The International Consequences of Bretton Woods' Capital Controls and the Value of Geopolitical Stability

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A New Take on Bretton Woods

- Thousands of studies (24,792 per Jstor) focusing on the effects of BW international economic controls on global economic activity
- BW was a huge package of controls ranging from fixed exchange rates to restrictions on international capital mobility
- Virtually all BW analysis focus exclusively on nominal exchange rate policies
  - relatively little to no analysis of impact of BW restrictions on international capital mobility
  - important open question since BW has been by far the largest experiment in imposing impediments to capital mobility

What we do and what we find

- We develop a GE multi-region model in which we analyze the positive and normative effects of BW impediments to international capital mobility on the world economy
- We find impediments to international capital mobility:
  - reduced world output by 0.6%
  - significantly reduced US welfare
  - increased Europe & RoW welfare
- We interpret U.S. welfare loss as cost of attempting to preserve international economic & political stability based on US international political goals during the cold war

Bretton Woods: Searching for International Economic Stability

- What was BW? Impediments to international capital mobility and fixed exchange rates
- Bretton Woods Goal: Stable postwar international economic system
- Main Actors: Harry Dexter White (rep US) & John Maynard Keynes (rep Europe)
- Worry that in absence of BW impediments that capital flight & volatile nominal exchange rates of the 1930's would return
- Worry that these factors would damage ally recoveries, LDC growth, international political stability

Challenges in modeling BW

- Complex from an institutional standpoint (created IMF and WB)
- Both nominal exchange rate controls and impediments to international capital mobility
- Given complexity, we apply international business cycle accounting to capture BW policies within one or more distortions
- We follow Chari, Kehoe and McGrattan (2007, closed economy) and Ohanian, Restrepo-Echavarria, and Wright (OREW, AER 2018, open economy)
- We show how BW exchange rate controls and international capital mobility impediments show up as a single distortion in one of the model's foc
- We can separately identify the role of international capital mobility impediments from fixed exchange rate effects from this distorted foc

The Model Economy I

Households:

Consider a world populated by three regions, indexed by j. The problem of region $j's$ representative household is to maximize:

$$E_0\left[\sum_{t=0}^{\infty}\beta^t\left\{\ln\left(\frac{C_{jt}}{N_{jt}}\right)-\frac{\varphi}{1+\gamma}h_{jt}^{1+\gamma}\right\}N_{jt}\right],$$

subject to a flow budget constraint for each state and date

$$\begin{aligned} & C_{jt}+P_{jt}^{K}K_{jt+1}+E_t\left[q_{t+1}B_{jt+1}\right] \\ \leq\ & \left(1-\tau_{jt}^{h}\right)W_{jt}h_{jt}N_{jt}+\left(1-\tau_{jt}^{K}\right)\left(r_{jt}^{K}+P_{jt}^{*K}\right)K_{jt} \\ & +\left(1-\tau_{jt}^{B}+\Psi_{jt}\right)B_{jt}+T_{jt}+\Pi_{jt} \end{aligned}$$

The Model Economy II

Consumption Goods Sector:

- Hire labor and capital and produce according to a Cobb-Douglas production function

Investment Goods Sector:

- Produce new capital K_{jt+1} using I_{jt} deferred consumption and K_{jt} old capital goods to maximize profits

$$P_{jt}^{K}\left[(1-\delta)K_{jt}+I_{jt}-\phi\left(\frac{I_{jt}}{K_{jt}}\right)K_{jt}\right]-I_{jt}-P_{jt}^{*K}K_{jt}$$

Resource constraint:

$$\sum_{j}\{C_{jt}+I_{jt}+G_{jt}\}=\sum_{j}A_{jt}K_{jt}^{\alpha}\left(h_{jt}N_{jt}\right)^{1-\alpha}$$

Evolution of Uncertainty

- U.S. population and productivity evolve exogenously

$$\begin{aligned} \ln N_{Ut+1} &= \ln \eta_{ss} + \ln N_{Ut} + \sigma_U^N \varepsilon_{Ut}^N \\ \ln A_{Ut+1} &= \ln \pi_{ss} + \ln A_{Ut} + \sigma_U^A \varepsilon_{Ut}^A \end{aligned}$$

  with Europe and RoW relative to U.S.

$$N_{jt} = n_{jt} N_{Ut} \text{ and } A_{jt} = a_{jt} A_{Ut}$$

- All other taxes/controls $m = G, K, L, B$, univariate AR(1)'s

$$\ln\left(1-\tau_{jt+1}^m\right) = \left(1-\rho_j^m\right)\ln\left(1-\tau_{jSS}^m\right) + \rho_j^m \ln\left(1-\tau_{jt}^m\right) + \sigma_j^m \varepsilon_{jt}^m$$

Stationarity

- Scale all variables by stochastic trend in "effective population"

$$Z_t = A_{Ut}^{1/(1-\alpha)} N_{Ut}$$

  - After detrending, stationary AR(1) on

$$\pi_t = a_{Ut} = \frac{A_{Ut}}{A_{Ut-1}} \text{ and } \eta_t = n_{Ut} = \frac{N_{Ut}}{N_{Ut-1}}$$

- To achieve stationarity in long run relative consumptions
  - no capital controls in long-run: $\tau_{jSS}^B = 0$
  - mean reversion in relative consumption levels through

$$\Psi_{jt} = \left(1 - \tau_{jt}^B\right) \left[\left(\frac{C_{jt}/N_{jt}}{C_{Rt}/N_{Rt}} \frac{1}{\psi_{j0}} \right)^{-\psi_{j1}} - 1 \right]$$

Optimality Conditions

- Labor/leisure condition

$$\left(1-\tau_{jt}^{h}\right) W_{jt} \frac{N_{jt}}{C_{jt}} = \varphi h_{jt}^{\gamma}$$

- Euler equation for domestic capital

$$1 = E_t \left[\beta \frac{C_{jt}/N_{jt}}{C_{jt+1}/N_{jt+1}} \left(1-\tau_{jt+1}^{K}\right) \frac{r_{jt+1}^{K} + P_{jt+1}^{*K}}{P_{jt}^{K}} \right]$$

- Euler equation for state-contingent international assets

$$\frac{C_{jt+1}/N_{jt+1}}{C_{jt}/N_{jt}} = \frac{\beta}{q_{t+1}} \left(1-\tau_{jt+1}^{B}+\Psi_{jt}\right)$$

What about exchange rate effects on capital flows?

A model with non-tradable goods, everything else the same

Households:

Extending Backus and Smith (1993), the problem of region $j's$ representative household is to maximize:

$$E_0\left[\sum_{t=0}^{\infty}\beta^t\left\{\ln\left(\frac{C_{jt}}{N_{jt}}\right)-\frac{\psi}{1+\gamma}h_{jt}^{1+\gamma}\right\}N_{jt}\right],$$

subject to a flow budget constraint for each state and date

$$\begin{aligned} & X_{jt}+P_{jt}^{D}D_{jt}+P_{jt}^{K}K_{jt+1}+E_t\left[q_{t+1}B_{jt+1}\right] \\ \leq\ & \left(1-\tau_{jt}^{h}\right)W_{jt}h_{jt}N_{jt}+\left(1-\tau_{jt}^{K}\right)\left(r_{jt}^{K}+P_{jt}^{*K}\right)K_{jt} \\ & +\left(1-\tau_{jt}^{B}+\Psi_{jt}\right)B_{jt}+T_{jt}+\Pi_{jt}+P_{jt}^{D}Y_{jt}^{D} \end{aligned}$$

where $C_{jt}=\left[\alpha X_{jt}^{\rho}+(1-\alpha)D_{jt}^{\rho}\right]^{1/\rho}$

Open economy distortions: model with and without exchange rates

- In the benchmark model the Euler equations for state-contingent assets imply:

$$\underbrace{\left(\frac{C_{jt+1}/N_{jt+1}}{C_{Rt+1}/N_{Rt+1}}\right)\left(\frac{C_{Rt}/N_{Rt}}{C_{jt}/N_{jt}}\right)}_{\textit{International capital controls}} = \frac{1-\tau^{B}_{jt}+\Psi_{jt}}{1-\tau^{B}_{Rt}+\Psi_{Rt}} = \zeta^{B}_{jt+1}$$

- In the model with non-traded goods the Euler equations for state-contingent assets imply:

$$\underbrace{\left(\frac{C_{jt+1}/N_{jt+1}}{C_{Rt+1}/N_{Rt+1}}\right)\left(\frac{C_{Rt}/N_{Rt}}{C_{jt}/N_{jt}}\right)}_{\textit{International capital controls}}\underbrace{\left(\frac{P_{jt+1}/P_{Rt+1}}{P_{jt}/P_{Rt}}\right)}_{\textit{Exchange rate effects}} = \zeta^{NTB}_{jt+1}$$

  where the exchange rate can be defined as $Q_{jRt} = \frac{P_{jt}}{P_{Rt}}$

- International distortion is multiplicatively separable between the capital mobility component and the exchange rate component

The effects of capital controls vs exchange rates on capital flows

- We can quantify the contribution of capital mobility impediments and real exchange rate effects:

$$\underbrace{\left(\frac{C_{jt+1}/N_{jt+1}}{C_{Rt+1}/N_{Rt+1}}\right)\left(\frac{C_{Rt}/N_{Rt}}{C_{jt}/N_{jt}}\right)}_{\textit{International capital controls}}\underbrace{\left(\frac{Q_{jRt+1}}{Q_{jRt}}\right)}_{\textit{Exchange rate effects}} = \zeta_{jt+1}^{NTB}$$

- One issue - are the two uncorrelated?
- It turns out they are!
  - regressing the log of international capital controls on the log of real exchange rate effects returns an R-squared of roughly zero
- This allows us to focus on the model without non-traded goods where the international distortion is fully identified by international capital controls

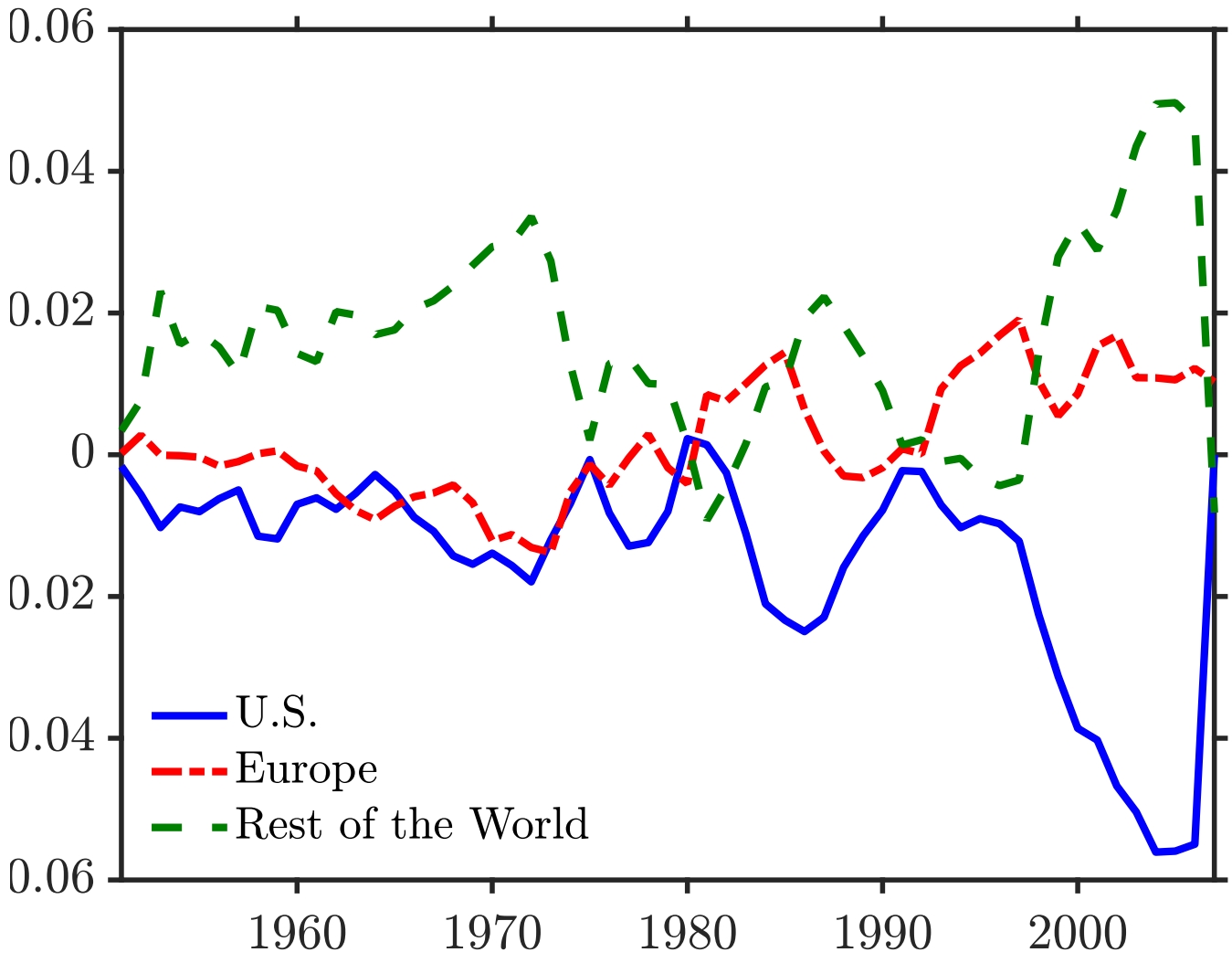
Data and Regions

- Countries that are market economies from 1950 onwards:
  - United States
  - Europe: Austria, Belgium, Denmark, Luxembourg, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland, Turkey, UK
  - RoW: Japan, Korea, Taiwan, Hong Kong, Singapore, Canada, Australia, New Zealand, Iceland, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, Costa Rica
  - omitted countries include command economies (China, USSR), and those with data availability issues (India, Africa)
- Our data includes roughly 75% of world GDP as of 1950
- Data sources: OECD, WDI, WTESI, supplemented by Mitchell (2001) and other country specific sources
- Data: output, consumption, hours worked, investment, population, net-exports (capital flows)

Quantitative Methodology

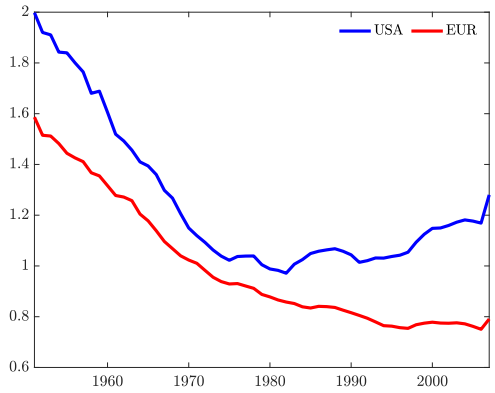
- Log-linear approximation around steady state (2nd order for welfare)
- Set parameters governing preferences, production, adjustment costs Calibration
- Kalman-Filter to calculate the likelihood and recover distortions
- Maximum Likelihood Estimation for unknown parameters Estimation
- Benchmark results fully account for output, consumption, hours, investment, population, and net-exports

Direction and size of Capital Flows (NX % GDP)

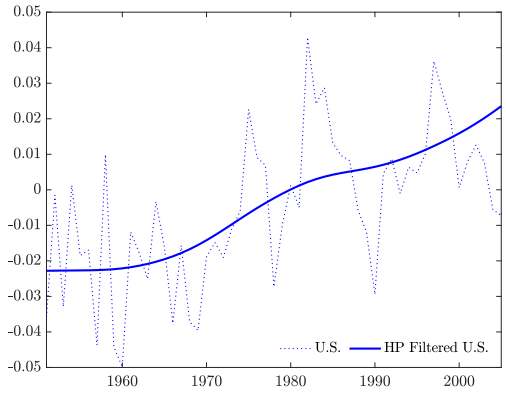


Relative Consumptions and Capital Controls

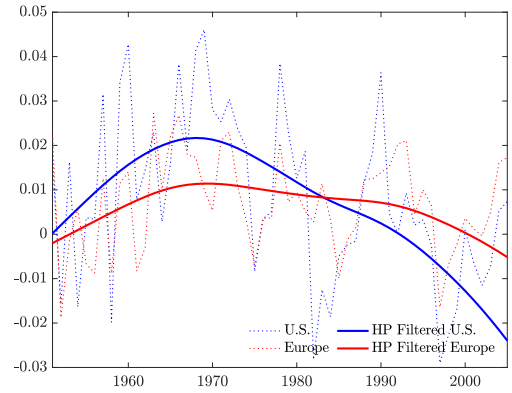
Relative Consumption



Per Capita Relative Consumption Growth



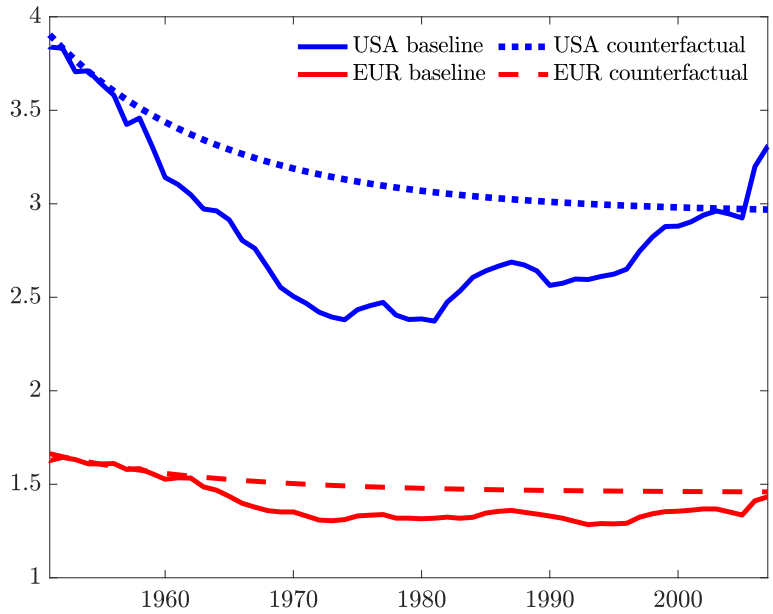
Capital Controls (τ_{jt}^{B})



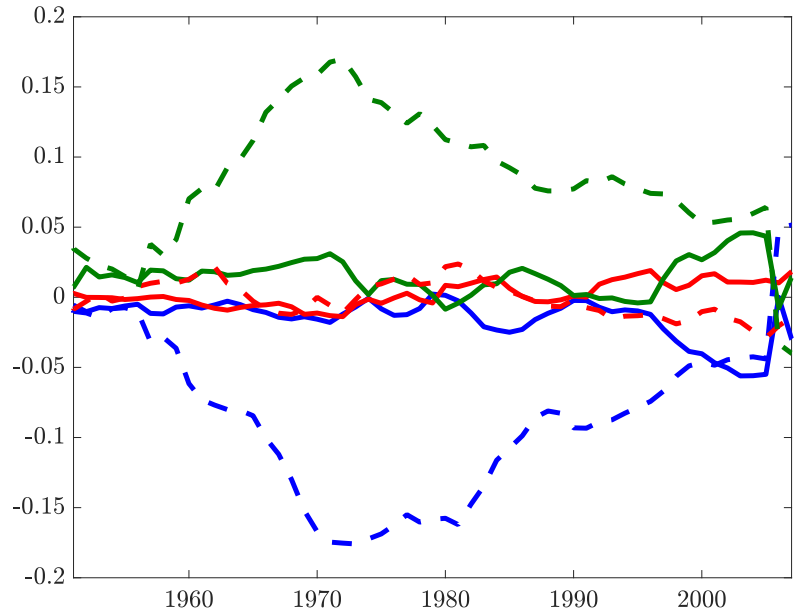
- Large differences in consumption growth indicate countries facing very different intertemporal prices and large impediments to intertemporal trade
- A decreasing or low τ_B encourages capital inflows/deters capital outflows
- An increasing or high τ_B deters capital inflows/encourages capital outflows
- Counterfactual exercise: remove impediments to international capital mobility $\left(\tau_{jt}^{B} = 0\right)$ Capital Controls

Capital Flows in the Absence of Capital Controls

Relative consumption per-capita



Capital flows

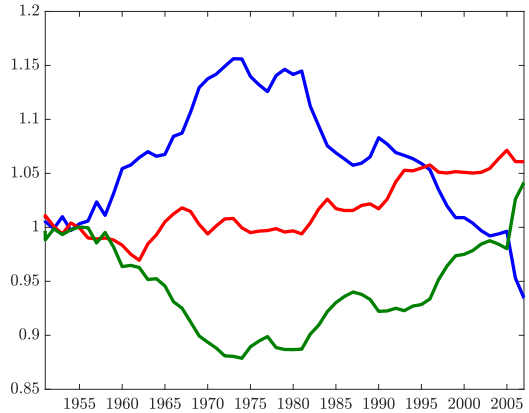


Magnitude of historically observed capital flows:

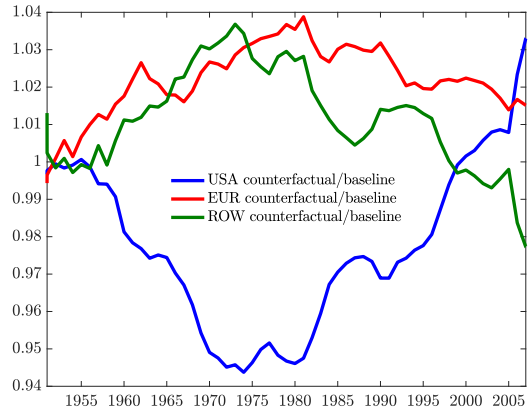
- Average around 4% in late 19th century rising to 7% pre WW1.
- Argentina 18.7% in late 1870s
- Finland 14.2% 1914-1918
- Australia 12.8% 1927-31
- France 11.7% 1919-1926
- Italy 11.7% 1914-1918

Counterfactual: how capital controls affected the world economy

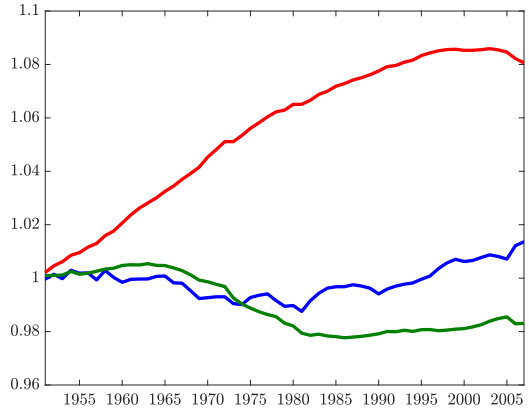
Consumption



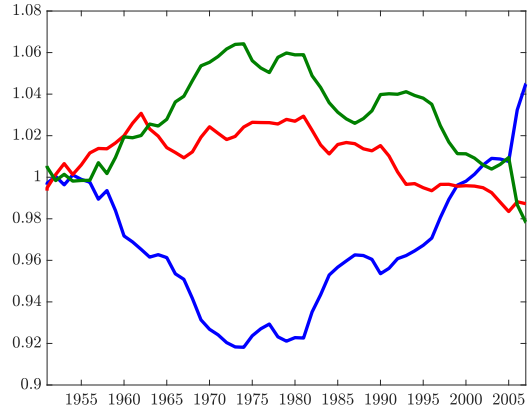
Output



Capital

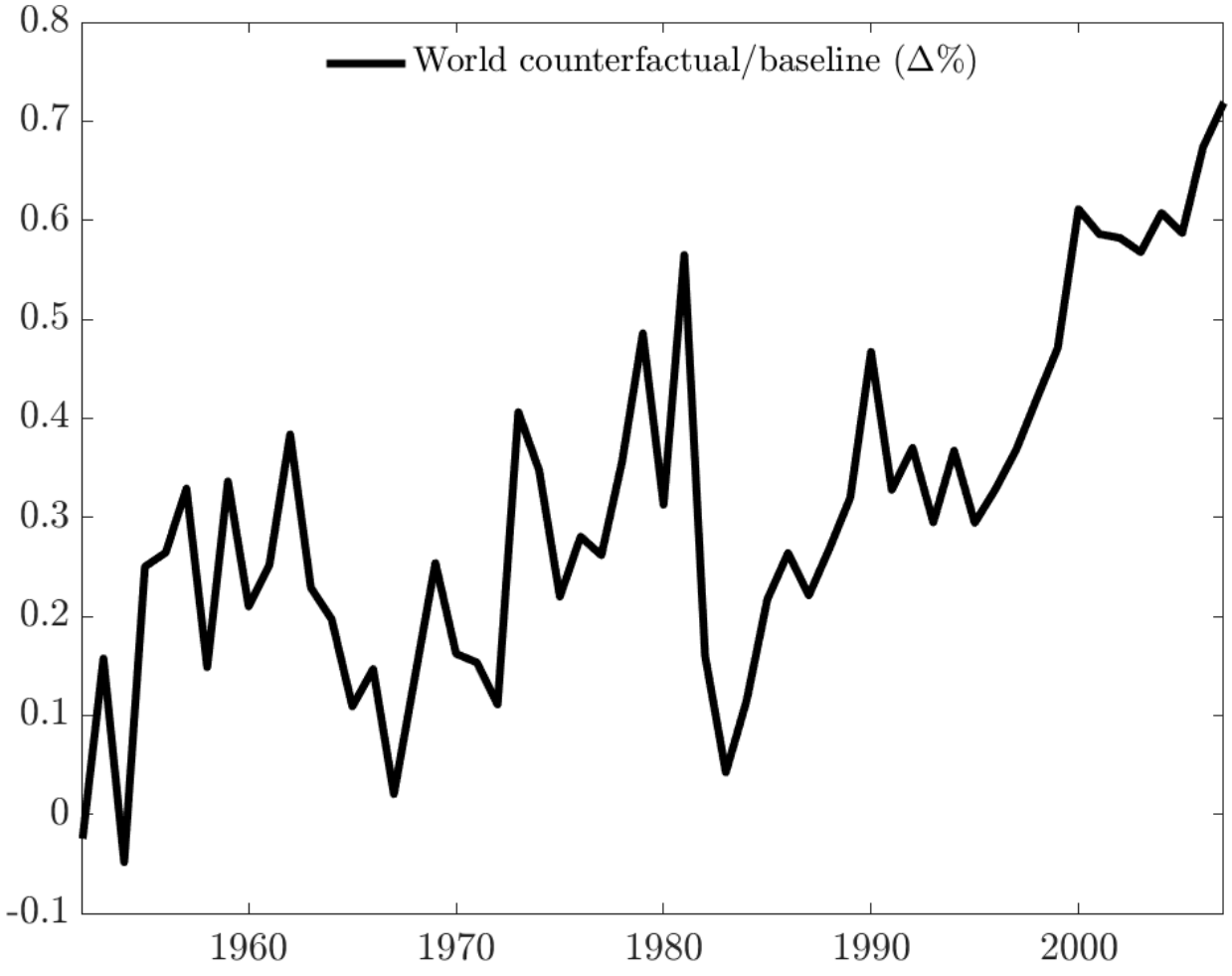


Hours



Labor Wedge

Output Effects of Capital Controls



The Welfare Effects of Capital Controls

Region	Consumption Equivalent
U.S.	-4.44%
Europe	1.33%
Rest fo the World	4.54%

U.S. International Economic & Political Goals

- Promote ally reconstruction, LDC growth, support friendly governments
- Prevent hostiles (Nazis first, Soviets later) from influencing other countries
- U.S. viewed international capital markets prone to crises
- Crises drain capital, depress growth, create political instability
- Controls to keep capital in these countries

Impediments to international capital mobility Imposed Huge Welfare Cost on U.S.

- Why did U.S. want these?
  - Our Thesis: U.S. willing to pay to prevent capital flight & crises
- Our findings interpreted as an estimate of the perceived value of controls
- Supported broader, expensive international policy agenda
- But this has been overlooked in almost all open economy post-WW II studies
- Integrating political economy and defense goals into international models may shed new light on policy choices and their effects.

Common Parameters

Parameter	Notation	Value
Preferences		
Discount Factor	β	0.96
Frisch Elasticity of Labor Supply	$1/\gamma$	2/3
Preference for Leisure	φ	1
Production		
Output Elasticity of Capital	α	0.36
Depreciation Rate	δ	0.07
Adjustment Cost Size	ν	5.5
Adjustment Cost Reference Level	κ	0.09

back

Estimated Parameters

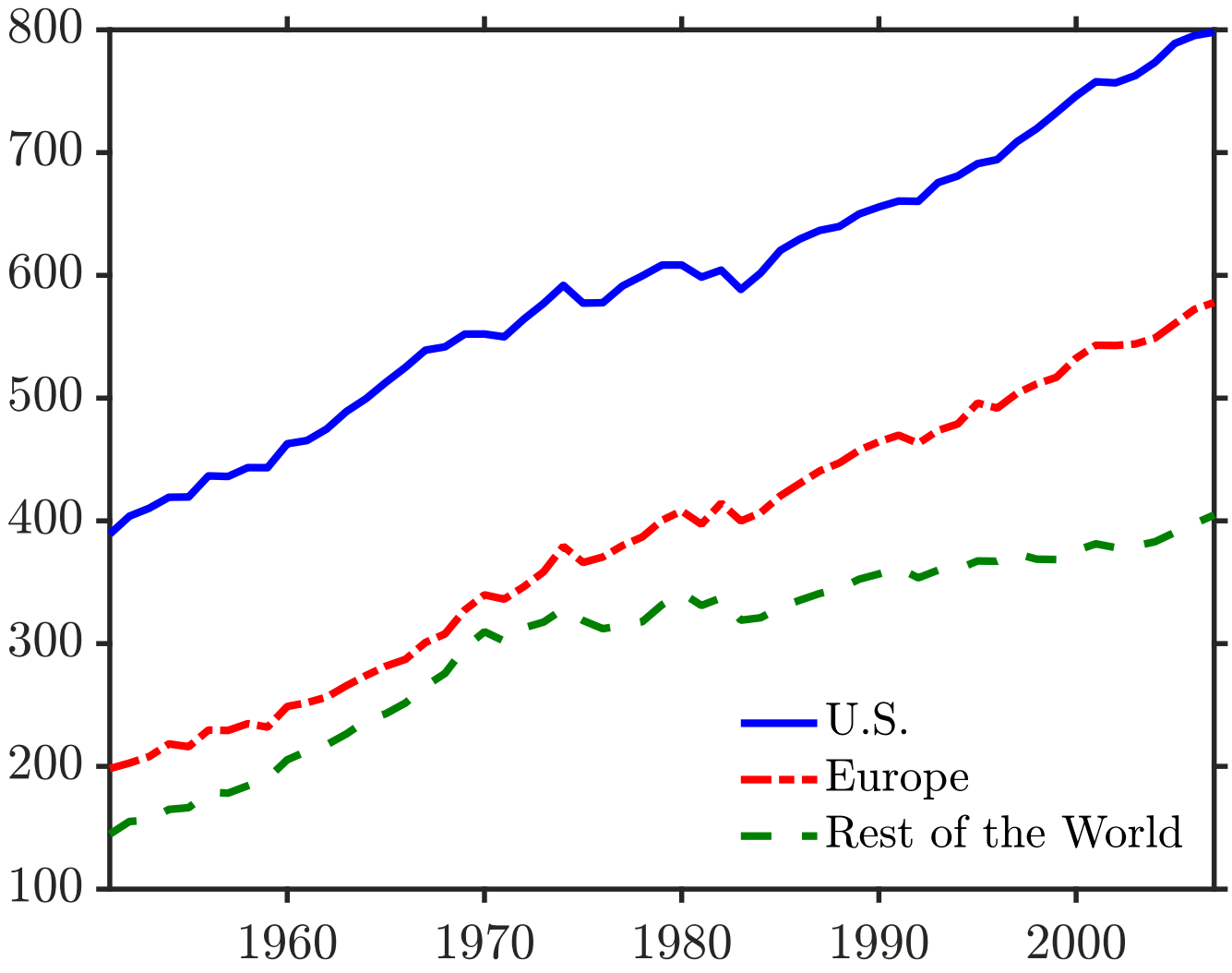
Table 1: Country Specific Parameter Values

Process	Region	Steady State	Persistence	Standard Deviation
Population	United States	$\eta_{ss} = 0.84$	$\rho^n_U = 1^{**}$	$\sigma^n_U = 0.003$
	Europe	$n_{Ess} = 0.77$	$\rho^n_E = 0.99$	$\sigma^n_E = 0.002$
	Rest of World	$n_{Rss} = 0.82$	$\rho^n_R = 0.98$	$\sigma^N_R = 0.003$
Productivity	United States	$\pi_{ss} = 1.01^{**}$	$\rho_\pi = 1^{**}$	$\sigma_\pi = 0.08^{*}$
	Europe	$a_{Ess} = 0.74^{*}$	$\rho^a_E = 0.99^{*}$	$\sigma^a_E = 0.02^{*}$
	Rest of World	$a_{Rss} = 0.52^{*}$	$\rho^a_R = 0.99^{*}$	$\sigma^a_R = 0.03^{*}$
Government Wedge	United States	$g_{Uss} = 0.18$	$\rho^g_U = 0.94$	$\sigma^g_U = 0.03$
	Europe	$g_{Ess} = 0.20$	$\rho^g_E = 0.20$	$\sigma^g_E = 0.03$
	Rest of World	$g_{Rss} = 0.13$	$\rho^g_R = 0.13$	$\sigma^g_R = 0.10$
Labor Wedge	United States	$\tau^h_{Uss} = 1.93$	$\rho^h_U = 0.99^{*}$	$\sigma^h_U = 0.04^{*}$
	Europe	$\tau^h_{Ess} = 1.91$	$\rho^h_E = 0.99^{*}$	$\sigma^h_E = 0.03^{*}$
	Rest of World	$\tau^h_{Rss} = 1.79$	$\rho^h_R = 0.99^{*}$	$\sigma^h_R = 0.02^{*}$
Capital Wedge	United States	$\tau^k_{Uss} = 0.94$	$\rho^K_U = 0.99^{*}$	$\sigma^K_U = 0.03^{*}$
	Europe	$\tau^k_{Ess} = 0.94$	$\rho^h_U = 0.99^{*}$	$\sigma^K_U = 0.27^{*}$
	Rest of World	$\tau^k_{Rss} = 0.98$	$\rho^h_R = 0.99^{*}$	$\sigma^K_R = 0.01^{*}$
International Wedge	United States	$\tau^B_{Uss} = 2.95^{**}$	$\rho^B_U = 0.93$	$\sigma^B_U = 0.02$
	Europe	$\tau^B_{Ess} = 1.46^{**}$	$\rho^B_E = 0.93$	$\sigma^B_E = 0.01$
Portfolio Tax	United States	$\psi_{U0} = -0.08$	$1-\psi_{U1} = 0.94$	—
	Europe	$\psi_{E0} = -0.04$	$1-\psi_{E1} = 0.97$	—

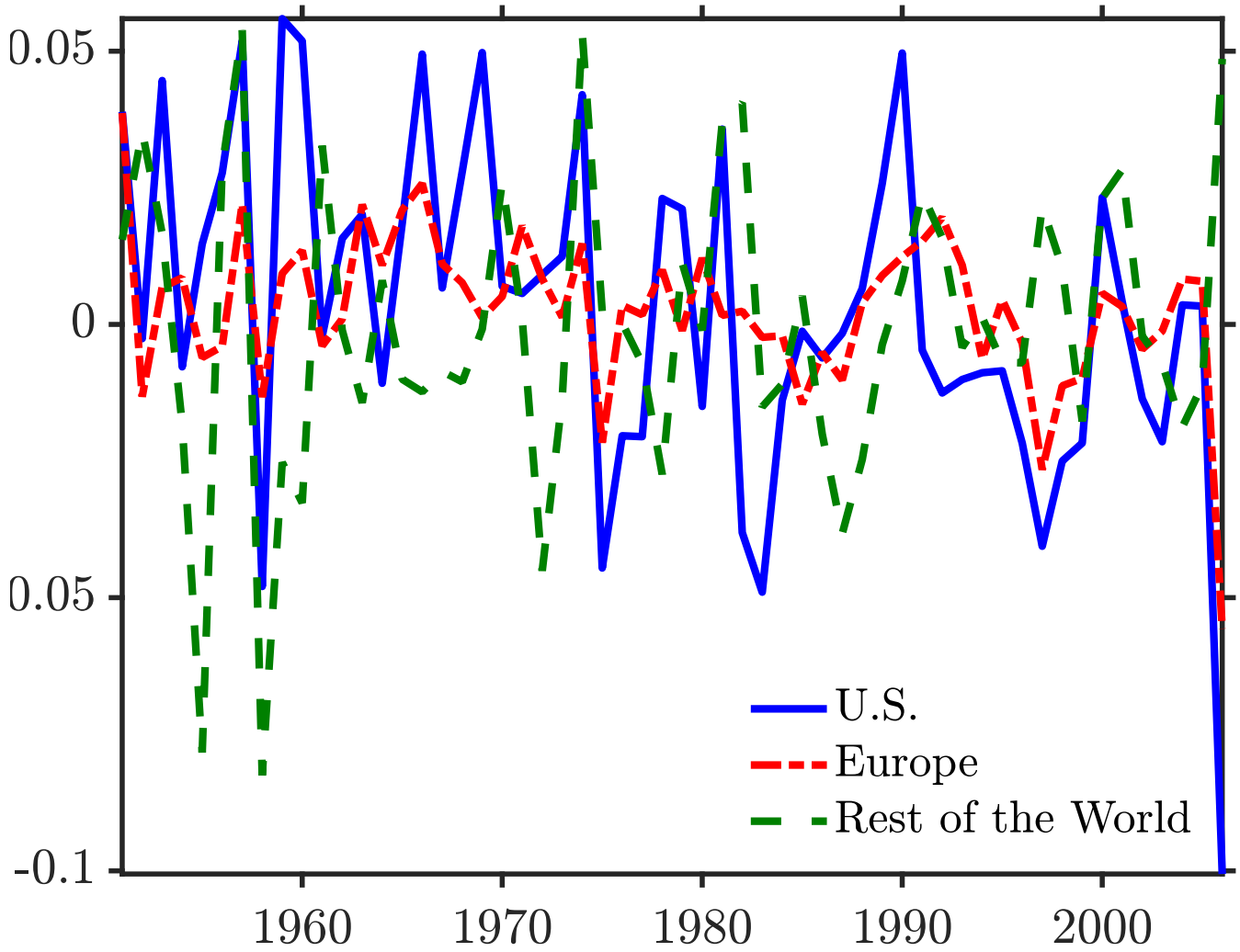
Notes: * denotes parameter is estimated inside the model; ** denotes the parameter is set by assumption; all other parameters are estimated, or calibrated to match some feature of the data, outside the model; "—" denotes "Not Applicable". Appendix C contains more details on the estimation procedures.

back

Productivity



Distortions in Domestic Capital Markets



Pseudo-Planners Problem

The planner maximizes:

$$E_0\left[\sum_j \sum_{t=0}^{\infty} \chi_{jt}^C \beta^t \left\{\ln\left(\frac{C_{jt}}{N_{jt}}\right) - \chi_{jt}^H \frac{\psi}{1+\gamma} h_{jt}^{1+\gamma}\right\} N_{jt}\right],$$

subject to a resource constraint for each state and date

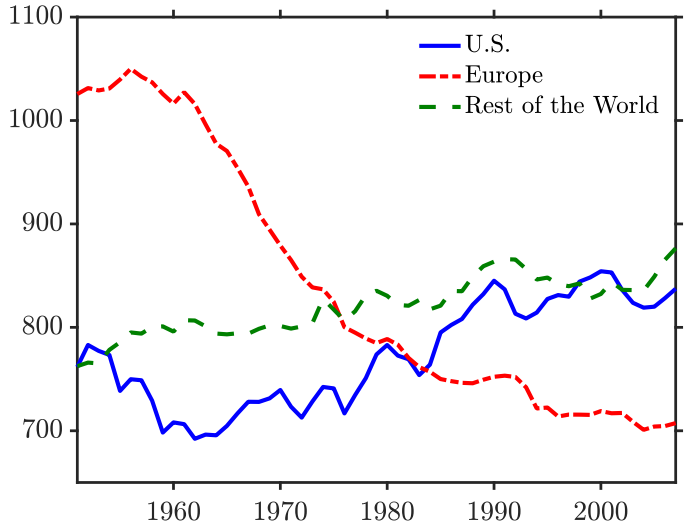
$$\sum_j \left\{C_{jt} + \chi_{jt}^I X_{jt} + G_{jt}\right\} = \sum_j A_{jt} K_{jt}^{\alpha} \left(h_{jt} N_{jt}\right)^{1-\alpha}$$

and capital evolution equations of the form

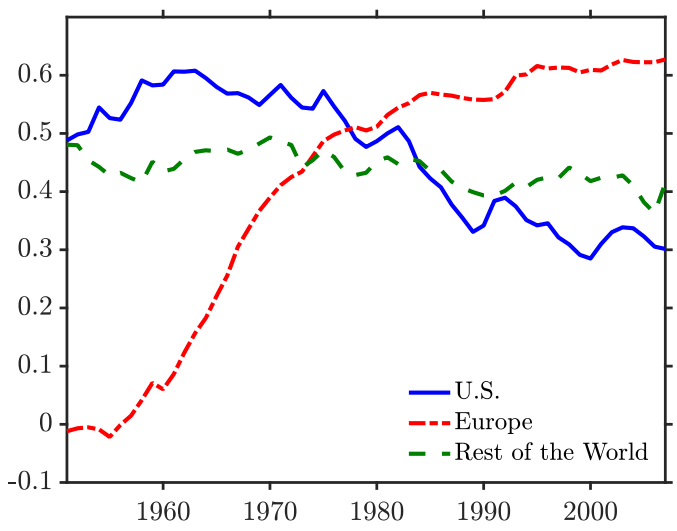
$$K_{jt+1} = (1-\delta) K_{jt} + X_{jt} - \phi\left(\frac{X_{jt}}{K_{jt}}\right) K_{jt}.$$

Distortions in Labor Markets

Per-capita Hours Worked

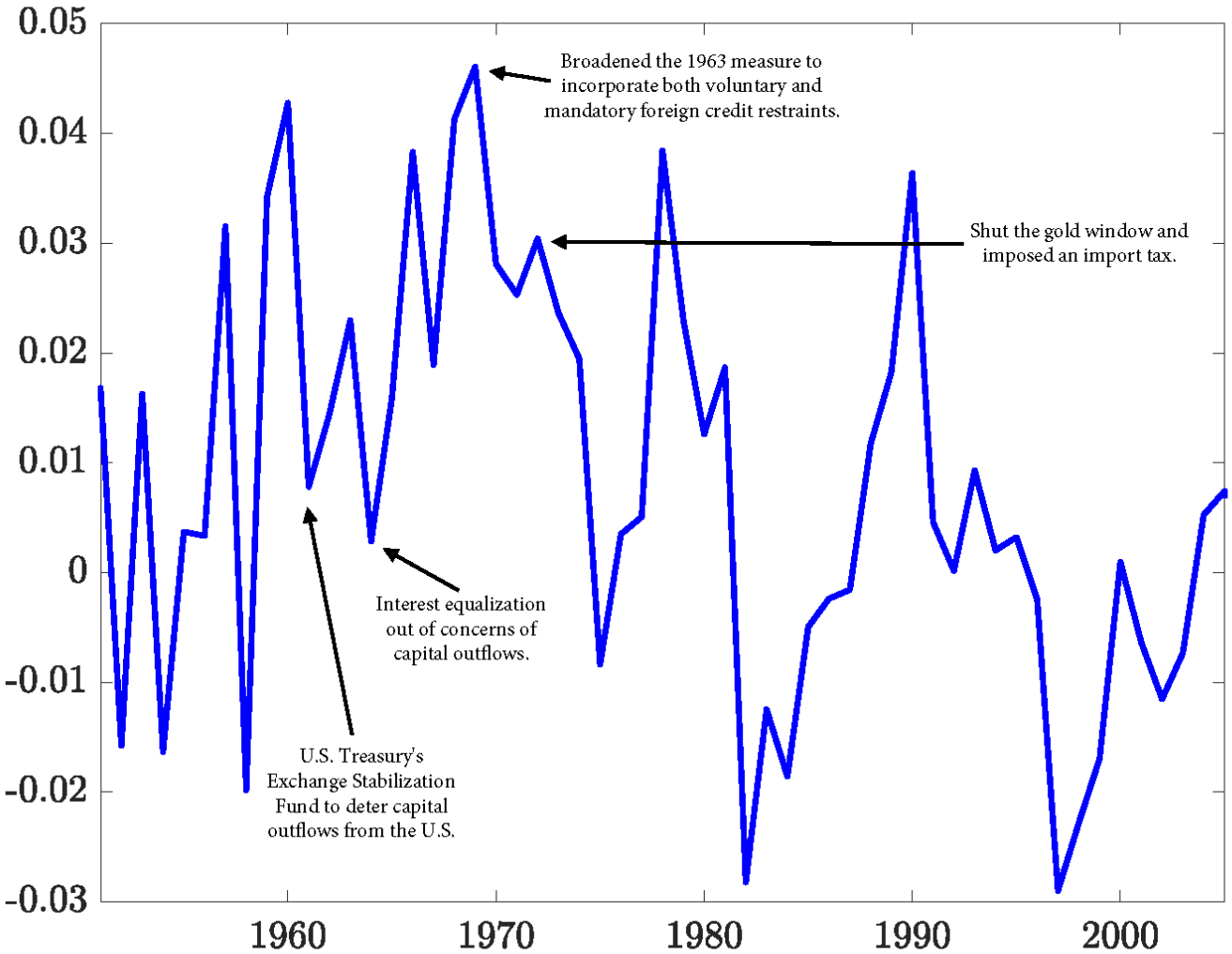


Labor Market Distortions



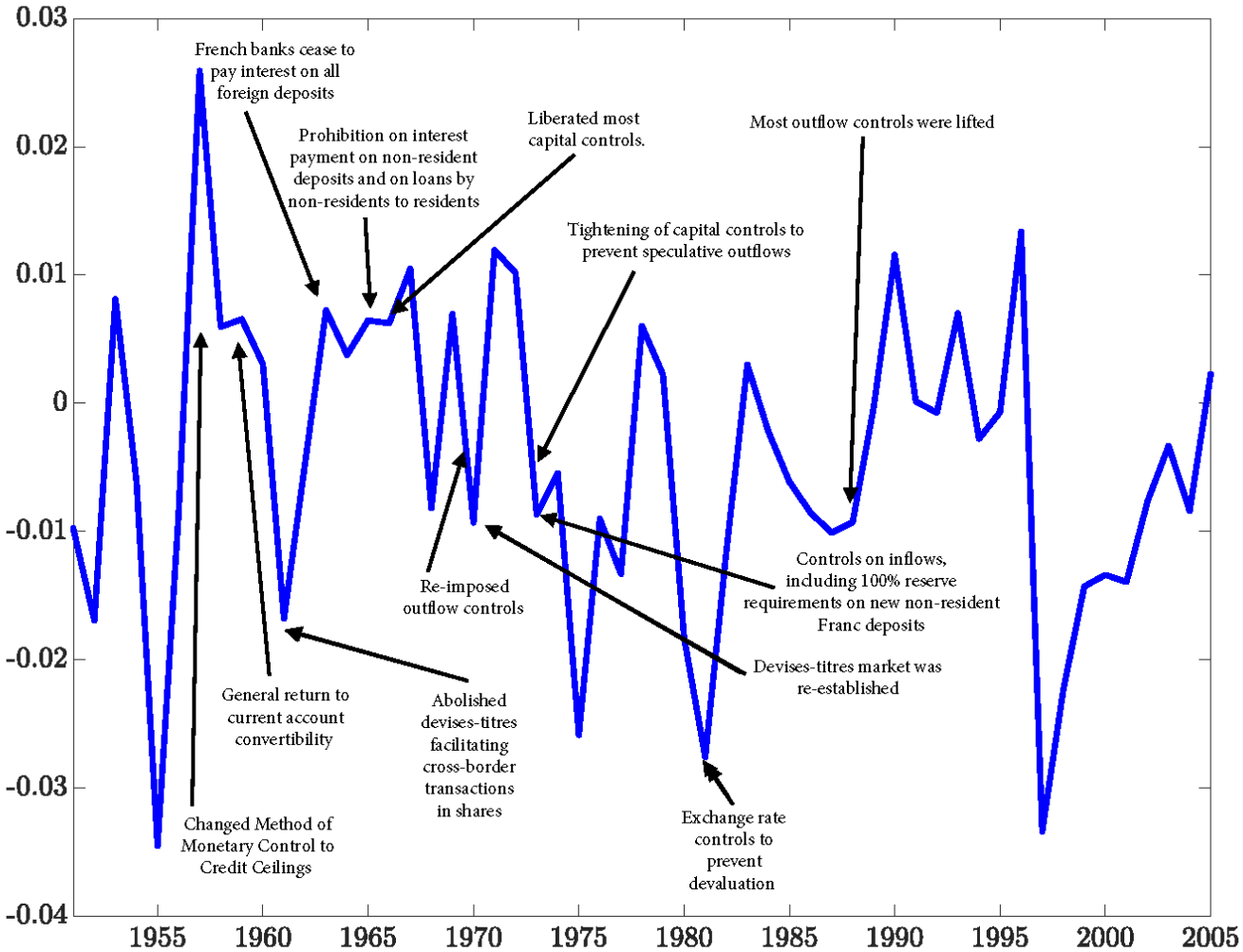
back

U.S. Impediments to International Capital Mobility



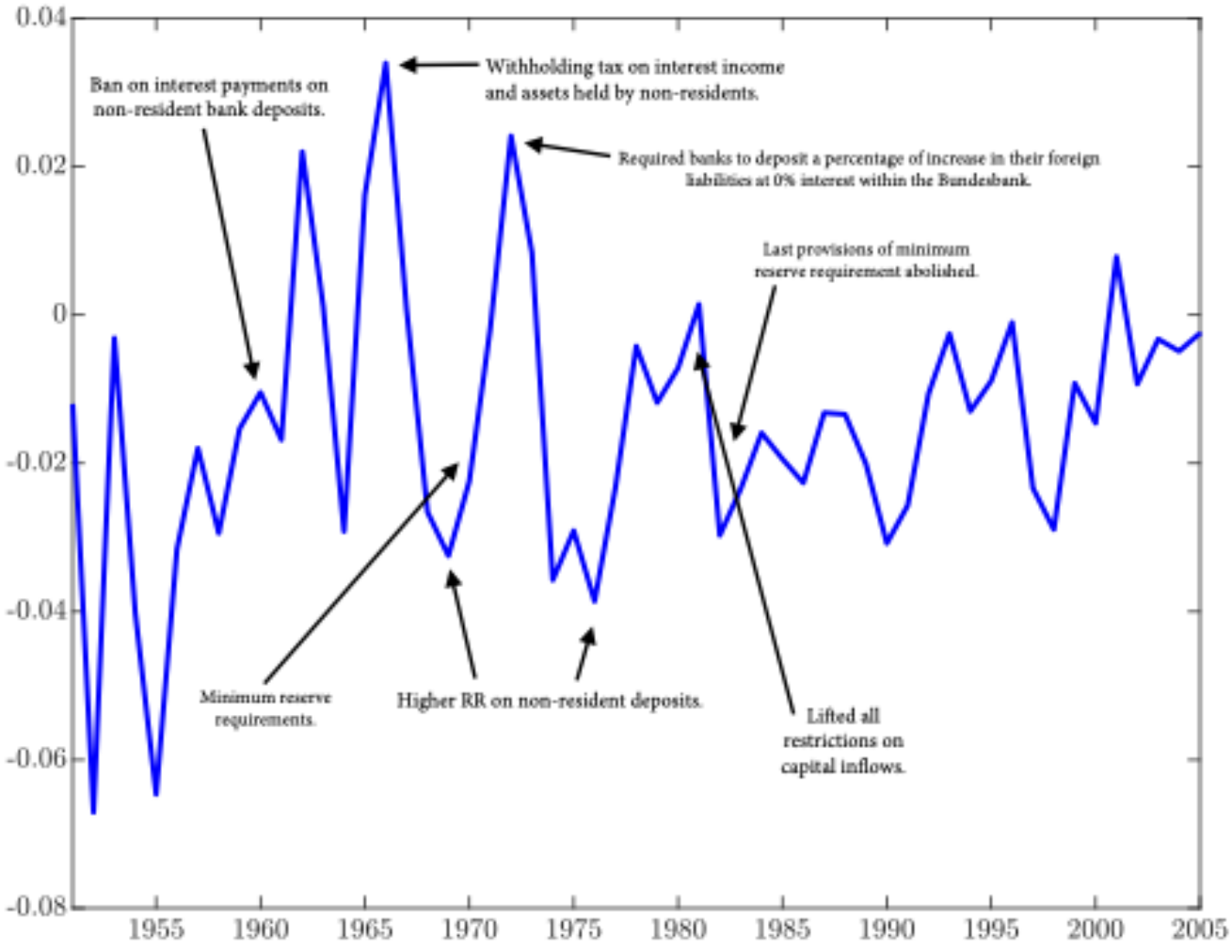
back

France Impediments to International Capital Mobility



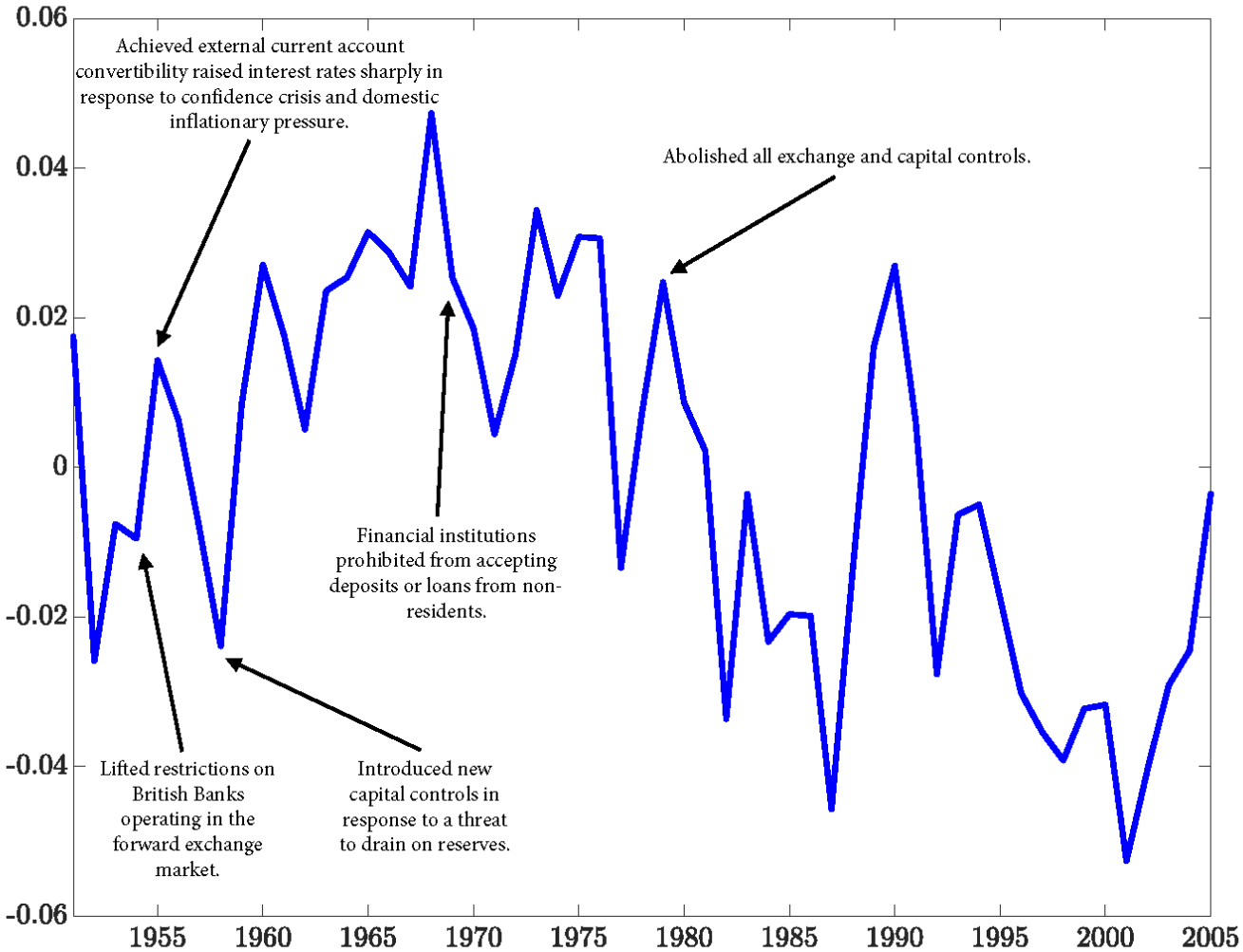
back

Germany Impediments to International Capital Mobility



back

U.K. Impediments to International Capital Mobility



back