

# An Exploration of the Japanese Slow Down during the 1990s

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# Motivation

- ▶ Striking aspects of the Japanese stagnation of the 1990s:
  - ▶ Driven by TFP
  - ▶ Severity: TFP growth from 2.4% (1983-1991), to 0.2% (1991-2000)
  - ▶ Persistence of slowdown
- ▶ Cogley and Nason (1995), persistence in real business cycles models comes from the persistence of the shocks
- ▶ None of the shocks that arguably have hit the Japanese economy seem to have persisted for a decade
- ▶ A successful account of the Japanese stagnation requires a model where the propagation mechanisms generate a significant amount of persistence

# Motivation: The Goal

Explore the potential of various shocks and mechanisms to account for the Japanese Slowdown in a context where:

- ▶ Productivity is endogenous as in Comin and Gertler (2006): A unified explanation for the co-movements of TFP, technology diffusion and R&D over the short and medium term.
- ▶ Two-country framework to allow for:
  - ▶ foreign influence on technology (Braun et al., 2006) , competition and trade
  - ▶ amplification through exchange rate fluctuations

# Some facts

- ▶ Exploration of some facts to
  - ▶ understand main features of the data
  - ▶ look for evidence on the propagation mechanisms

Figure 1; Detrended Real GNP per working age population

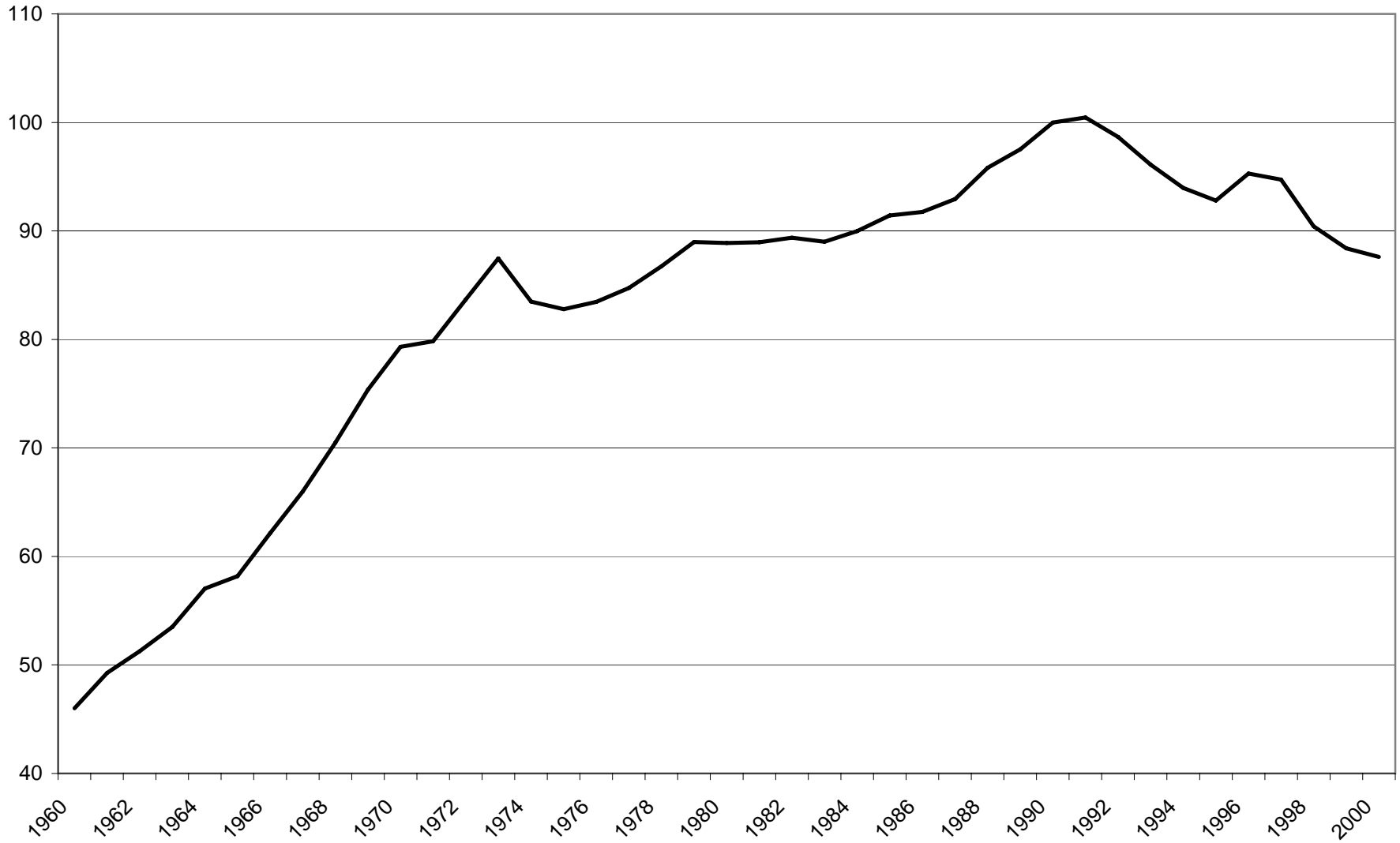


Figure 2: Detrended TFP

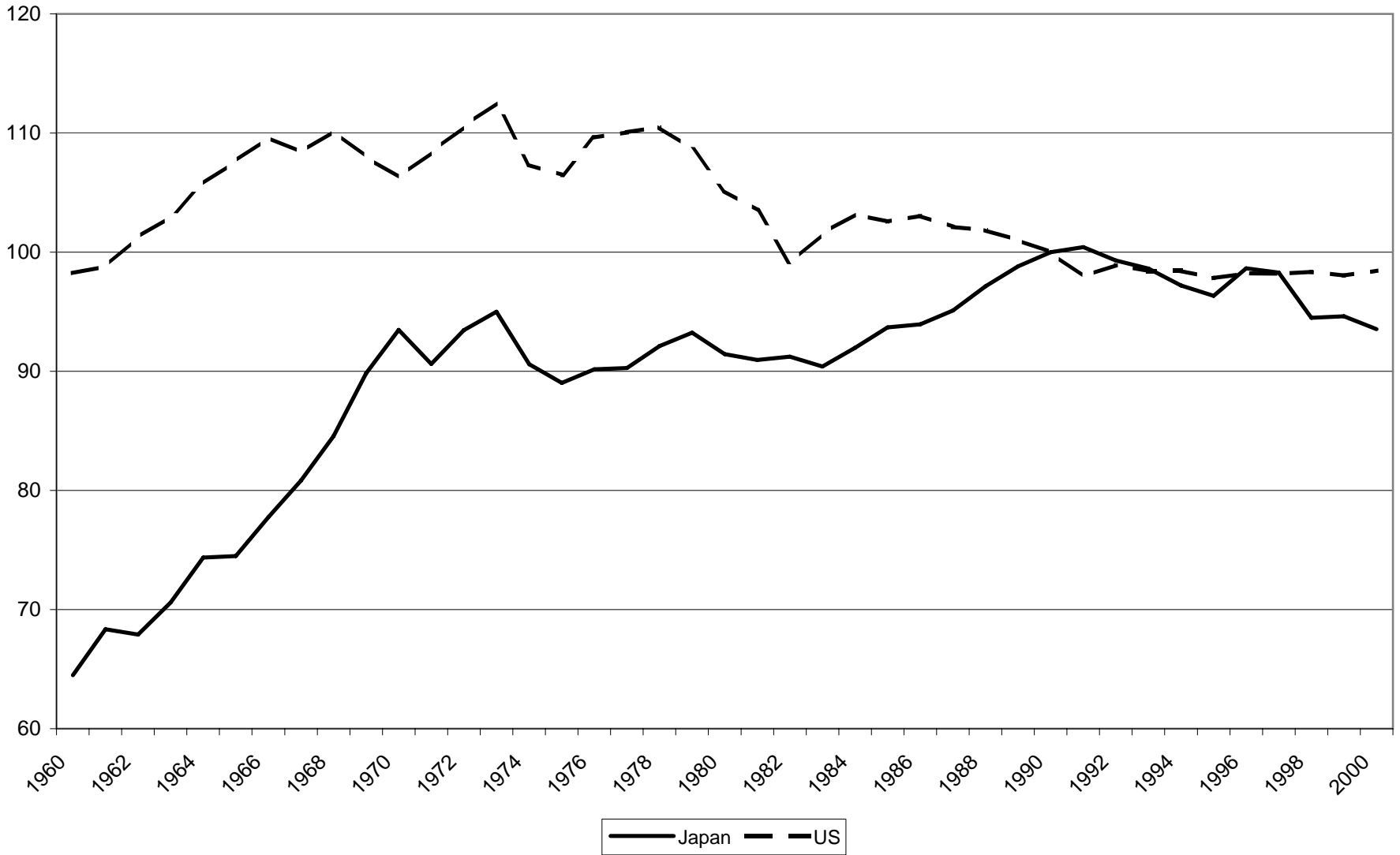


Figure 3: TFP of services and non-services

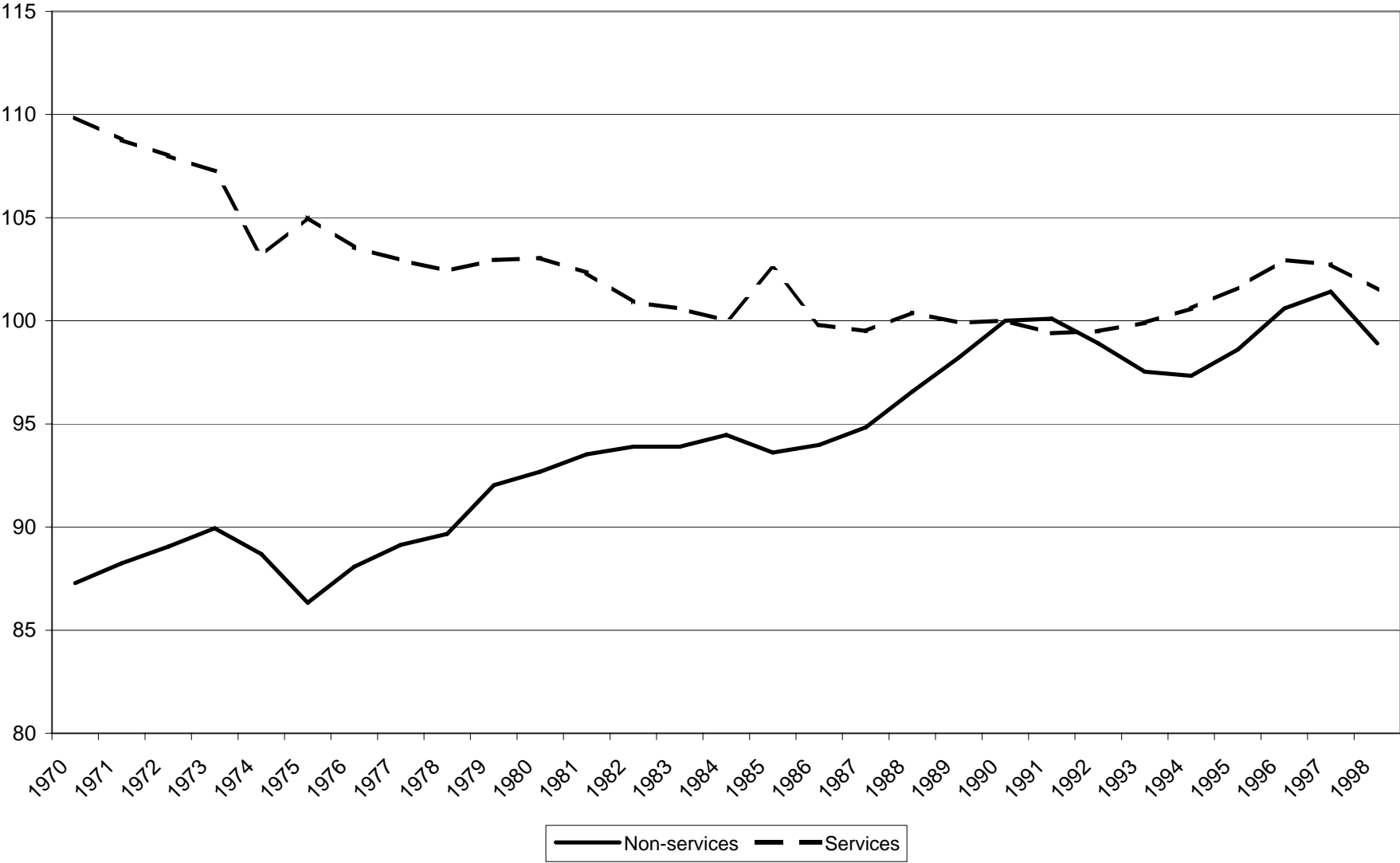


Figure 4: TFP in selected manufacturing sectors

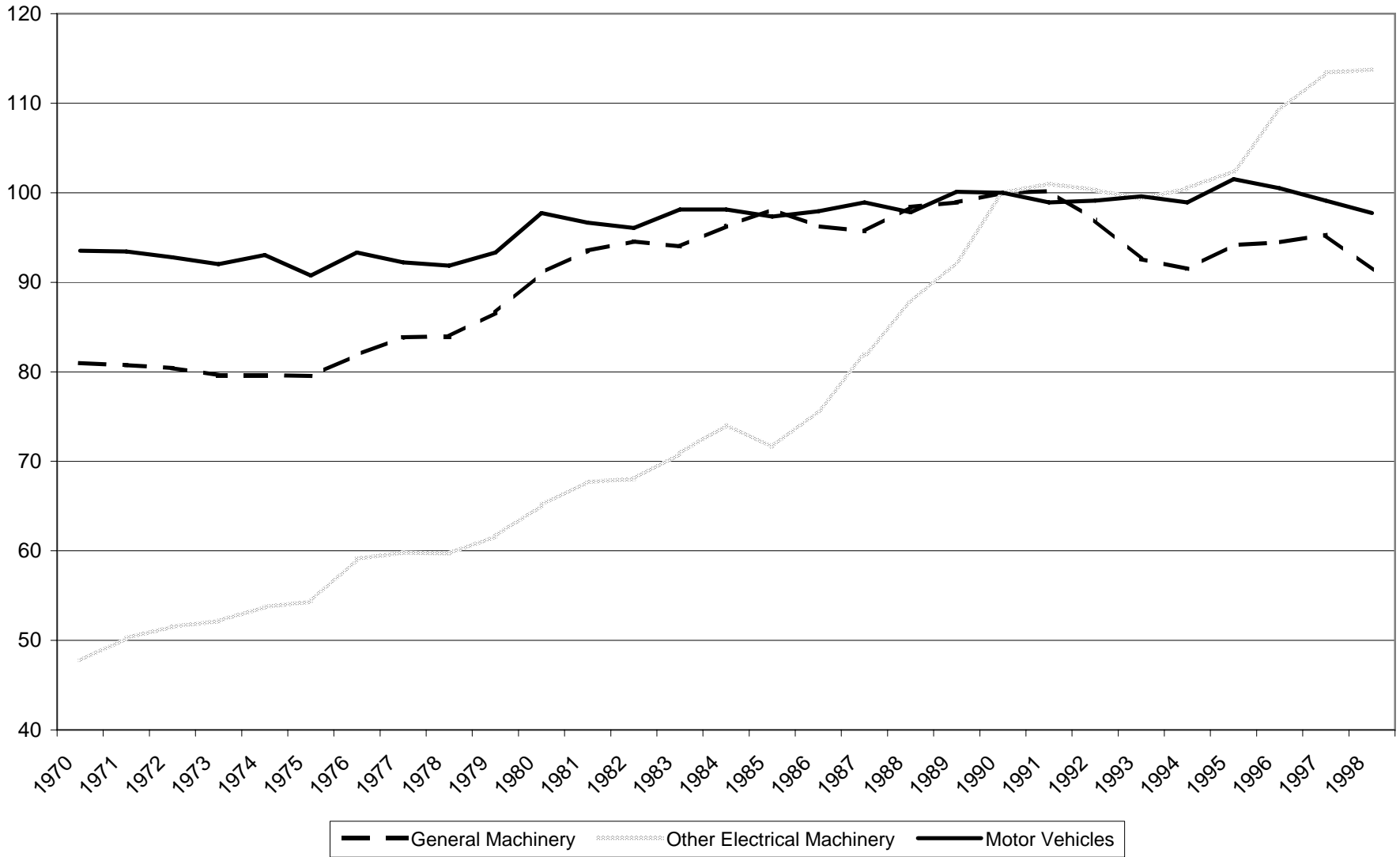


Figure 5: Real expenses in R&D detrended at 2 percent per year

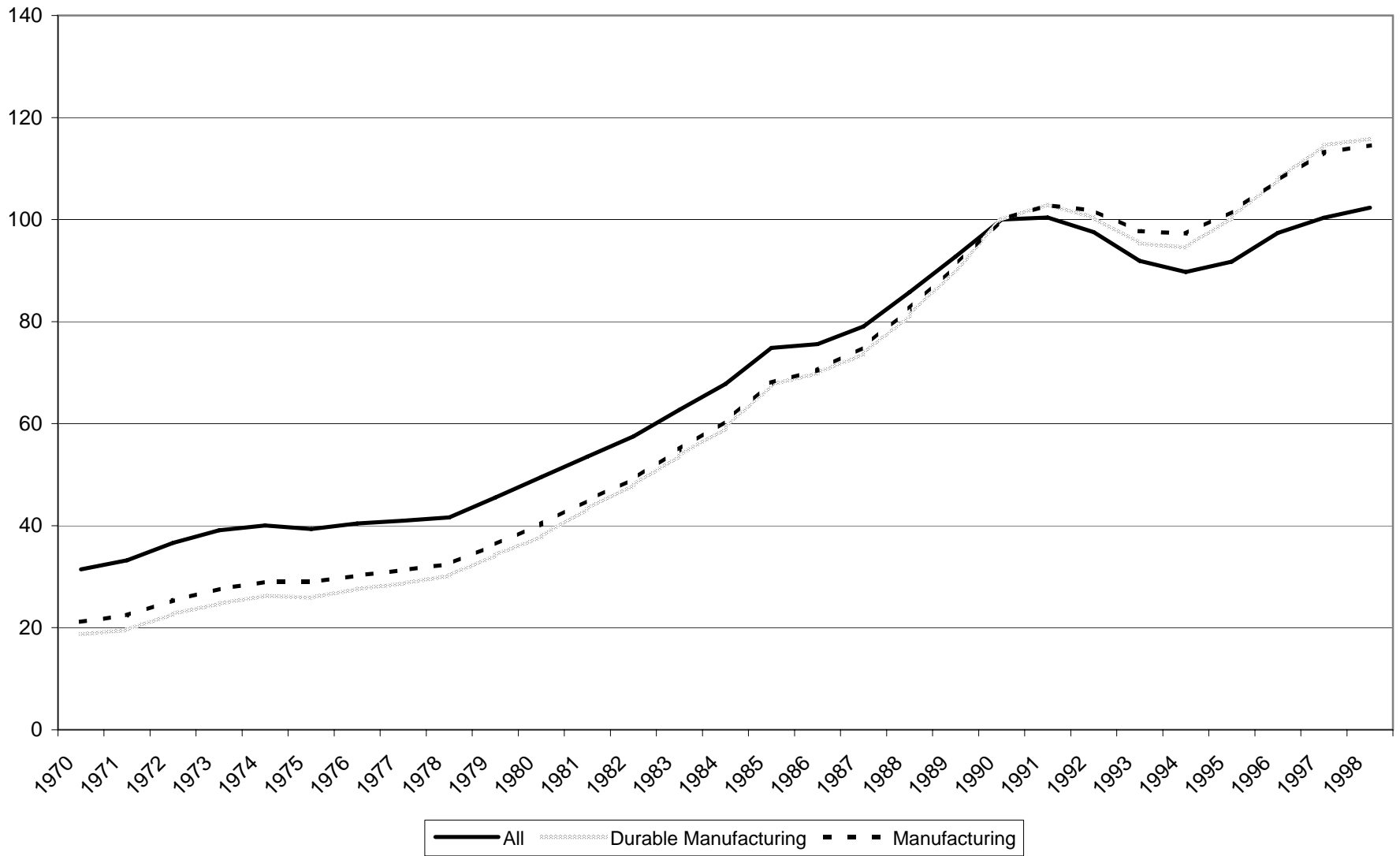


Figure 6: Real R&D Expenditures detrended at 2 percent

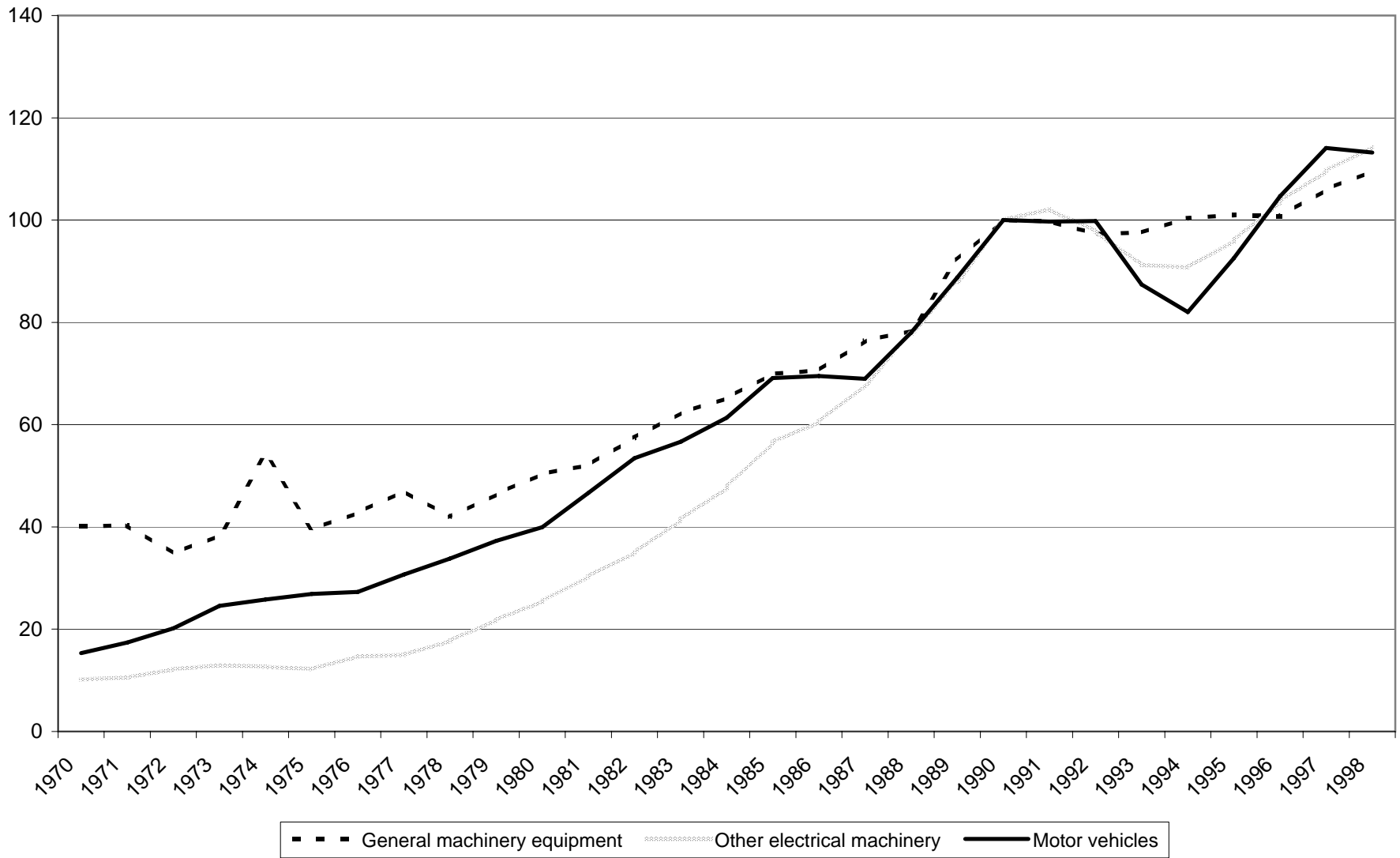


Figure 7: Real Wage rates

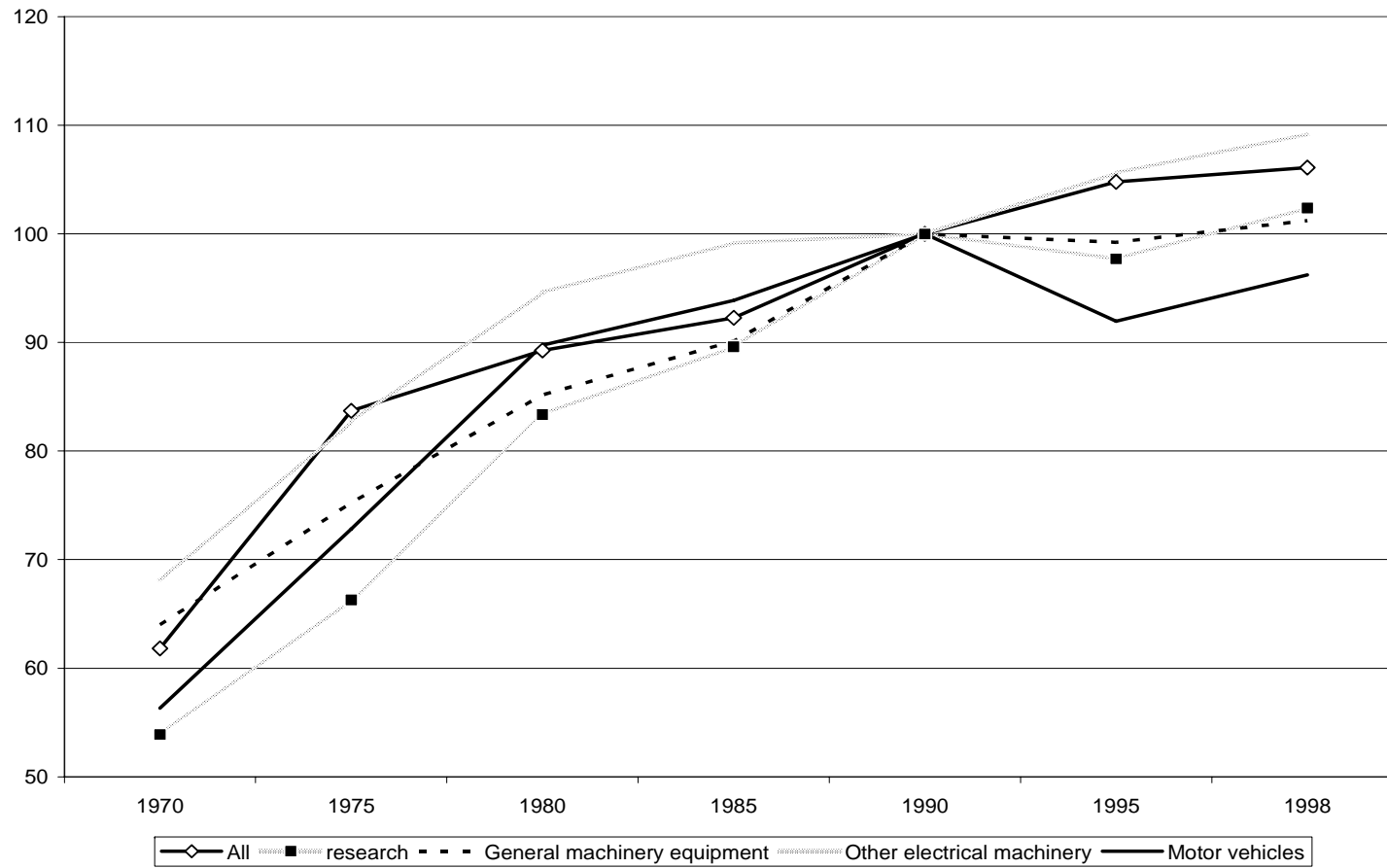


Figure 8: Computers per capita

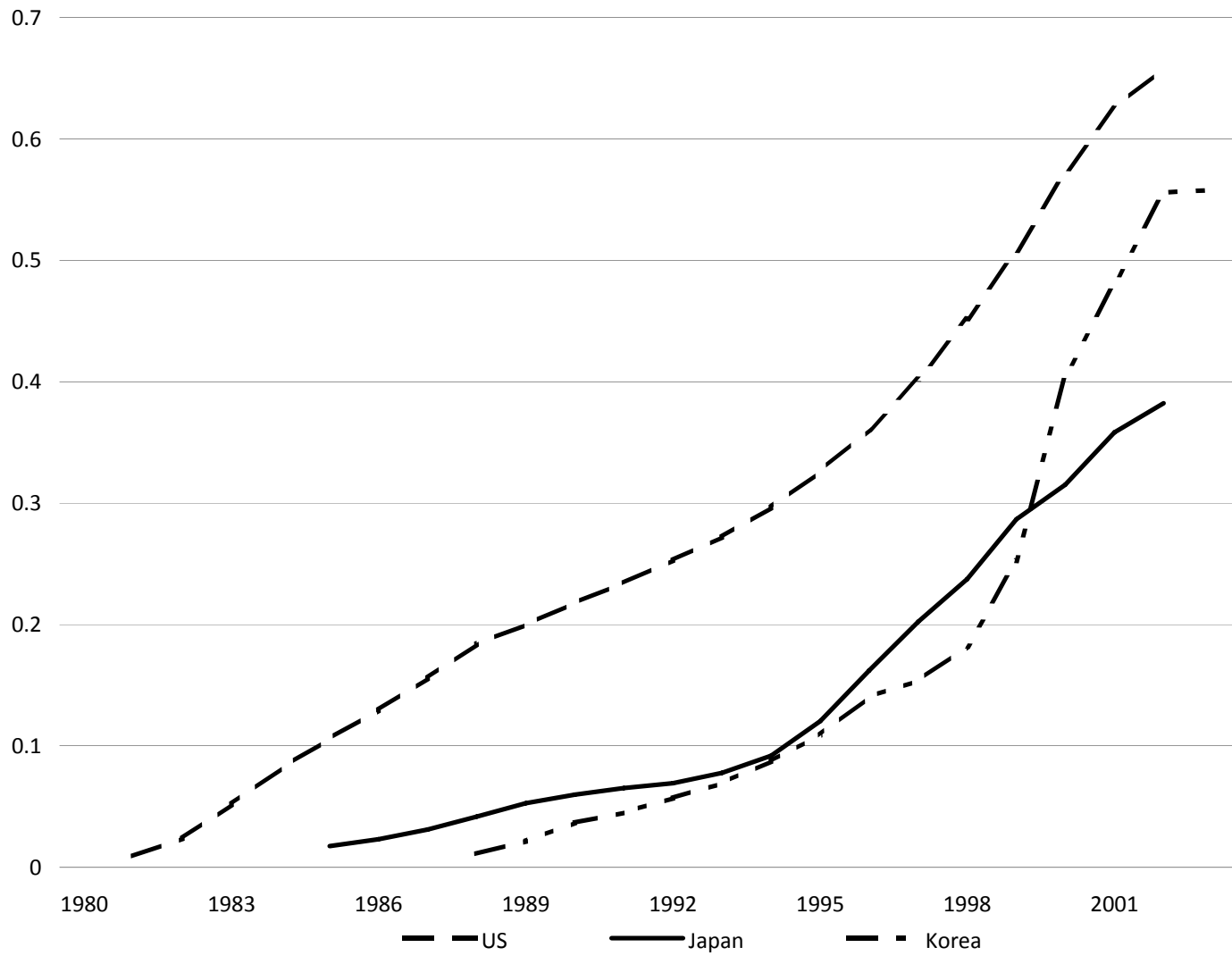


Figure 9: Internet Users per capita

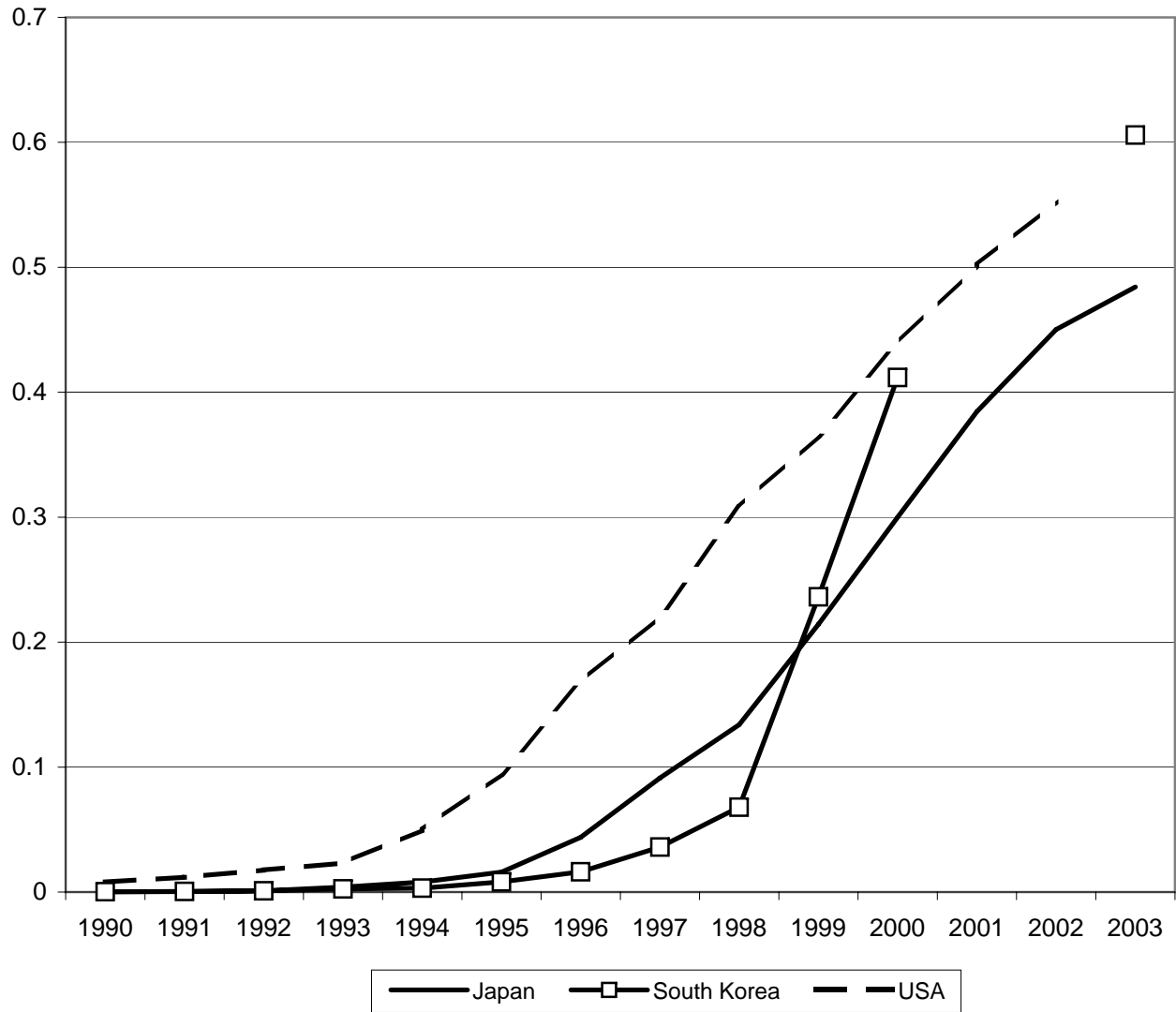


Figure 10: Yens per dollar

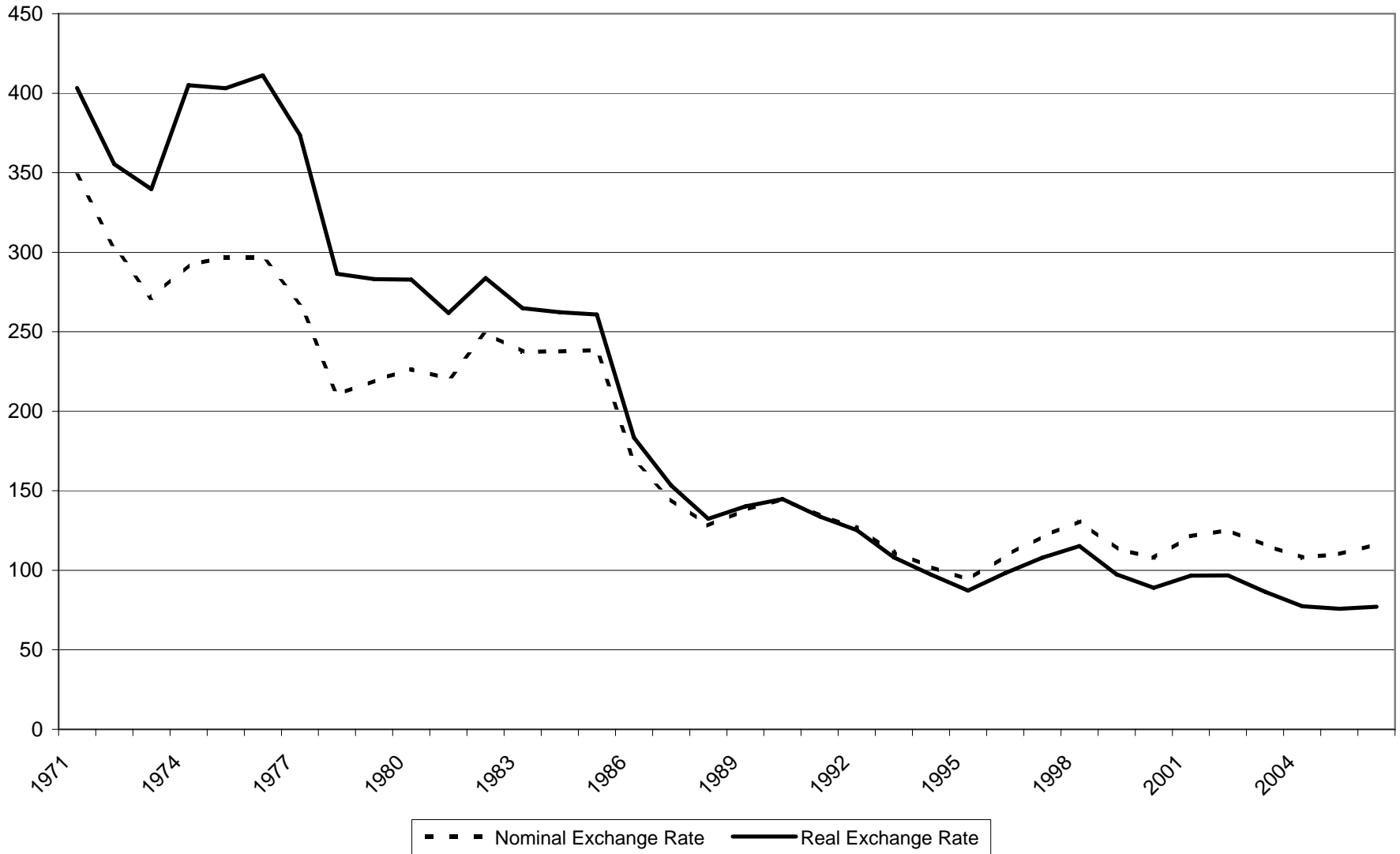


Figure 11: corporate operating surplus over GDP

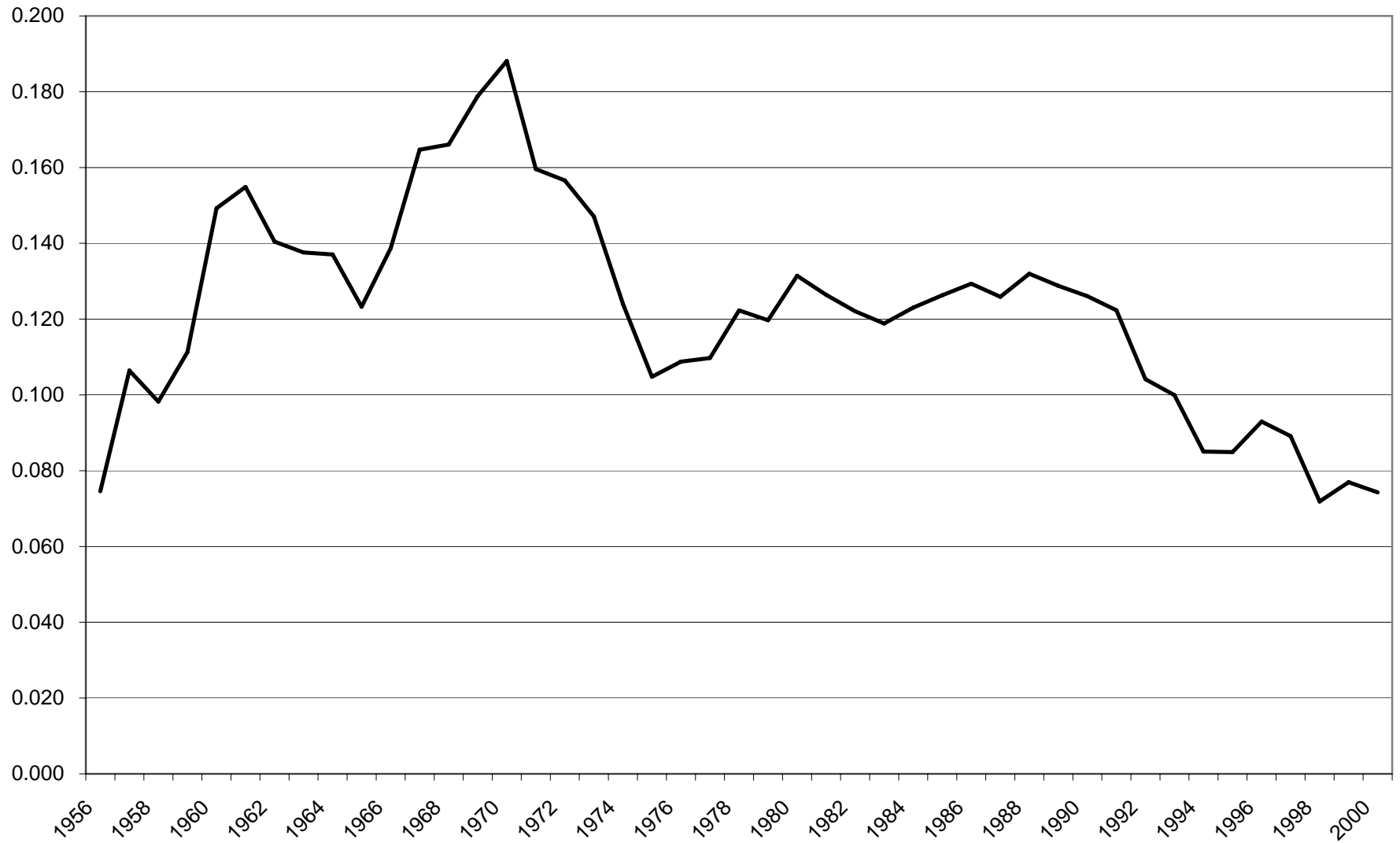


Figure 12: Operating income over gross output

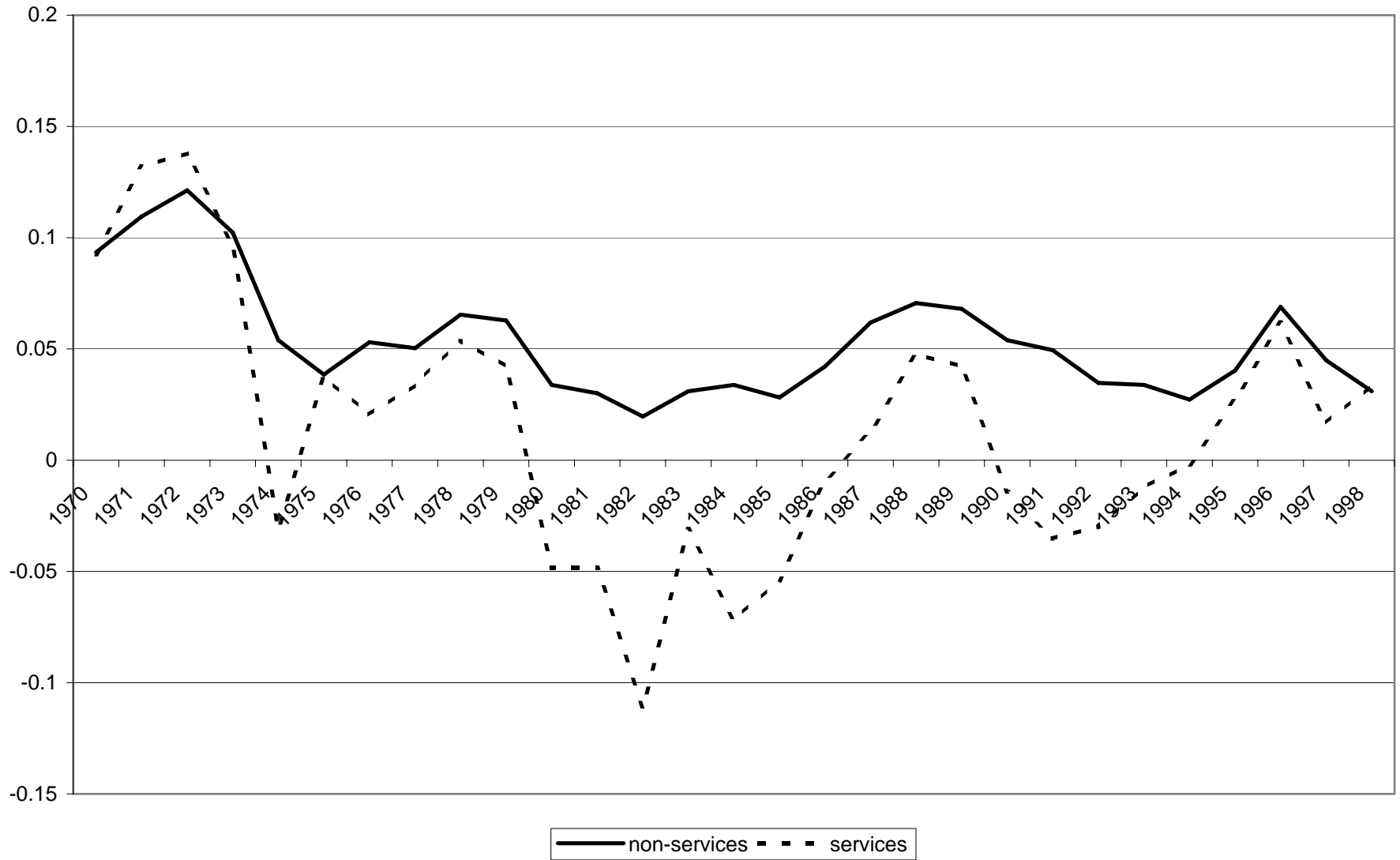


Figure 13: Employment Share in Durable Manufacturing



Figure 14: Employment Share in Motor Vehicles Manufacturing

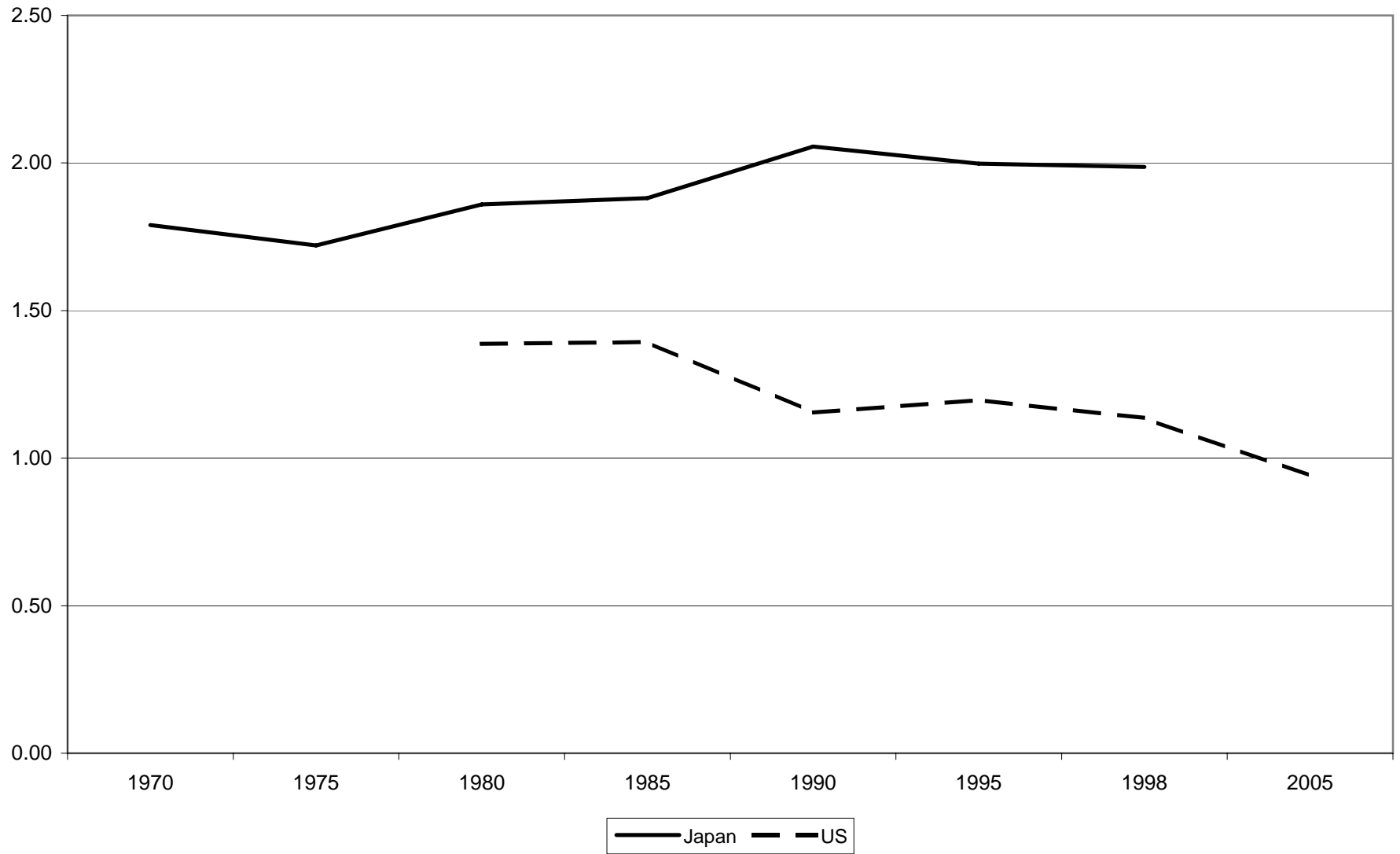


Figure 15: Markups and relative Japanese demand

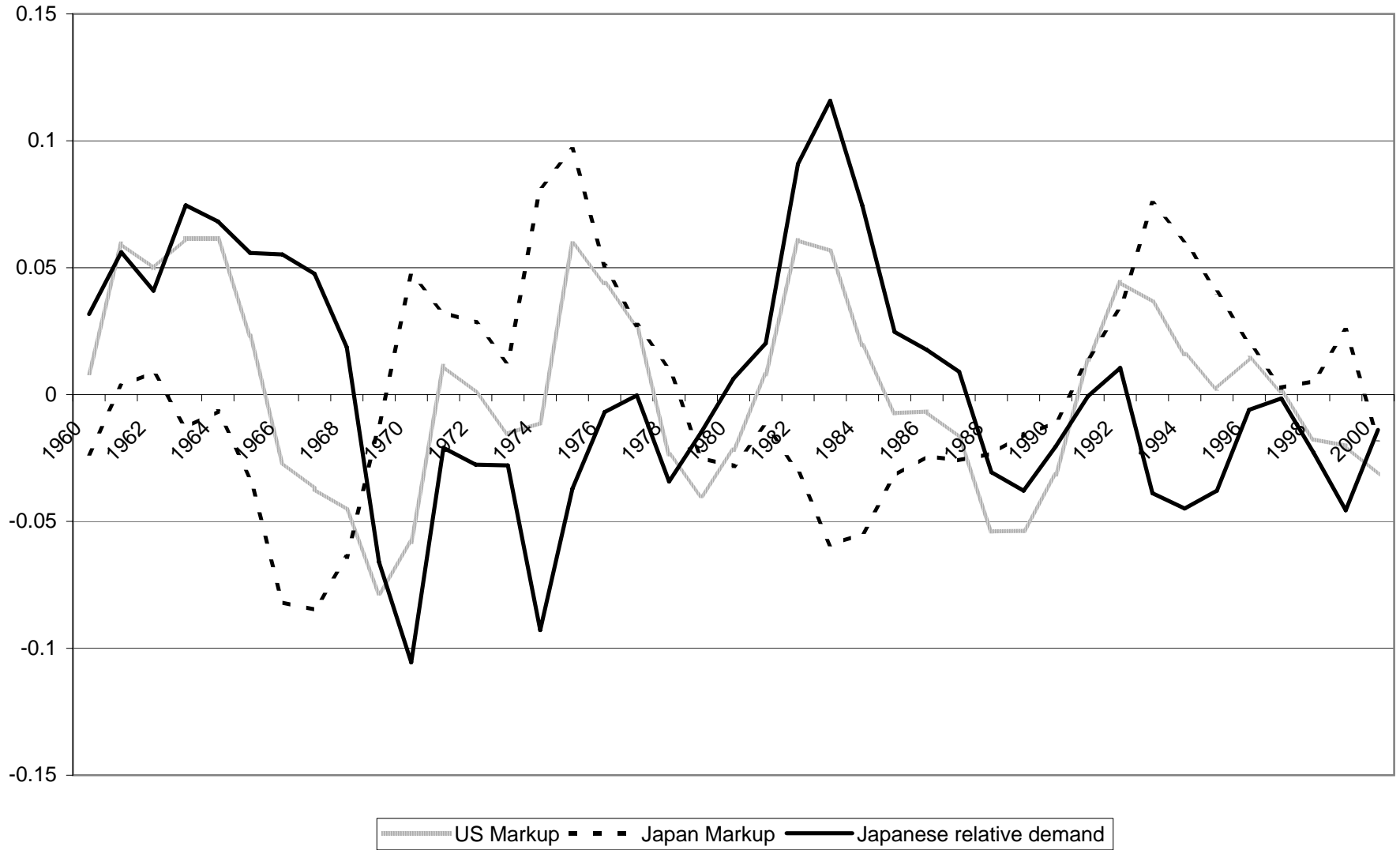


Table 1: Jobs outsourced as share of domestic employment in the sector

	<u>1987</u>	<u>1998</u>
Manufacturing	6.41	17.15
Durable Manufacturing	8.27	21.15
Motor Vehicles	10.46	35.65
General Machinery Equipment	2.90	8.88

Table 2: Determinants of the Yen-Dollar exchange rate

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<u>Dependent variable</u>	<u>Nominal Exchange Rate</u>	<u>Real Exchange Rate</u>
(log) TFP Japan	-3.28 (23.01)	-4.52 (27.11)
Japanese relative demand	1.11 (3.06)	0.82 (92.03)
N	30	30
R <sup>2</sup>	0.94	0.96

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Note: Confidence intervals computed with robust standard errors in parenthesis

# Model features

- ▶ Two asymmetric countries (i.e., the U.S. and Japan) that trade intermediate goods used to produce new capital.
- ▶ Endogenous development of these intermediate goods in both countries as in Comin and Gertler (2006).
- ▶ Endogenous determination of the range of intermediate goods that are suitable for export between the two countries.
- ▶ Endogenous transfer of production of intermediate goods between the two countries (i.e., FDI).
- ▶ Monopolistic competition in the production of final goods.

# Model - Production

$$Y_{ct} = \left[ \int_0^{N_{ct}} Y_{ct}(j)^{\frac{1}{\mu_{ct}}} dj \right]^{\mu_{ct}}$$

$$Y_{ct}(j) = (1 + g)^t (u_{cjt} K_{cjt})^\alpha L_{cjt}^{1-\alpha}$$

# Model - Investment

$$K_{ct} = (1 - \delta(U_{ct}))K_{ct-1} + J_{ct}$$

$$J_{ct} = \left( \int_0^{N_{ct}^K} J_{ct}(r)^{\frac{1}{\mu_{ct}^K}} dr \right)^{\mu_{ct}^K}$$

$$J_{ct}(r) = \left( \int_0^{A_{ct}} I_{ct}^r(s)^{\frac{1}{\theta}} ds \right)^{\theta}, \text{ with } \theta > 1.$$

$$A_{ct} = A_{ct}^I + A_{ct}^g + A_{ct}^T + A_{ft}^g + A_{ft}^T$$

$$A_{ct+1}^I(p) = \varphi_{ct} S_{ct}(p) + (1 - \phi)(1 - \lambda_{ct}^g) A_{ct}^I(p)$$

$$\varphi_{ct} = \chi A_{ct}^I \left( \frac{S_{ct}}{P_{ct}^I K_{ct}} \right)^{\rho-1} (P_{ct}^I K_{ct})^{-1}$$

$$(1 - \phi)R_{ct}^{-1}E_t v_{ct+1} - \frac{1}{\varphi_{ct}} = 0$$

$$v_{ct} = \max_{x_{ct}} \{ \pi_{ct} - x_{ct}^g + R_{ct}^{-1}(1 - \phi)E_t [\lambda_{ct}(\Gamma_{ct}^g x_{ct}^g)v_{ct+1}^g + (1 - \lambda_{ct}(\Gamma_{ct}^g x_{ct}^g))v_{ct+1}] \}$$

$$\lambda' > 0, \lambda'' < 0,$$

$$\Gamma_{ct}^g = \frac{b^g}{(P_{ct}^I K_{ct} / A_{ct}^I)}$$

# Exporting technology

$$1 = R_{ct+1}^{-1} \Gamma_{ct}^g (1 - \phi) \lambda'_{ct} (\Gamma_{ct}^g x_{ct}^g) (v_{ct+1}^g - v_{ct+1})$$

$$A_{ct}^g = (1 - \phi) \lambda_{ct-1}^g A'_{ct-1} + (1 - \phi) (1 - \lambda_{ct-1}^T) A_{ct-1}^g$$

$$v_{ct}^g = \max_{x_{ct}^g} \pi_{ct}^g - e_t x_{ct}^{T*} + R_{ct}^{-1} (1 - \phi) E_t [\lambda_{ct} (\Gamma_{ct}^T x_{*t}^T) v_{ct+1}^T + (1 - \lambda_{ct} (\Gamma_{ct}^T x_{*t}^T)) v_{ct+1}^g]$$

Motivation for FDI: penetrating foreign market

$$1 = R_{ct+1}^{-1} \Gamma_{ct}^T (1 - \phi) \lambda'_{ct} (\Gamma_{ct}^T x_{ct}^T) (v_{ct+1}^T - v_{ct+1}^g)$$

$$\Gamma_{ct}^T = \frac{b^T}{(P_{ct}^I K_{ct} / A_{ct}^g)}$$

$$v_{ct}^T = \pi_{ct}^T + R_{ct+1}^{-1} (1 - \phi) E_t v_{ct+1}^T$$

$$A_{ct}^T = (1 - \phi) \lambda_{ct-1}^T A_{ct-1}^g + (1 - \phi) A_{ct-1}^T$$

# Model - closing the economy

- ▶ Physical capital is not mobile
- ▶ There are two domestic bonds that can be held at a cost
- ▶ Shocks:
  - ▶ wage markup:  $\ln C_{ct} - \mu_{ct}^w \frac{(L_{ct})^{\zeta+1}}{\zeta+1}$
  - ▶ foreign competition:  $\pi_{ct}^I, \pi_{ct}^G, \pi_{ct}^T$
  - ▶ trade frictions:  $\delta_{ct}$ , Current account