parameters to match the initial employment shares
- Consider $1/(1-\eta)$ to be a free parameter in order to study the implication of this parameter value for the findings
- Bah (2009), Duarte and Restuccia (2010), Ngai and Pissarides (2004, 2008), Rogerson (2008) argue and cite the empirical literature that $1/(1-\eta) \simeq 0.1 - 0.45$
- I study three values of $1/(1-\eta)$

Sectoral Employment Shares, 1950 - 2005



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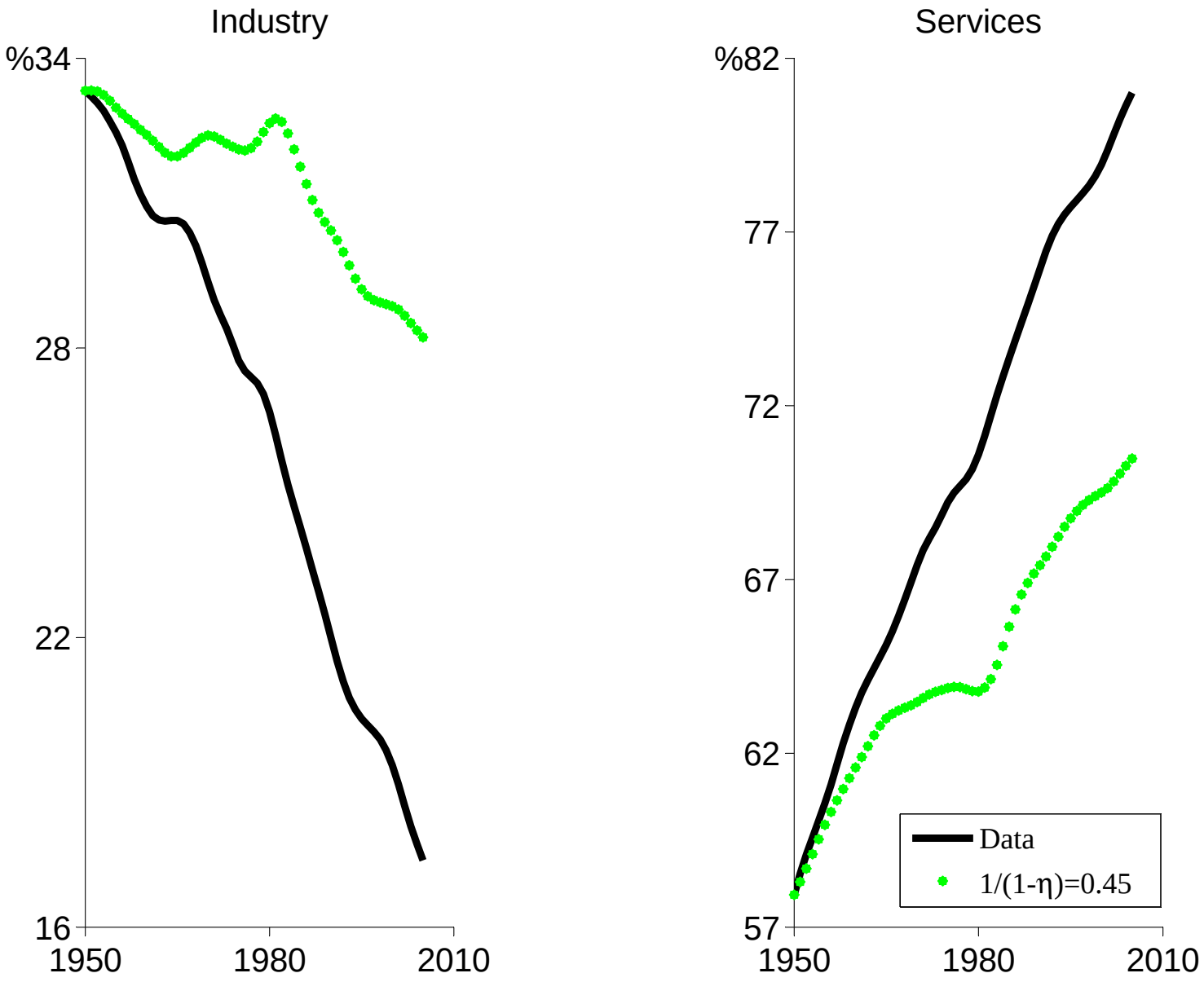

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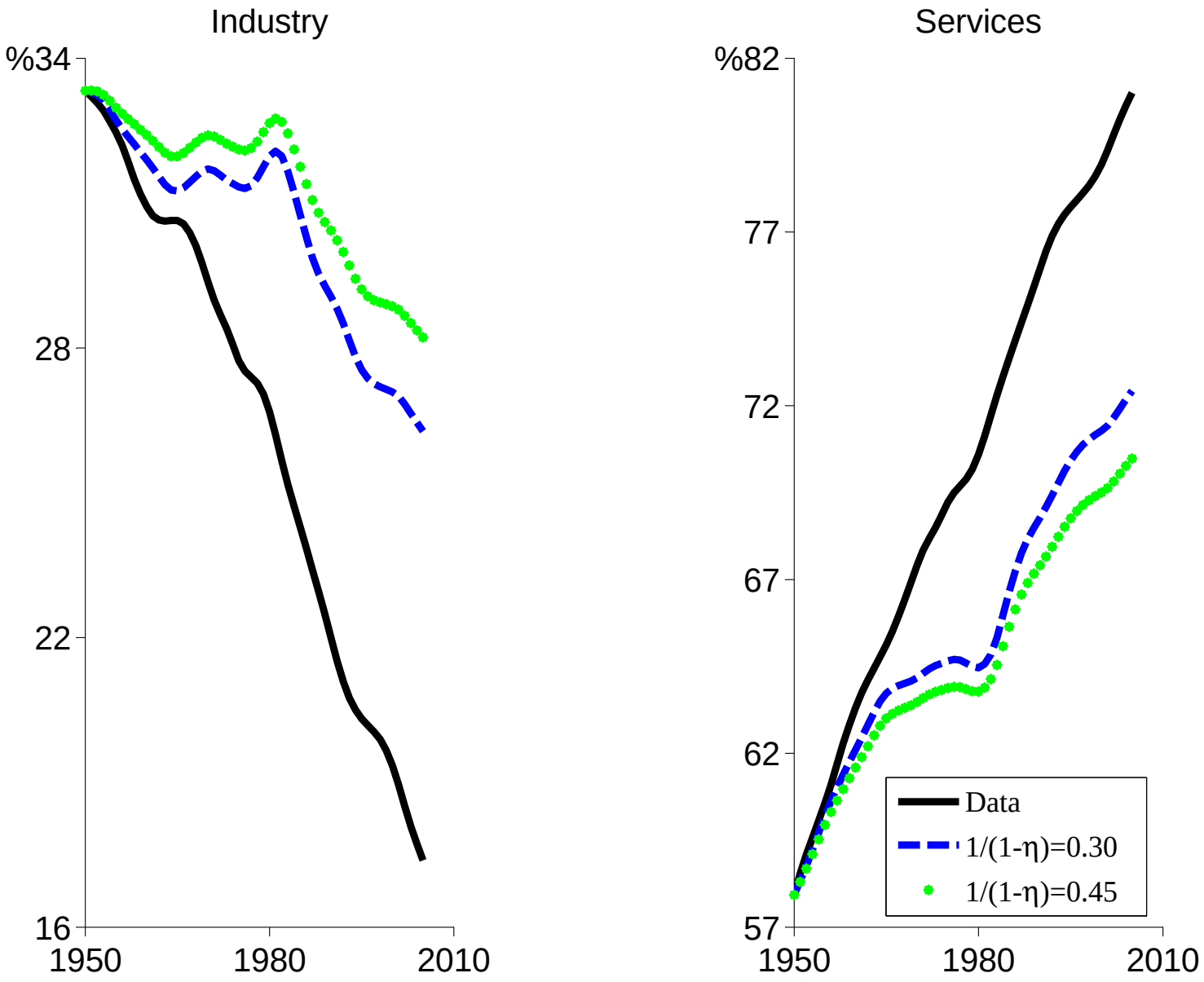

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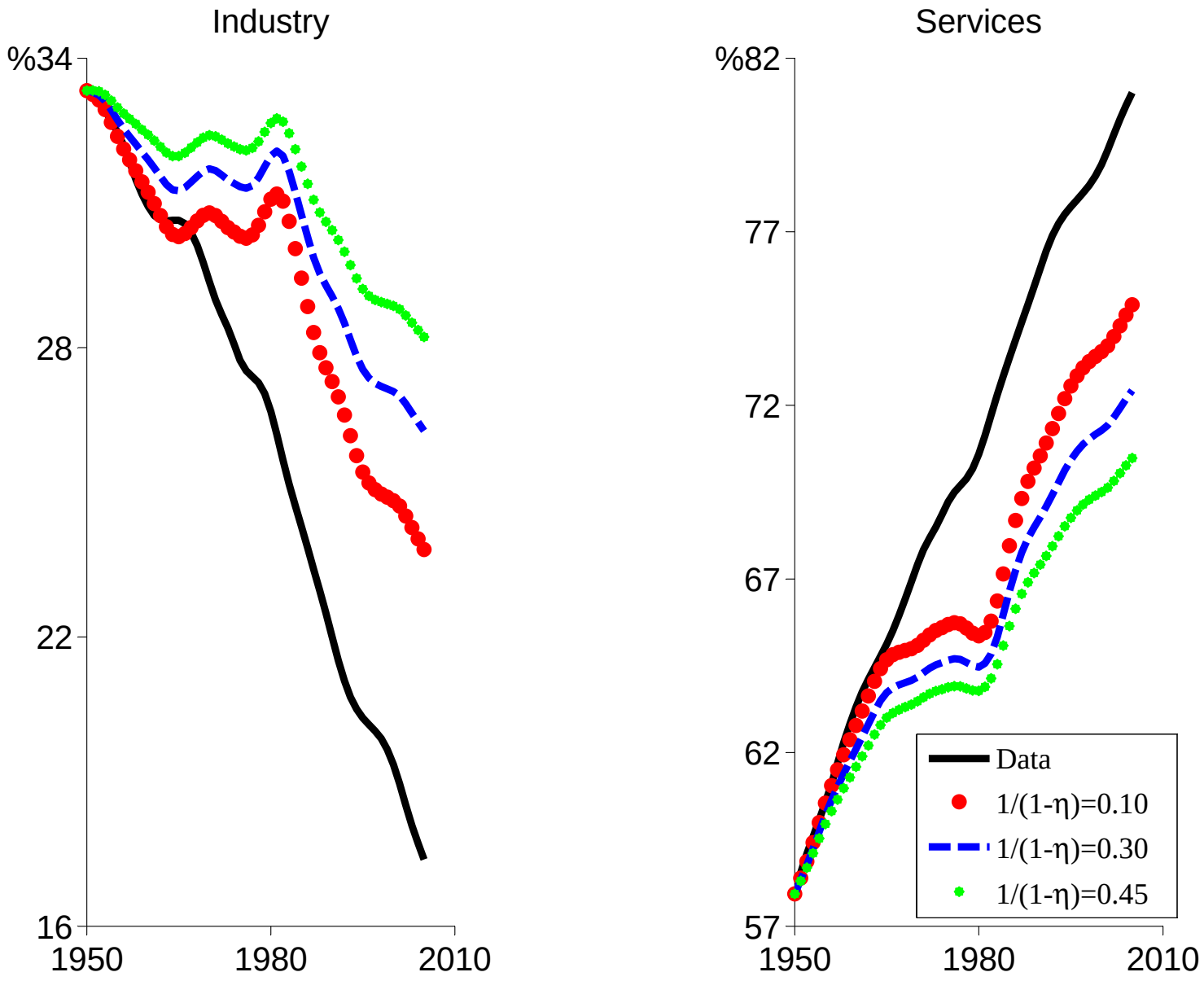


Problem with the Closed Economy

- Differential productivity gains in industry do not necessarily explain de-industrialization
- A major problem is that productivity growth in industry relative to services is not high enough to move labor out of the industrial sector
- This problem is robust under different values of the elasticity of substitution between industry and services

Does Openness Matter?

China has experienced high productivity growth in industry (especially after 1990)

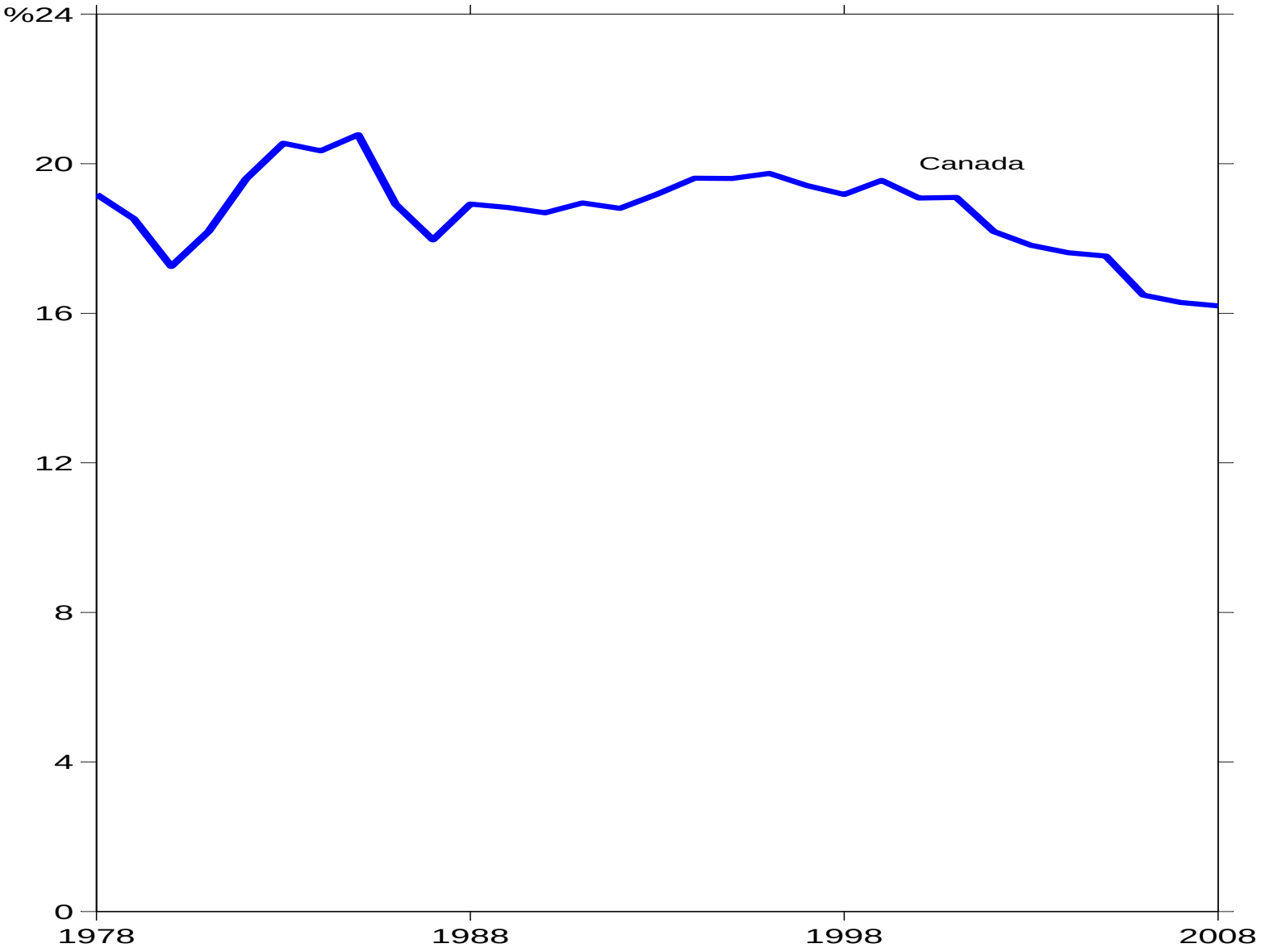
If modeled, will improve upon

1. Technology-based explanations
   (different rates of sectoral productivity growth)

2. Utility-based explanations
   (different income elasticities for different goods)

that can't account for last 3-4 decades in closed economy framework

U.S. Trade in Goods: Imports from



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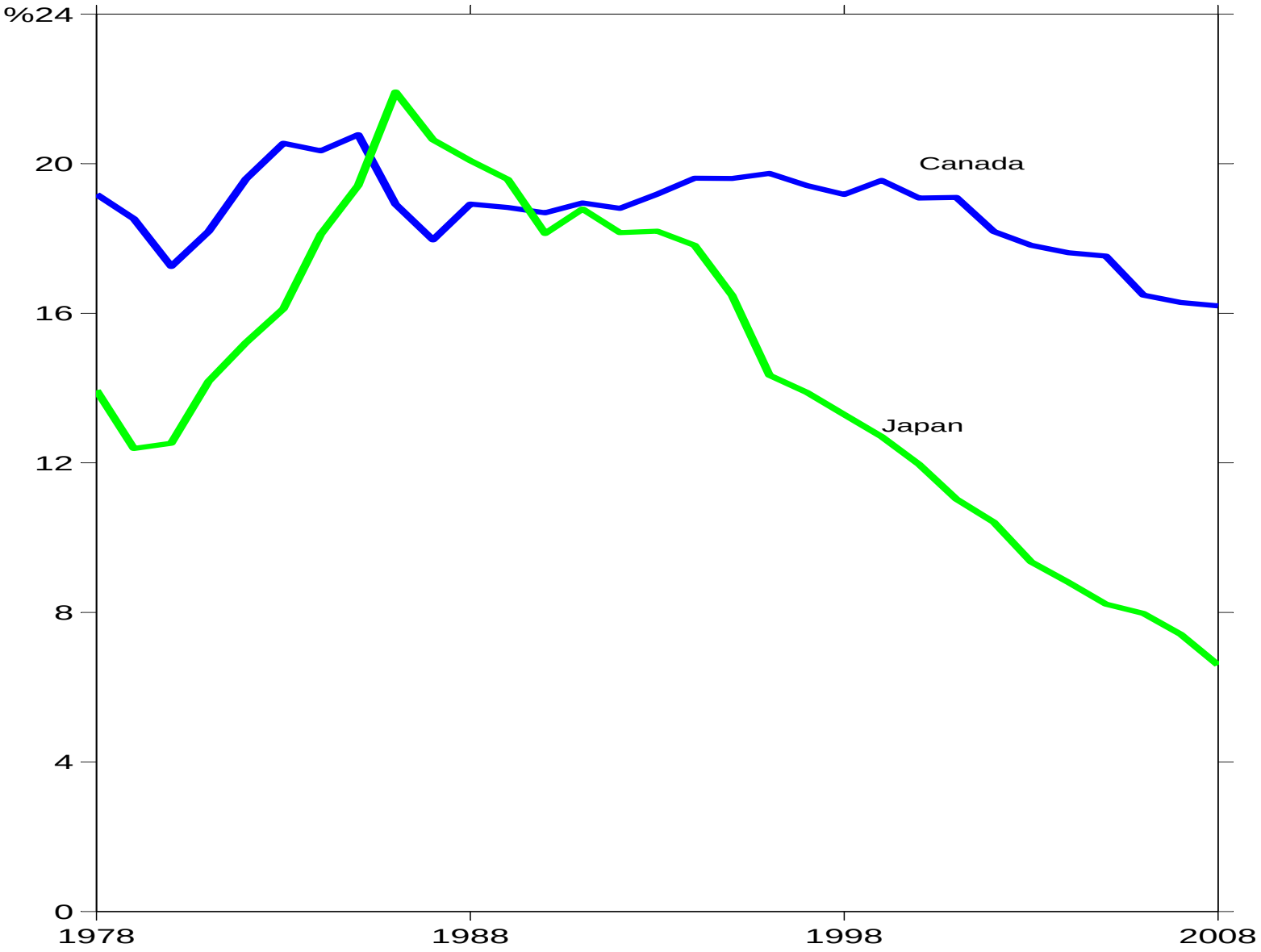

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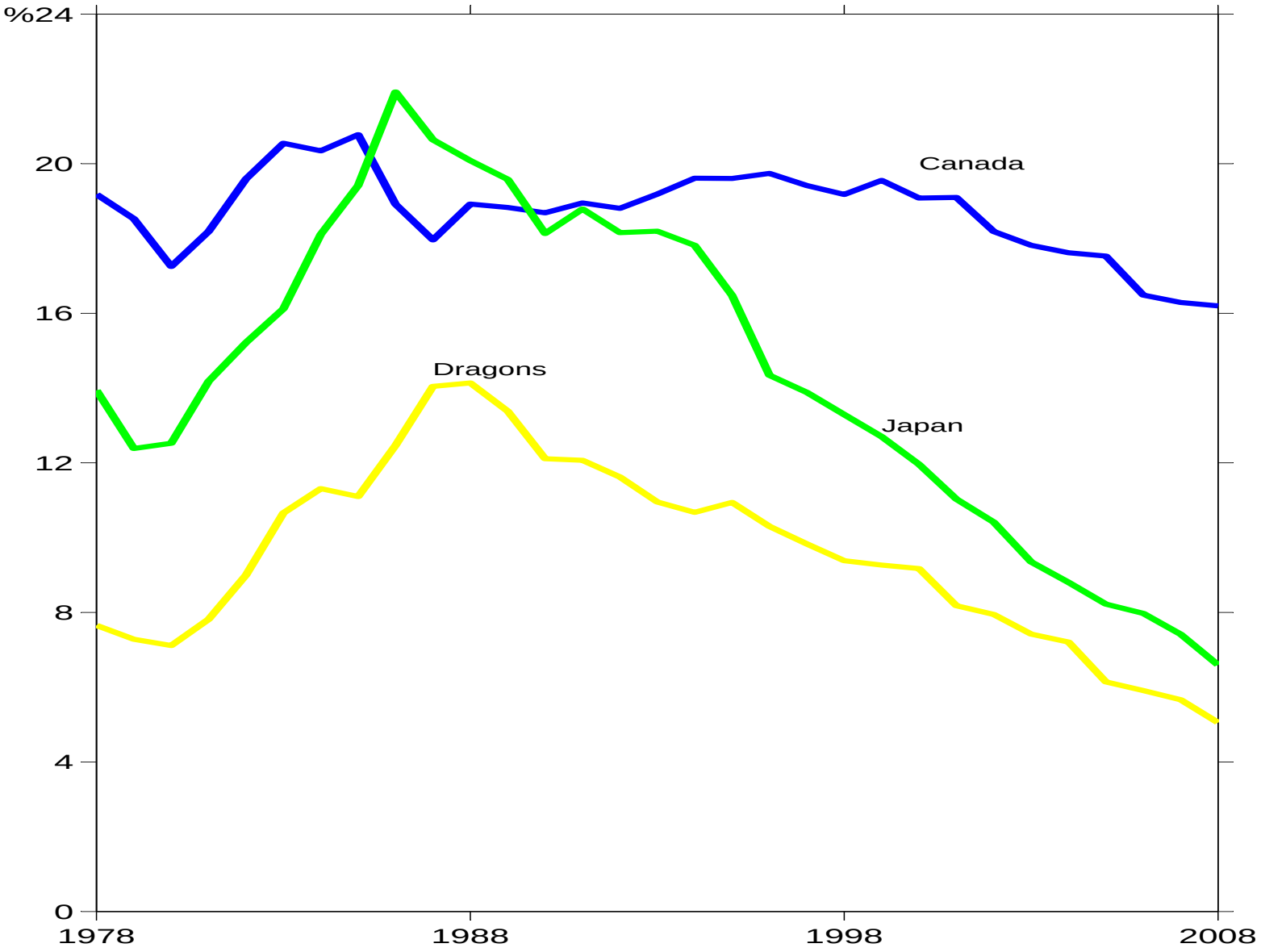

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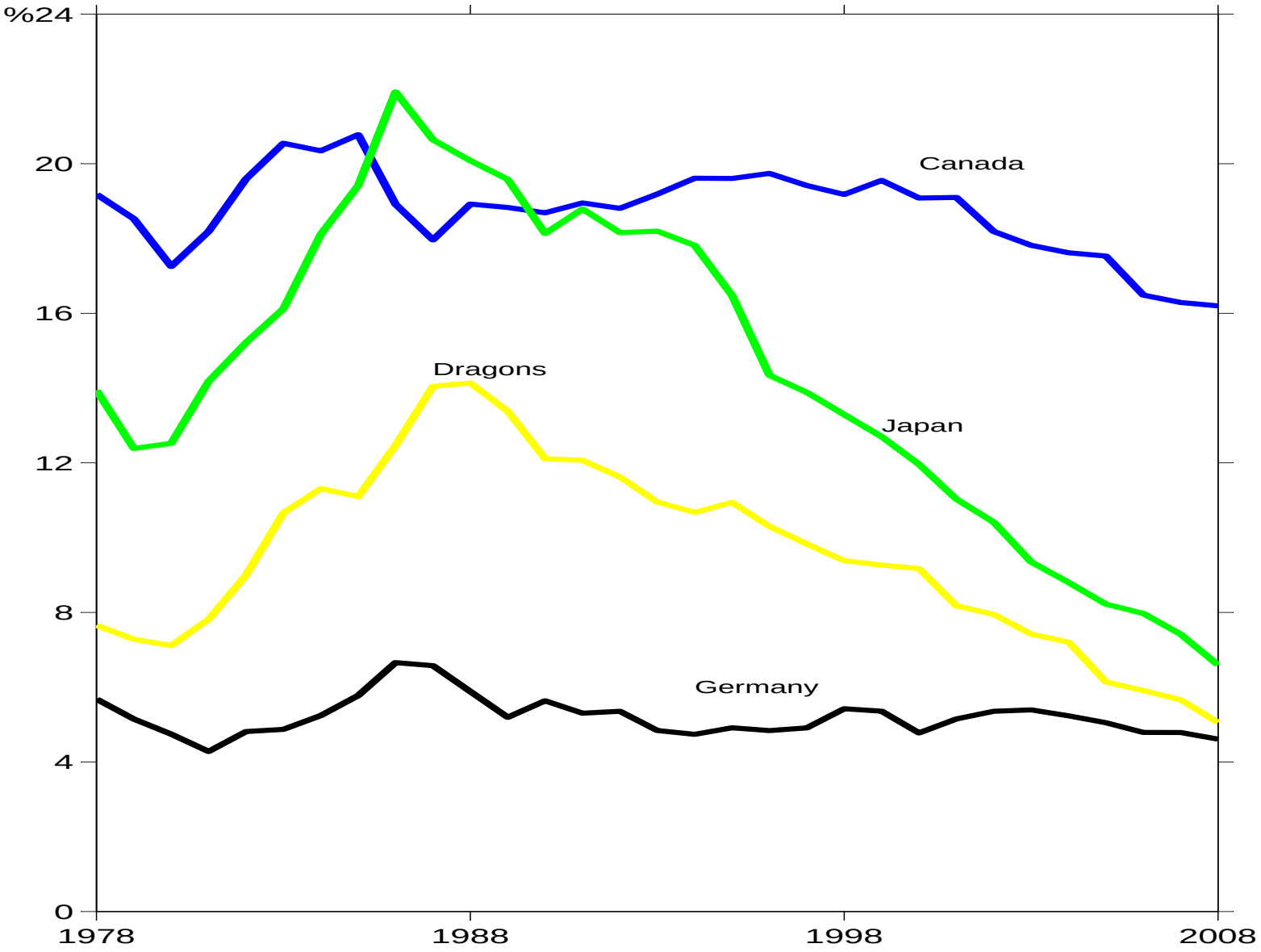

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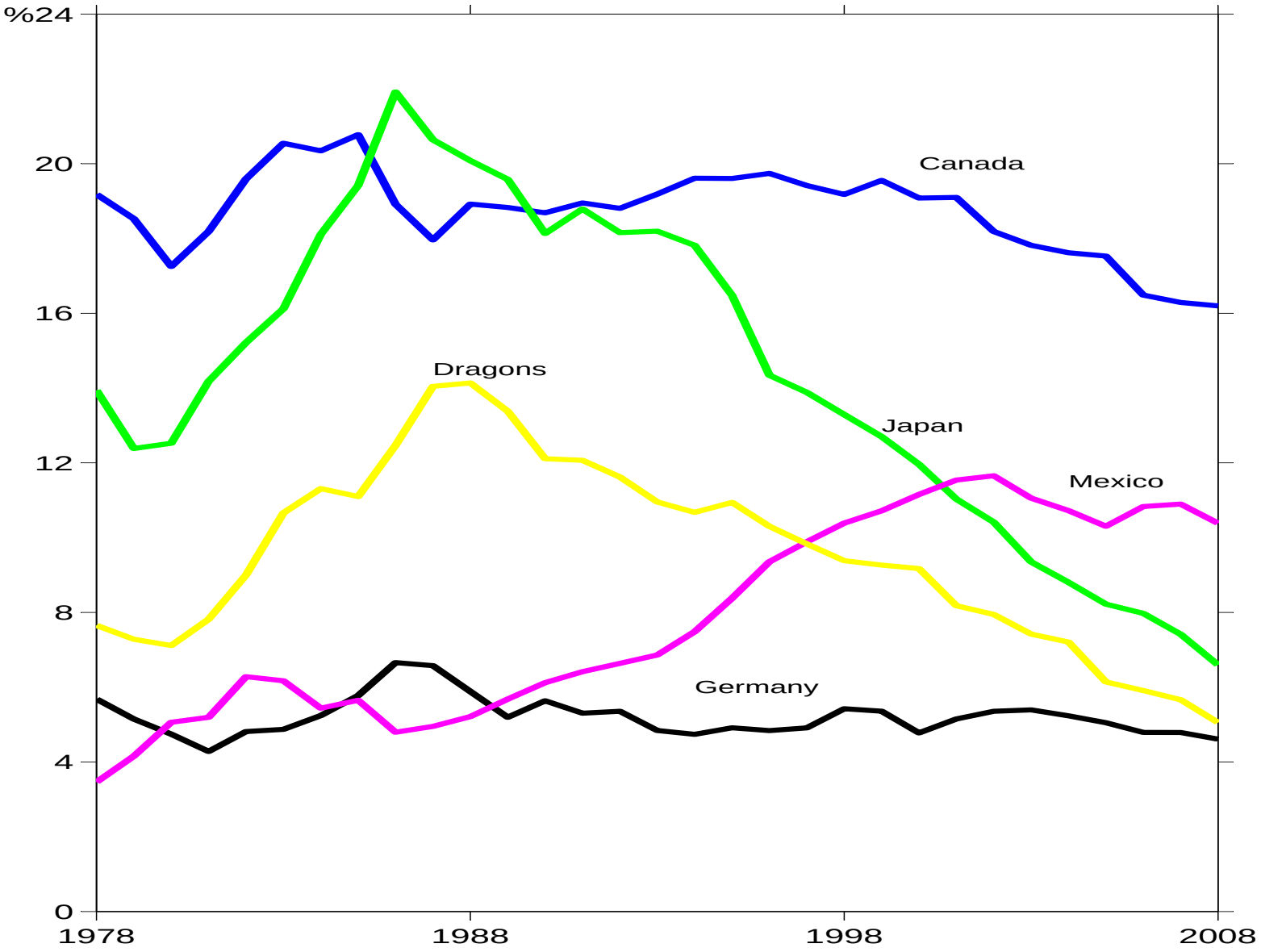

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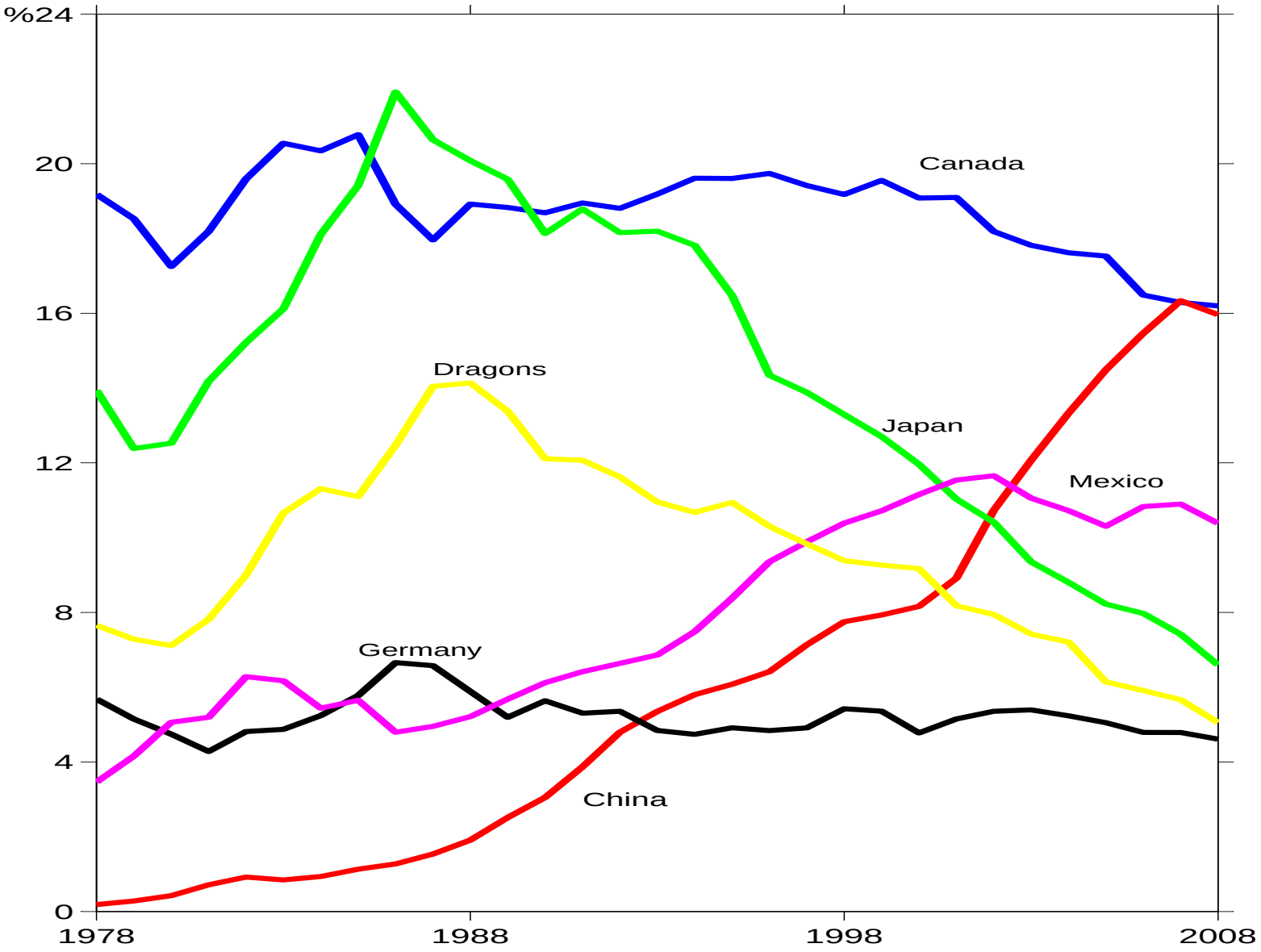

Structural Change in an Open Economy

Firm j Problem in Country i

$$\begin{aligned} max \quad & p_j^i Y_j^i - \omega^i L_j^i \\ & s.t. \\ & Y_j^i = \theta_j^i L_j^i \\ & L_j^i > 0 \end{aligned}$$

where

p_j^i is producer price for sector j in country i

Y_j^i is output produced in sector j in country i

ω^i is real wage in country i

L_j^i is labor employed in sector j in country i

θ_j^i is productivity of sector j in country i

The representative agent's utility function in country i is

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$1/(1-\eta)$ is substitution elasticity between industry and services

γ^i is share of industry in non-agricultural consumption in country i

Industrial good consumption in country i

$$I^i = \left((\mu^i)^{1-\rho} (I_i^i)^\rho + (1-\mu^i)^{1-\rho} (I_k^i)^\rho \right)^{1/\rho}$$

$1/(1-\rho)$ is the elasticity of substitution between home and foreign goods

μ^i is home-product consumption bias

Consumption bias is a stand-in for trade costs

Free borrowing / lending in a complete set of asset markets

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Free borrowing / lending in a complete set of asset markets

- Solve the World's social planner problem
- A sequence of static resource allocation problems

World's Social Planner Problem

$$Max \;\; \alpha U\left(\bar{\mathtt{A}}^{US}, C^{US}\right) + (1-\alpha) U\left(\bar{\mathtt{A}}^{Ch}, C^{Ch}\right) \qquad s.t.$$

$$Y_A^I = \theta_A^i L_A^i = \bar{\mathtt{A}}^i$$

$$Y_I^i = \theta_I^i L_I^i = I_i^i + I_i^k$$

$$Y_S^i = \theta_S^i L_S^i = S^i$$

$$L_A^i + L_I^i + L_S^i = 1$$

Quantitative Analysis

1. Numerical experiments to answer
   - How does openness effect de-industrialization in the United States?
   - What would have happened if the Chinese economy had productivity in industry same as the U.S.?
   - How does the elasticity of substitution between home and foreign goods affect the sectoral re-allocation of labor?

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2. Data and Parameters
   - Feed the path of actual sectoral productivity growth rates
   - Parameterization of the model

Time Path of Exogenous Variables

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Use data on the growth rate of sectoral value added per worker in country i to obtain the time paths of sectoral productivity

$$\theta^i_{j,t+1} = (1 + g^i_{j,t})\theta^i_{j,t}, \quad \textit{for} \quad t = 1978, 1979, ...2004$$

Parameters

Subsistence in agriculture: $\bar{\mathtt{A}}^i$

- to match employment share of agriculture in 1978

Consumption weight on industrial goods: γ^i

- to match employment share of industry in 1978

Home-product consumption bias: μ^i

- to match the average import ratio

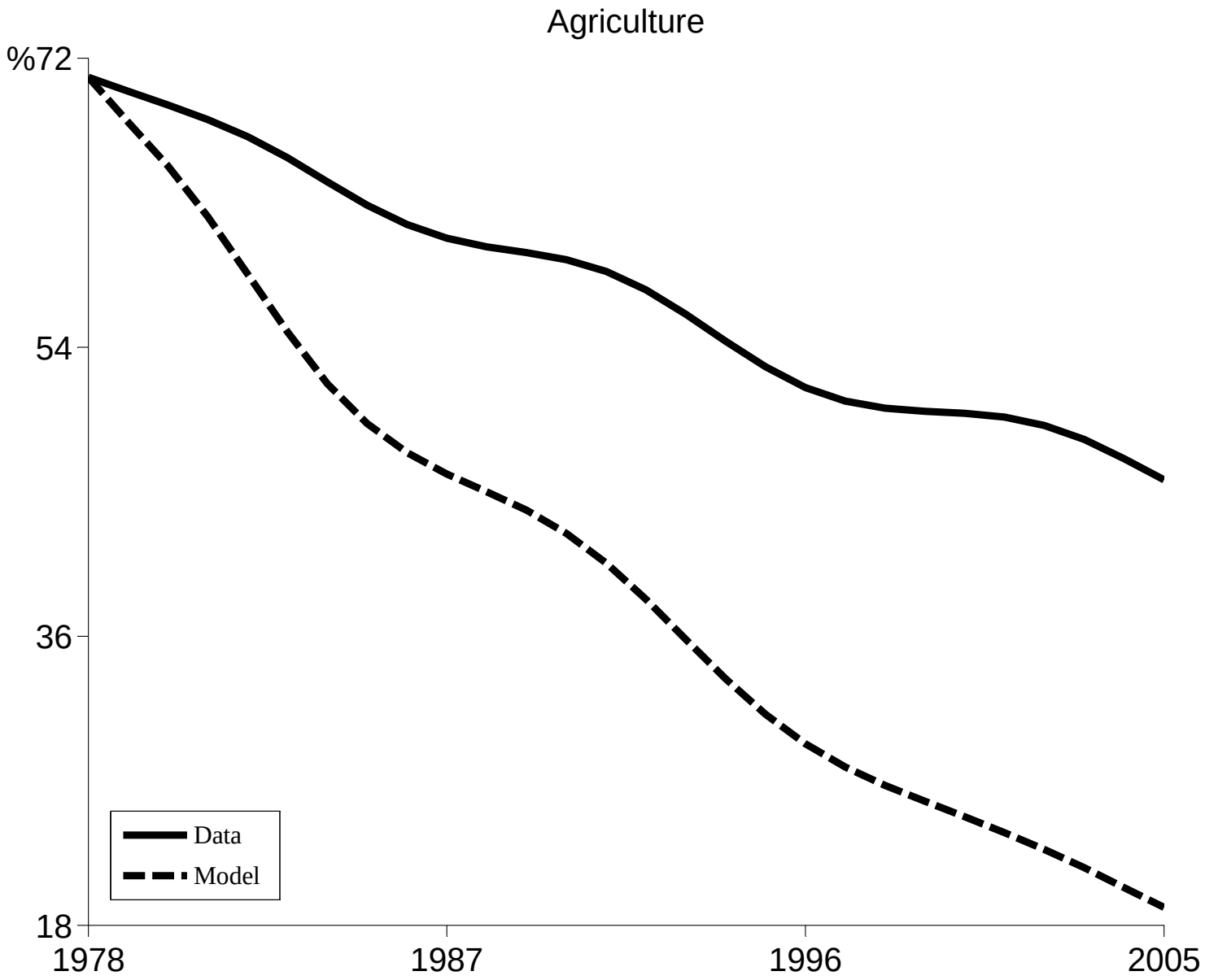
η: elasticity of substitution between tradables and nontradables

- 0.45

ρ: elasticity of substitution between home and foreign goods

- International Economics Literature: 1.5

Sectoral Employment Shares in China



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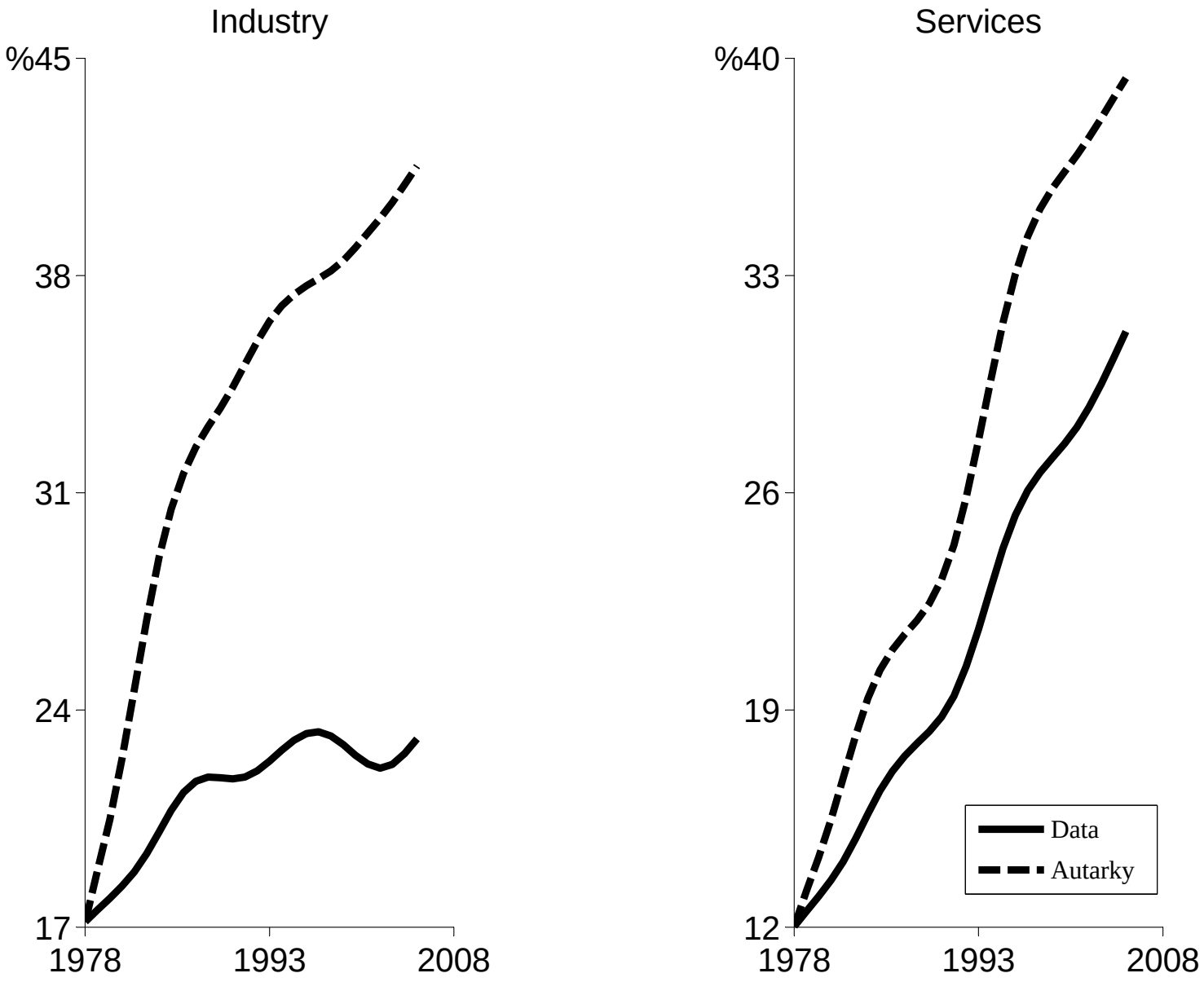

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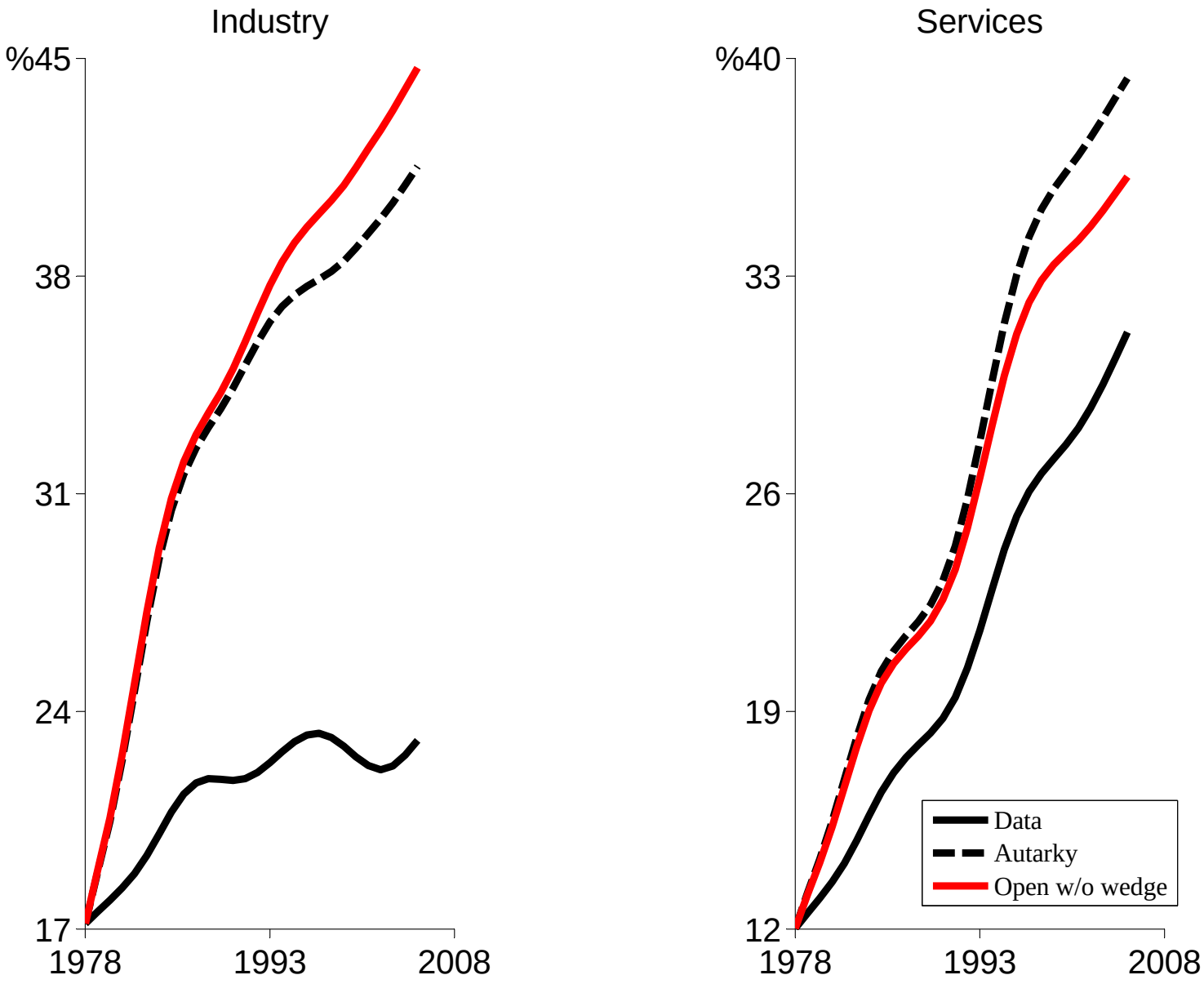

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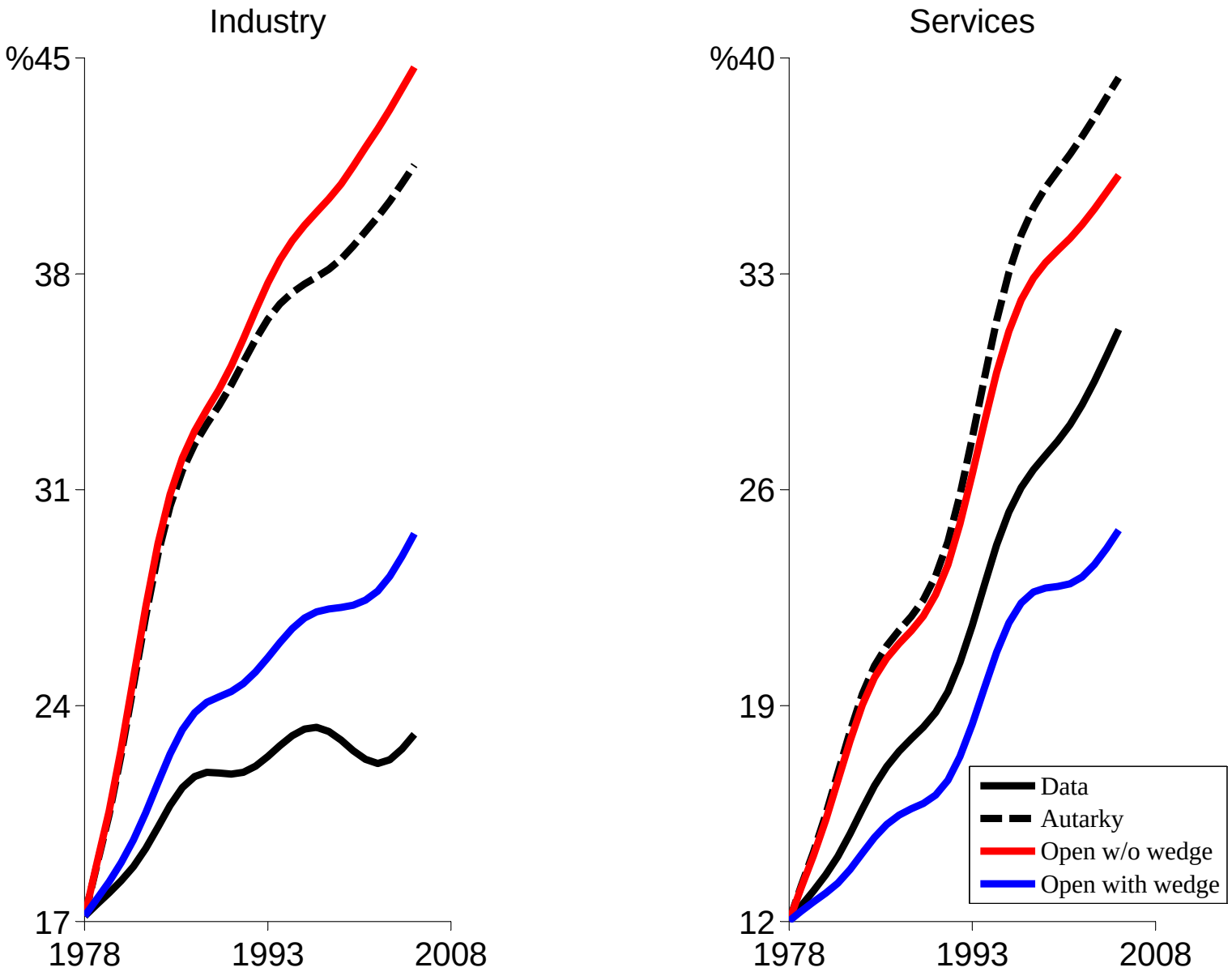
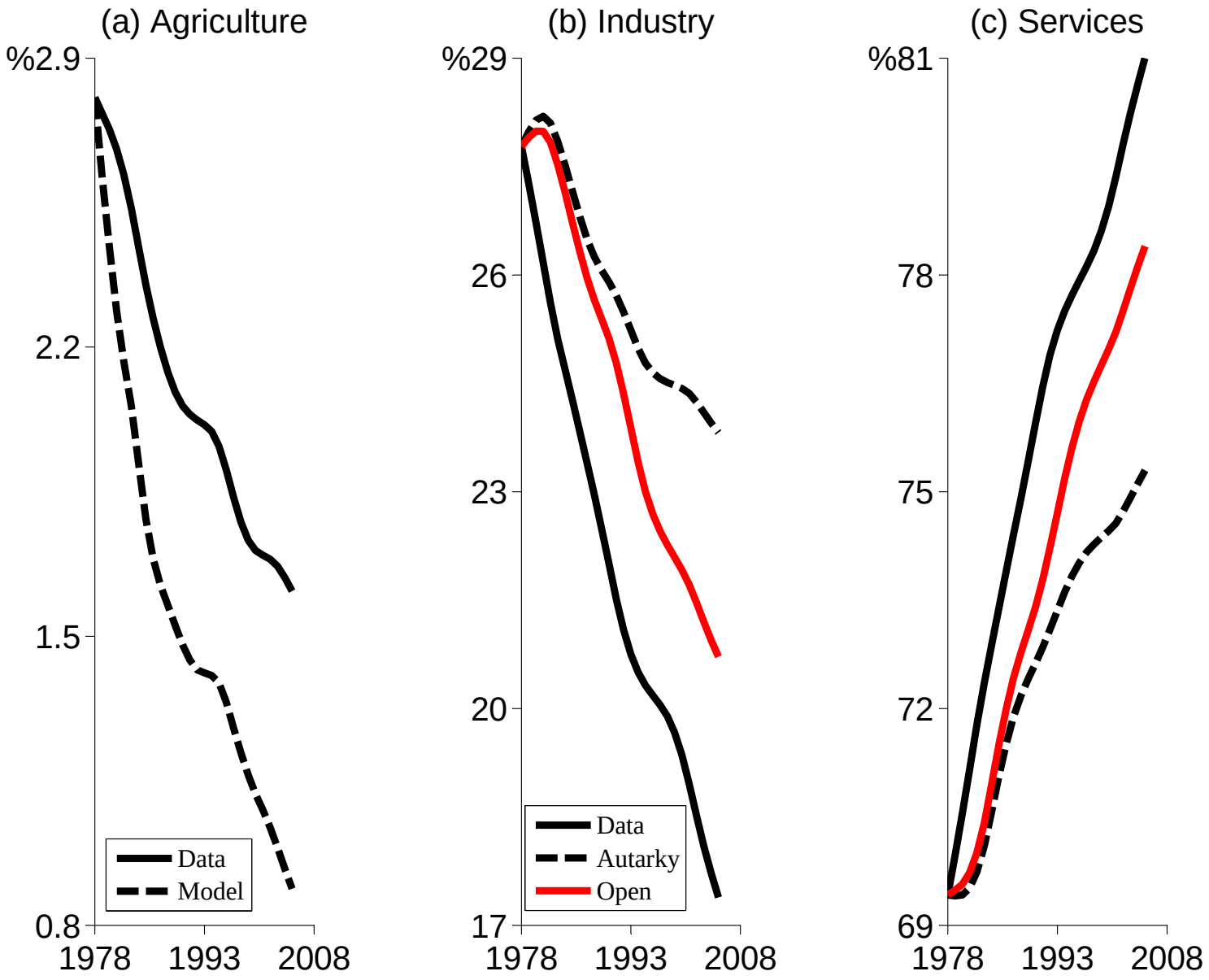
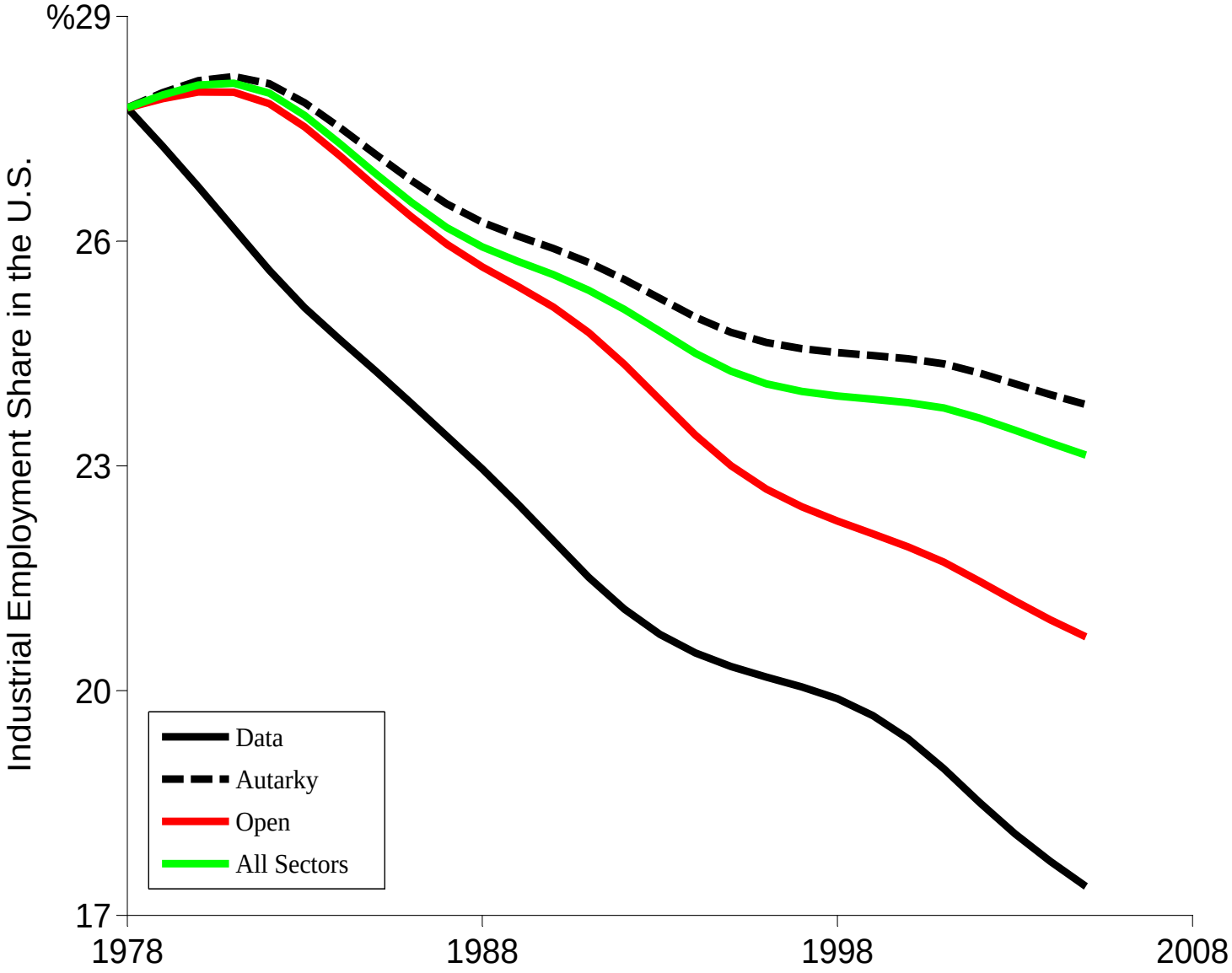


Sectoral Employment Shares in the U.S.

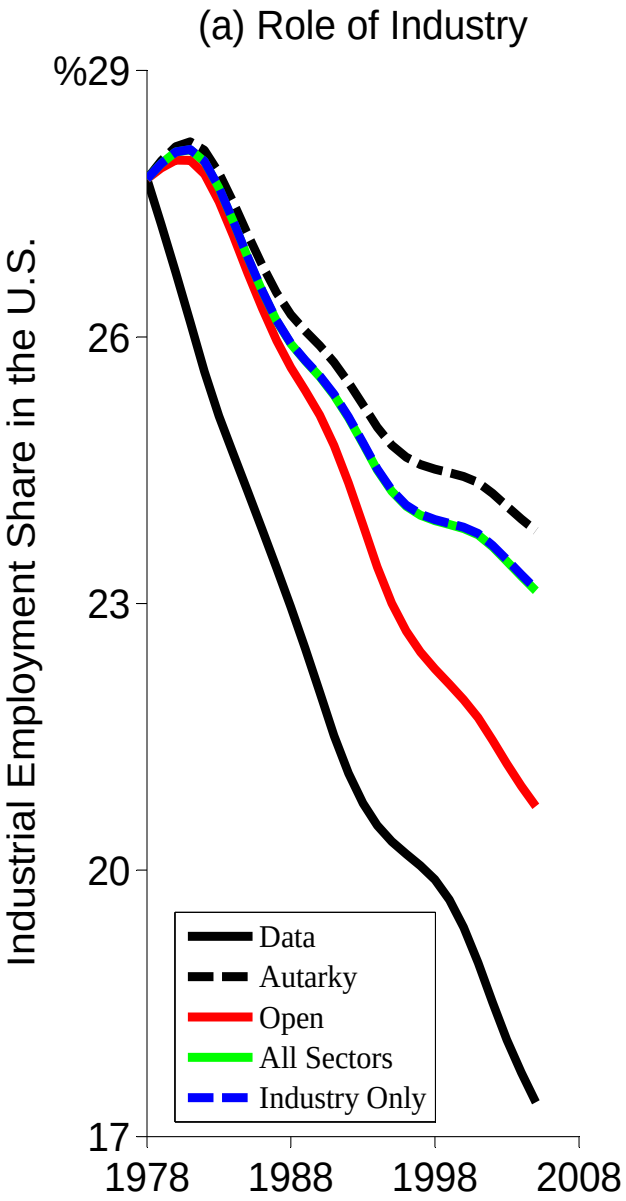


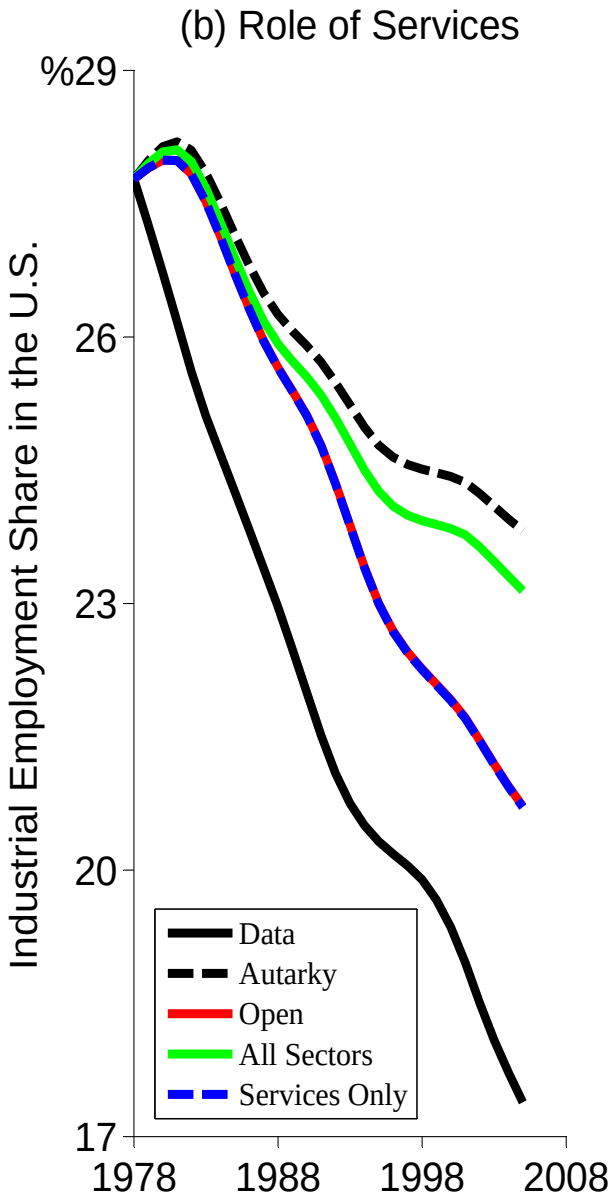
What would have happened if the Chinese economy had productivity in agriculture / industry / services / all sectors same as the United States?

Role of Productivity Differentials

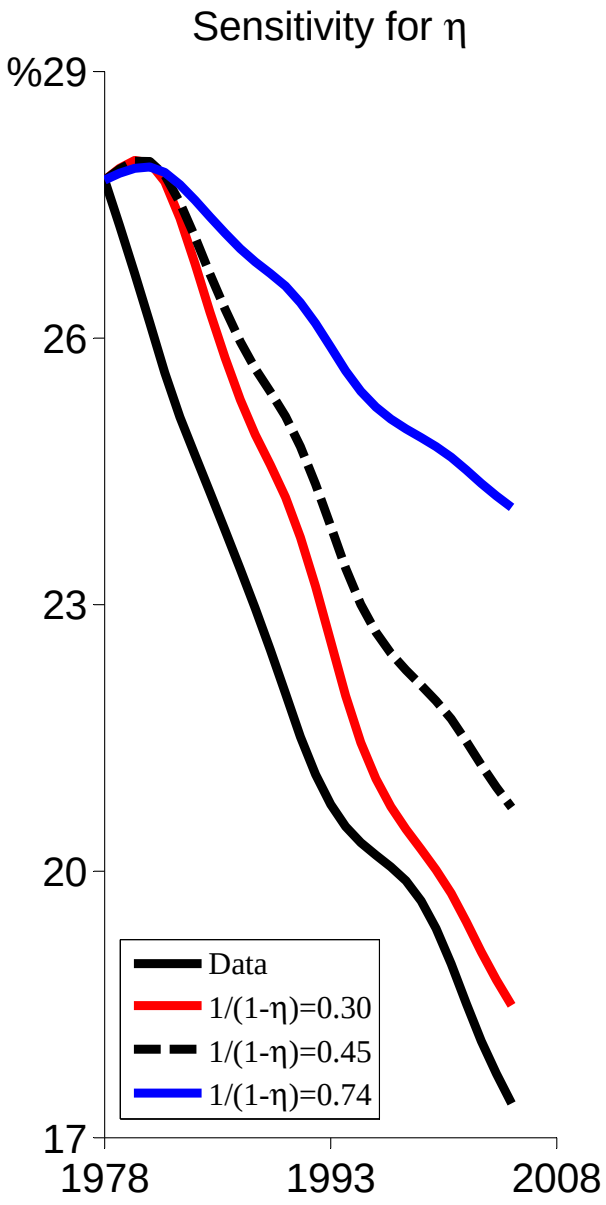


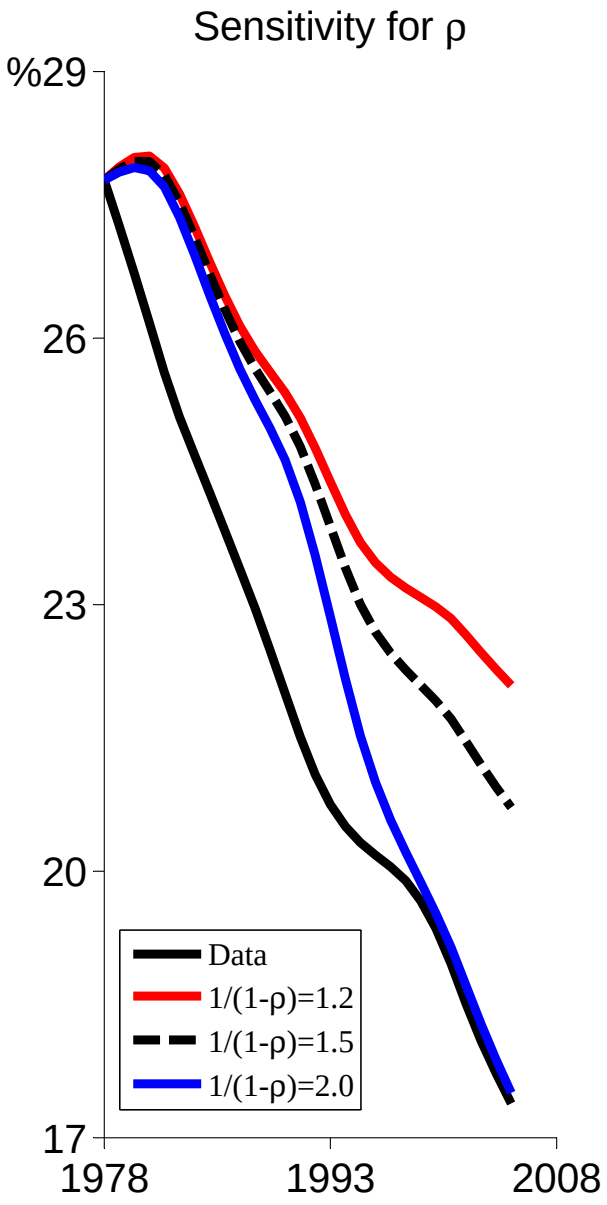
Role of Productivity Differentials in Industry and Services



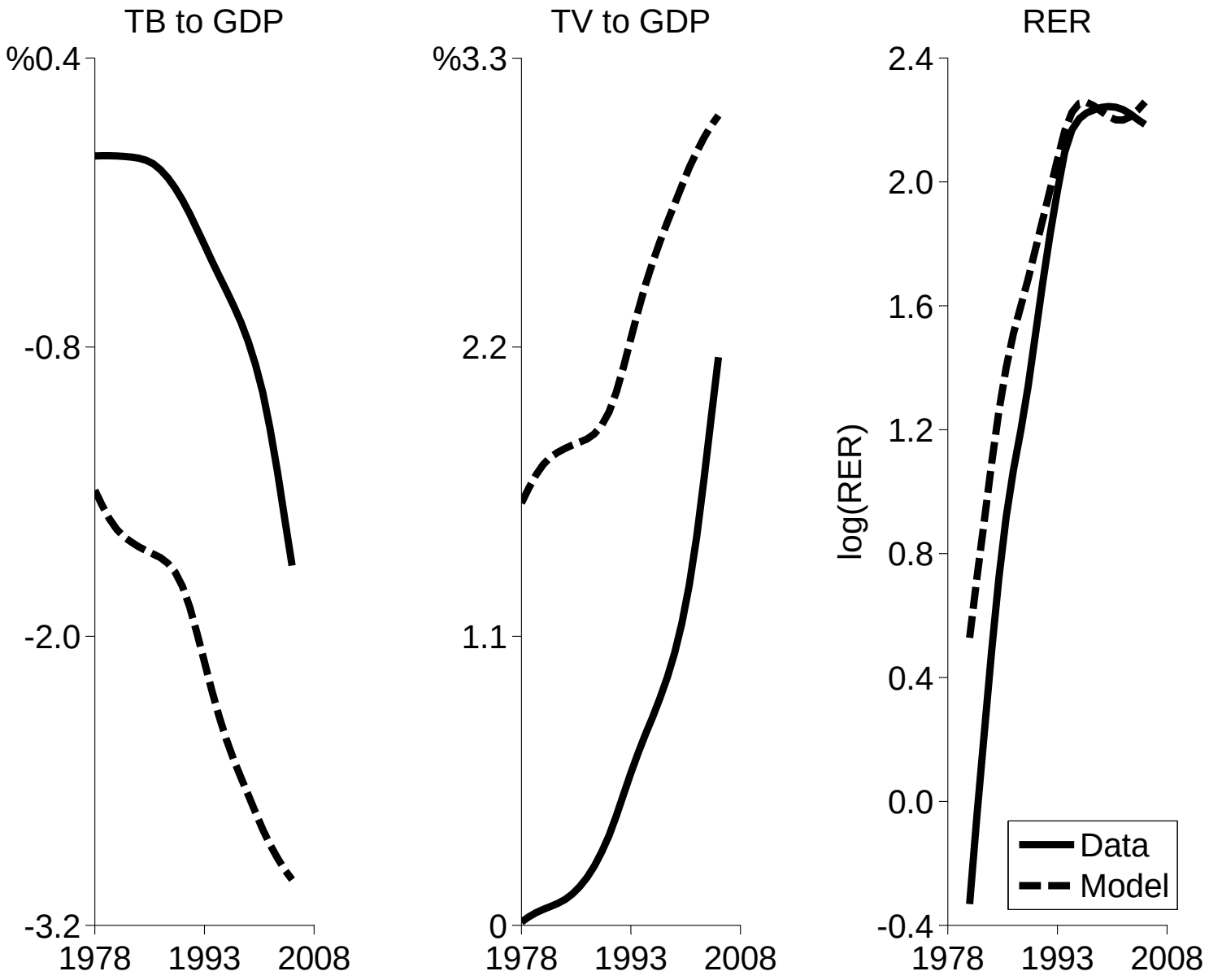


Sensitivity Analysis in the Open Economy

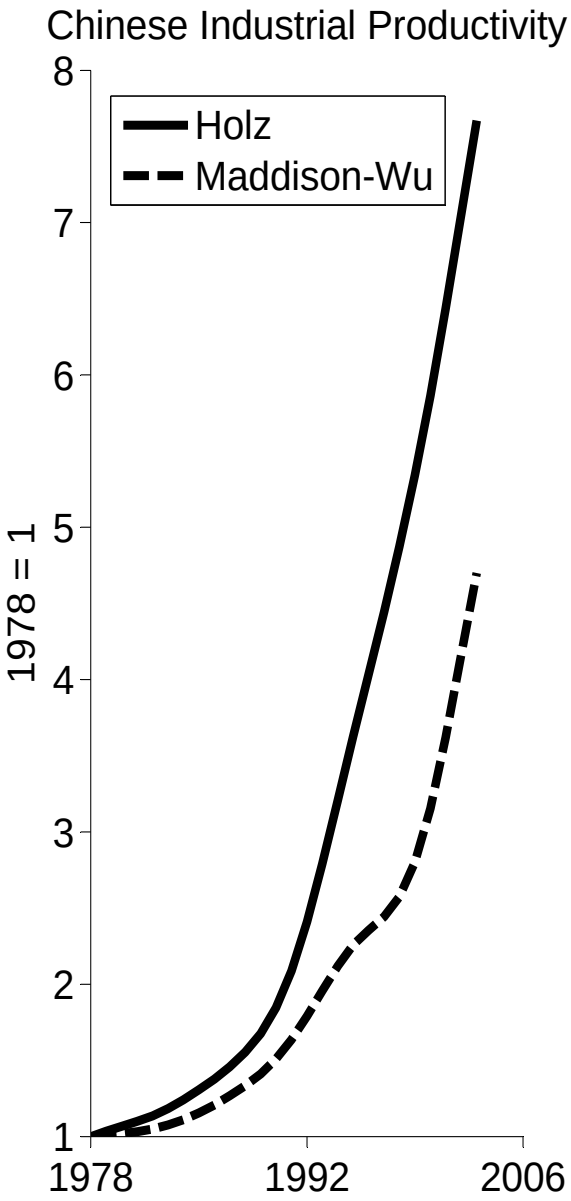


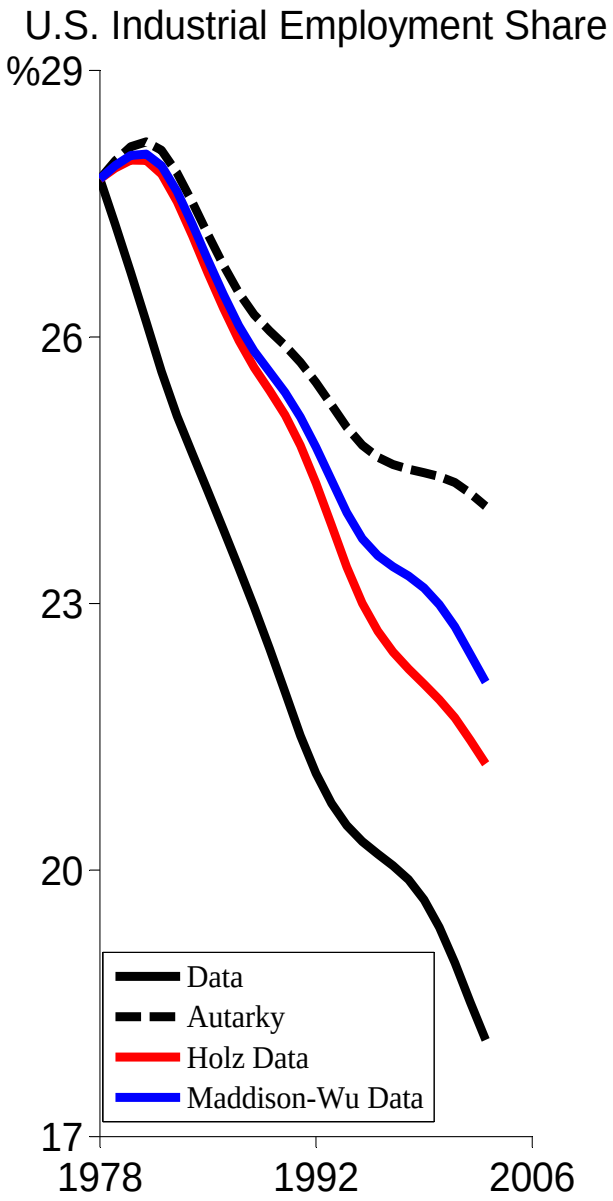


Trade Variables



Discussion on the Chinese Data





Concluding Remarks

- Openness matters for sectoral reallocation of labor!
- If the Chinese economy had productivity in industry same as the U.S., then the role of openness is diminished
- The higher the elasticity of substitution between home and foreign goods is, the more accelerated structural transformation
- Several additional questions can be profitably addressed in future work