Downward Nominal Wage Rigidity

Currency Pegs And Involuntary Unemployment

Stephanie Schmitt-Grohé Martín Uribe

Columbia University

August 18, 2013

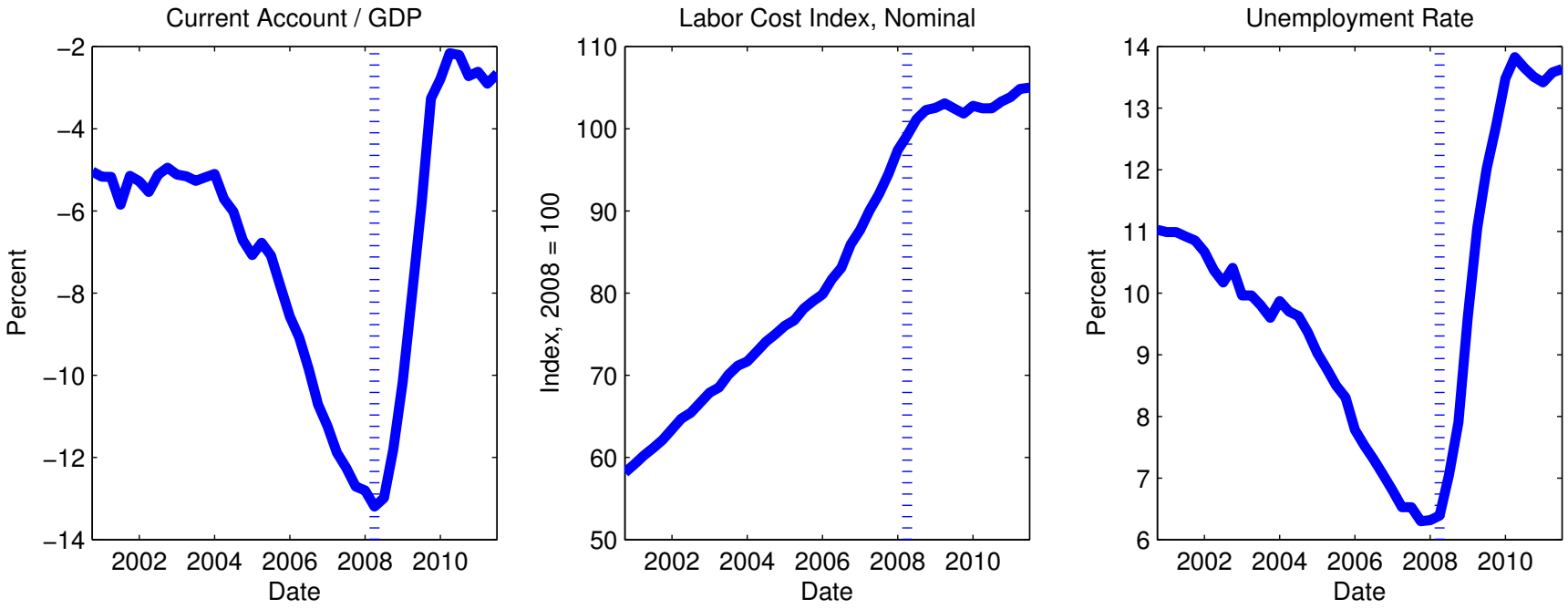
Motivation

- Typically, currency pegs are part of broader reform packages that include free capital mobility.

- For many countries, the combination of a fixed exchange rate and free capital mobility has been a mixed blessing.

- Example: The periphery of the eurozone. In the early 2000s, capital inflows fueled large increases in aggregate demand and real wages. After the crisis of 2008, capital inflows dried up, aggregate demand collapsed, but wages did not fall quickly enough, causing massive involuntary unemployment.

Boom-Bust Cycle in Peripheral Europe: 2000-2011



Data Source: Eurostat. All countries are either on the euro or pegging to it. Arithmetic mean of Bulgaria, Cyprus, Estonia, Greece, Ireland, Lithuania, Latvia, Portugal, Spain, Slovenia, and Slovakia. Wage data includes the public sector except for Spain.

Four Questions

(Q1) Are capital controls desirable (i.e., Ramsey optimal)?

(Q2) Is the optimal capital control policy prudential?

(Q3) How large are the unemployment gains associated with the optimal capital control policy?

(Q4) What are the cyclical and long-run effects of optimal capital controls?

Goal of This Paper

Address these questions within an optimizing, dynamic, stochastic, quantitative model of an emerging economy with downward nominal wage rigidity.

Preview of Our Answers

(Q1) Are capital controls desirable (i.e., Ramsey optimal)?
A: Yes.

(Q2) Is the optimal capital control policy prudential?
A: Yes.

(Q3) How large are the unemployment gains associated with the optimal capital control policy?
A: 10 percent.

(Q4) What are the cyclical and long-run effects of optimal capital controls on debt?
A: Foreign debt is lower and more volatile.

Related Literature On Optimal Capital Controls

Financial Distortions: Auernheimer and García-Saltos, 2000; Uribe, 2006, 2007; Lorenzoni, 2008; Korinek, 2010; Benigno et al., 2011; Bianchi, 2011; Jeanne and Korinek, 2012;

Trade Theory: Obstfeld and Rogoff, 1996; Costinot, Lorenzoni, and Werning, 2011;

Farhi and Werning, 2012.

A Disequilibrium Model

Nominal Wages are Downwardly Rigid

$$\boldsymbol{W_t \geq \gamma W_{t-1}}$$

$W_t =$ nominal wage rate in period t

$\gamma \geq 0$ degree of downward wage rigidity

Traded and Nontraded Goods

Traded goods: stochastic endowment, y_t^T

Nontraded goods: produced with labor, $y_t^N = F(h_t)$

The relative price on nontradables: $p_t = \frac{P_t^N}{P_t^T}$

Law of one price holds for tradables: $P_t^T = P_t^* E_t$

E_t = nominal exchange rate, fixed at $\bar{E}$ for all t.

Assume that $P_t^* = 1$

Firms in the Nontraded Sector

$$\max_{\{h_t\}} \quad [p_t F(h_t) - w_t h_t]$$

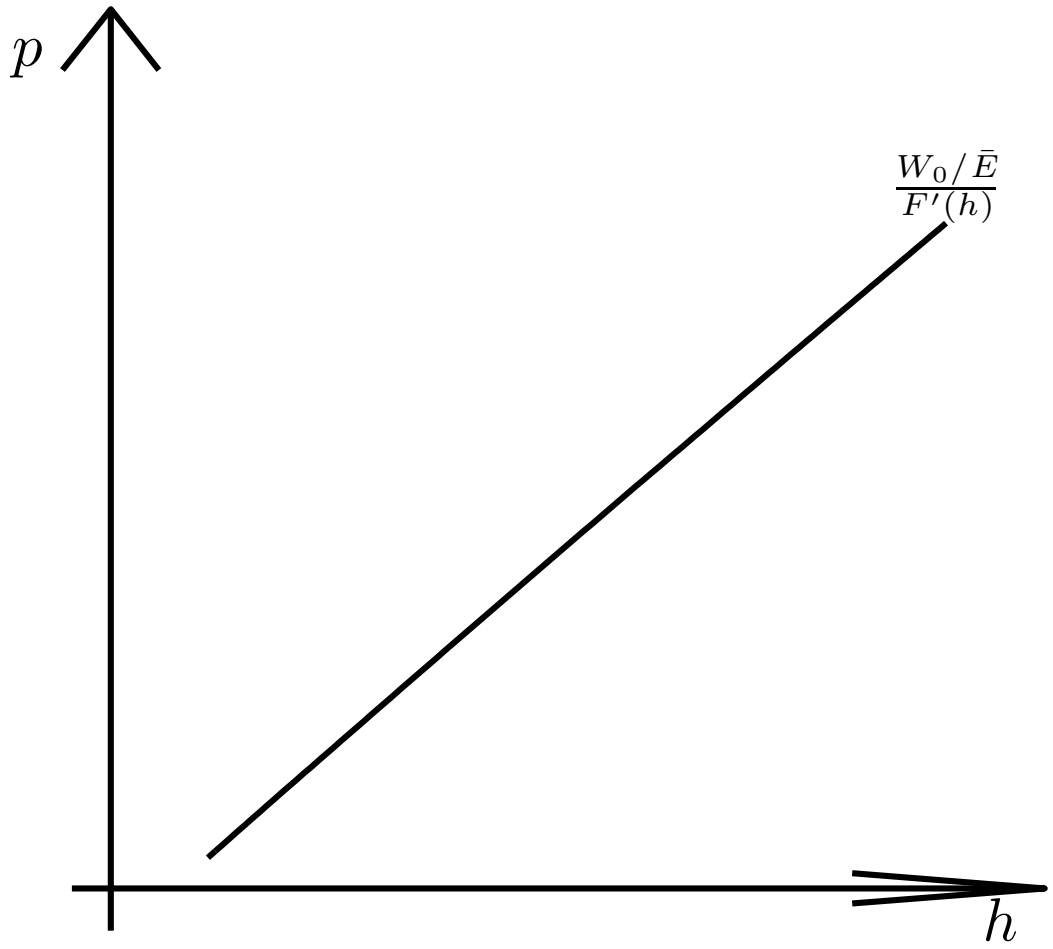
taking as given p_t and w_t.

$w_t \equiv W_t/E_t$ is the real wage in terms of tradables.

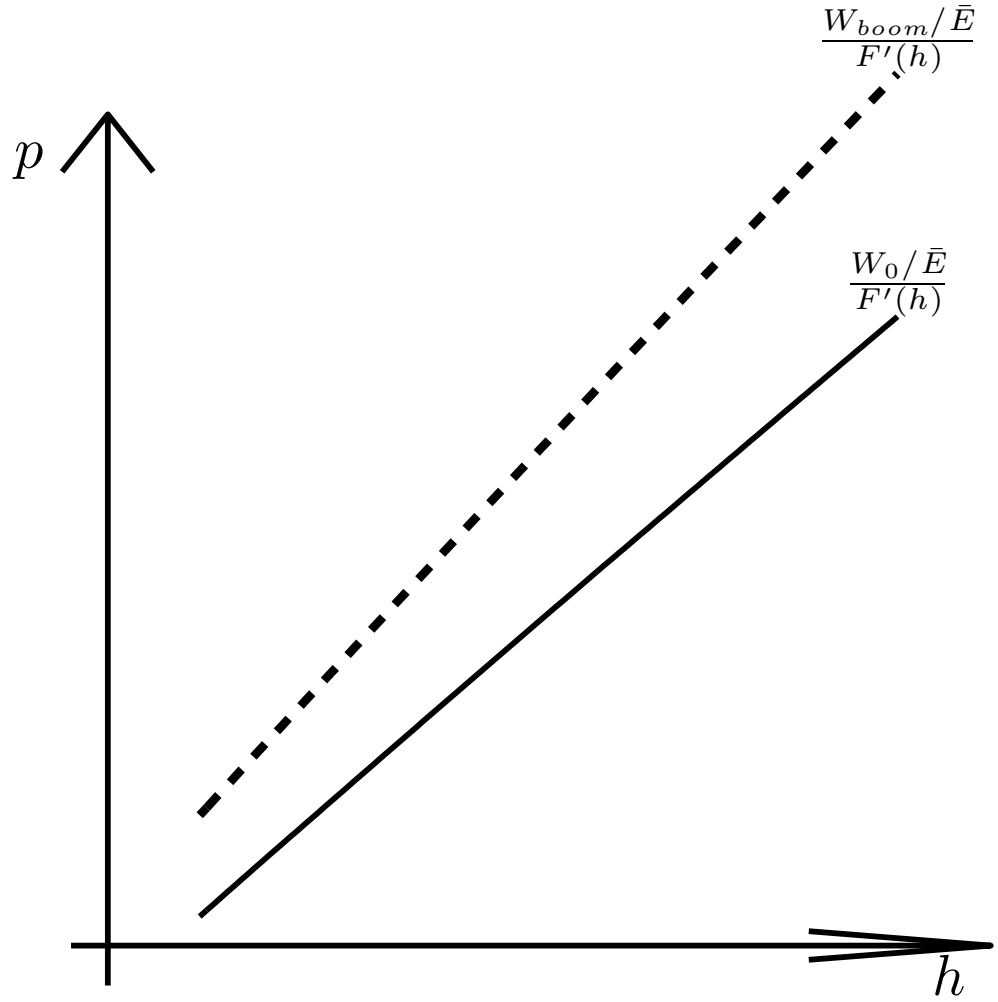
Optimality condition (or the Supply of Nontradables):

$$p_t = \frac{W_t/E_t}{F'(h_t)}$$

The Supply of Nontraded Goods



$W_t \uparrow$: A Wage Increase Shifts The Supply Schedule Up



$(W_{boom} > W_0)$

Households

$$\max_{\{c_t^T, c_t^N, d_{t+1}\}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(c_t)$$

subject to

$$c_t = A(c_t^T, c_t^N)$$

$$c_t^T + p_t c_t^N + d_t = y_t^T + w_t h_t + (1 - \tau_t^d)\frac{d_{t+1}}{1 + r_t} + \phi_t$$

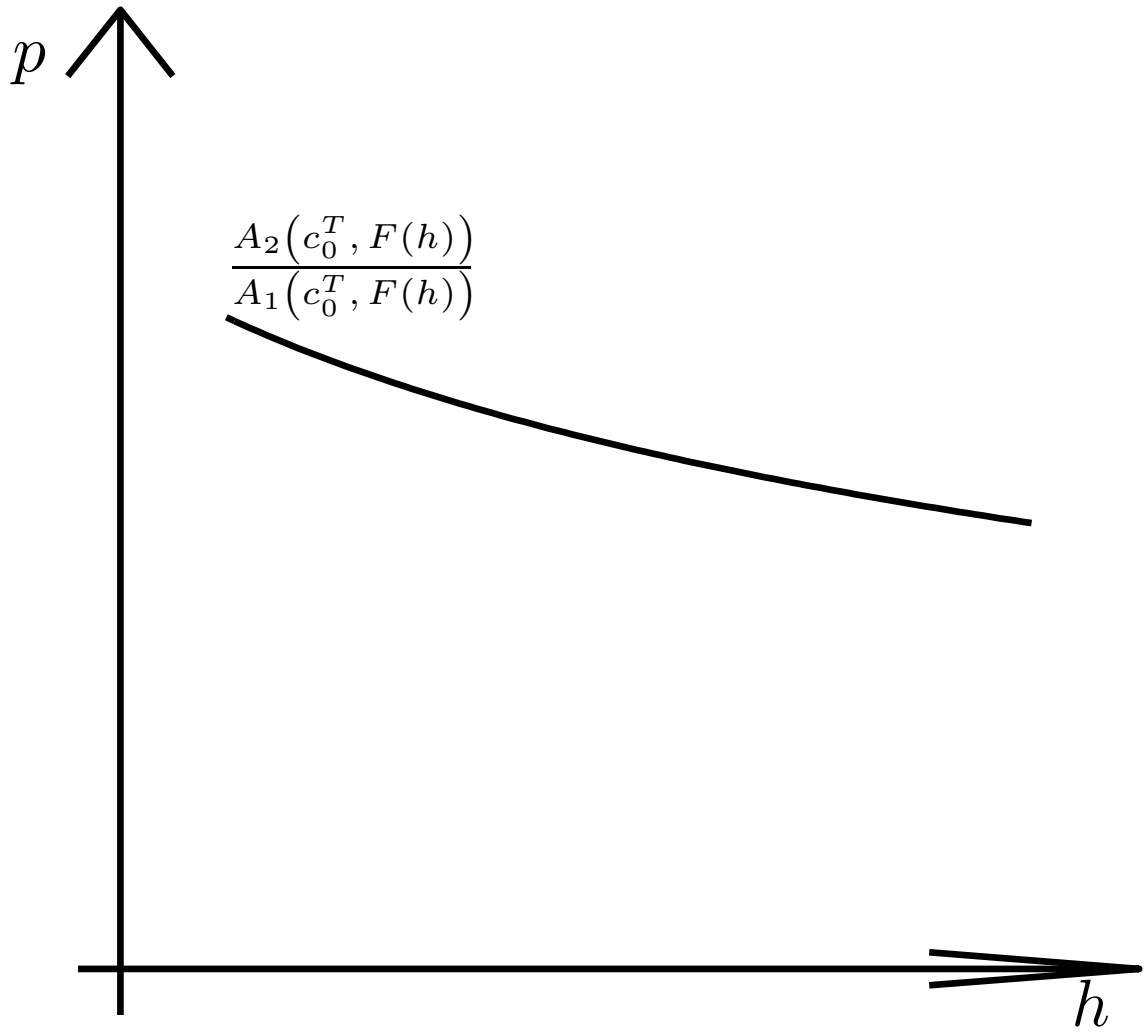
$$d_{t+1} \leq \bar{d}$$

• Workers supply $\bar{h}$ hours inelastically, but may not be able to sell them all. They take $h_t \leq \bar{h}$ as given.

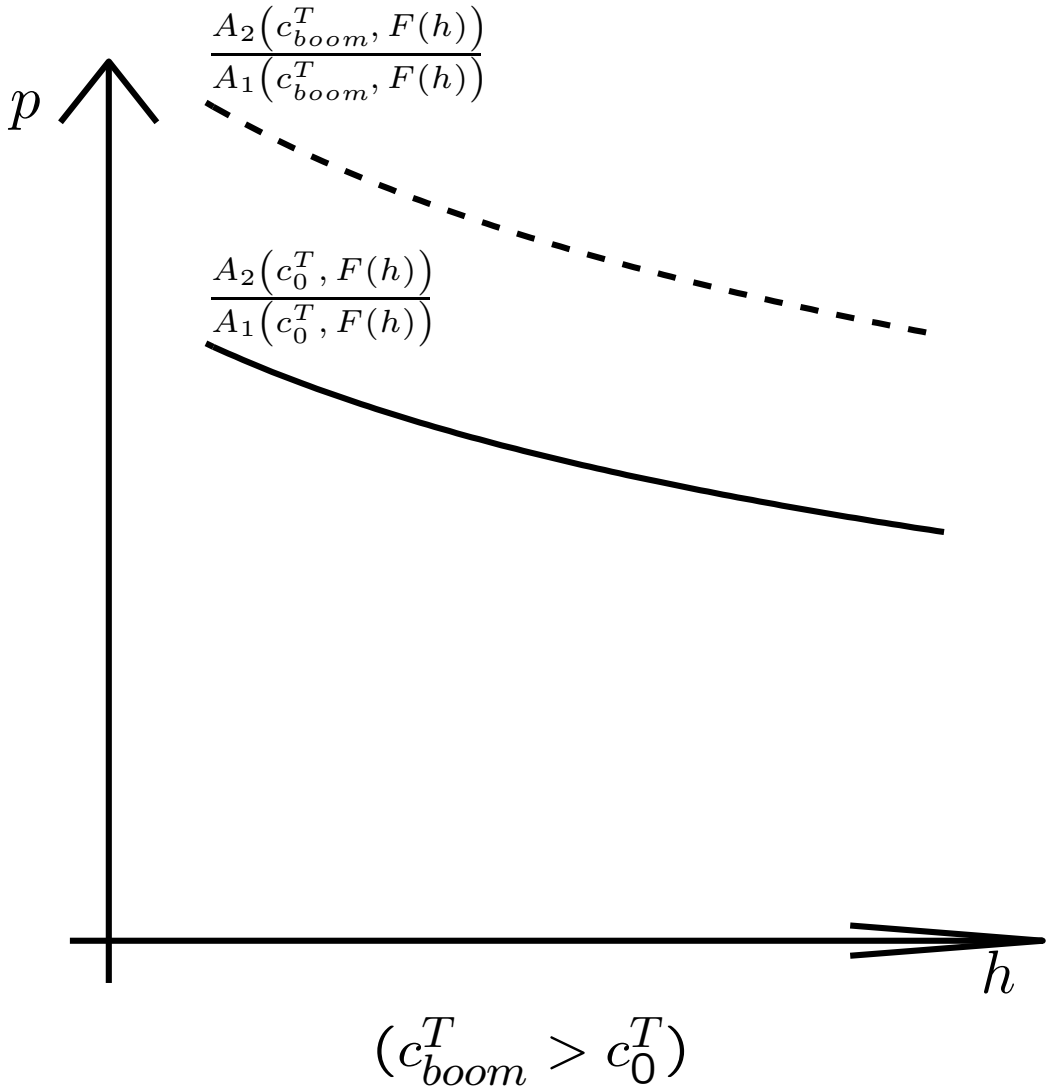
• One first-order condition (Demand for Nontradables):

$$\frac{A_2(c_t^T, c_t^N)}{A_1(c_t^T, c_t^N)} = p_t$$

The Demand for Nontraded Goods



$\mathbf{c_t^T \uparrow}$ Shifts the Demand Function Up



$(c_{boom}^T > c_0^T)$

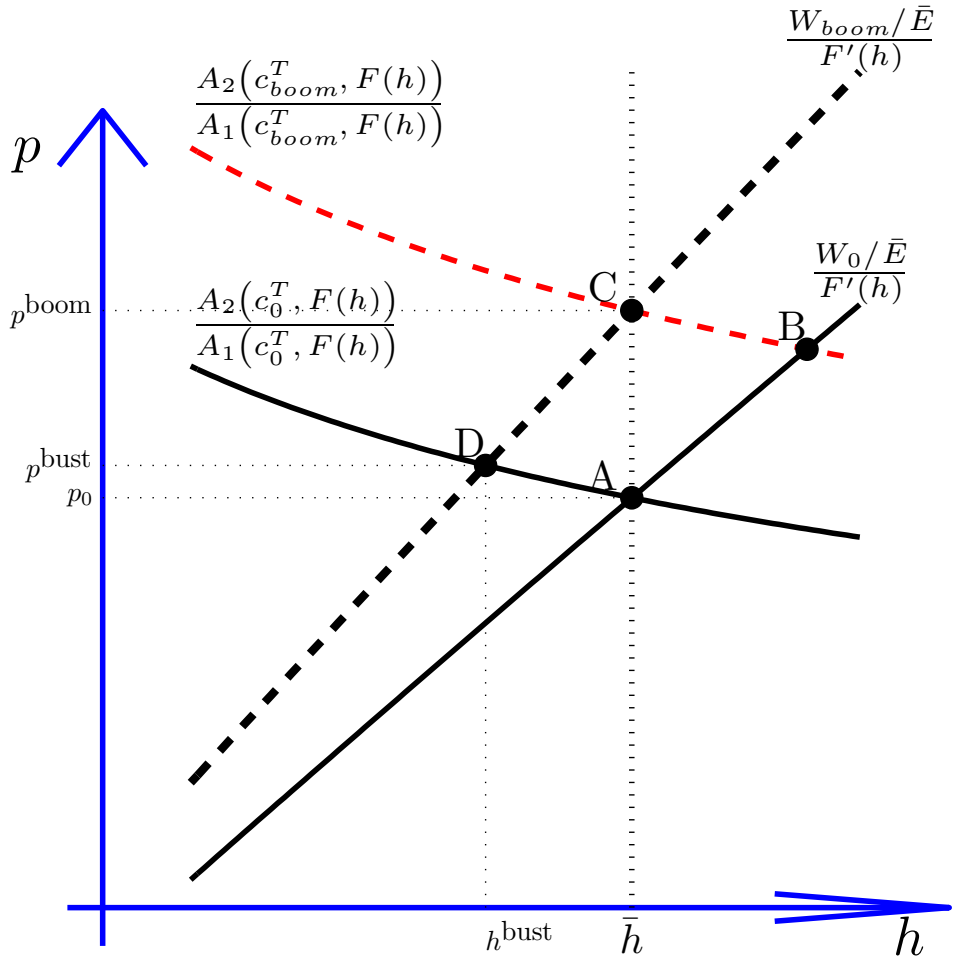
Disequilibrium in the Labor Market

$$W_t \geq \gamma W_{t-1}$$

$$h_t \leq \bar{h}$$

$$(\bar{h} - h_t)\,(W_t - \gamma W_{t-1}) = 0$$

Inefficient Boom-Bust Dynamics



$c^T_{boom} > c^T_0$ and $W_{boom} > W_0$

Key Prediction I: The Pecuniary Externality

Expansions in aggregate demand drive up real wages, putting the economy in a vulnerable situation. For in the contractionary phase of the cycle, downward wage rigidity and a fixed exchange rate prevent real wages from falling to the level consistent with full employment. Agents understand this mechanism, but are too small to internalize that their individual expenditure decisions collectively cause inefficiently large increases in wages during expansions and hence unemployment during contractions.

Key Prediction II

Aggregate Volatility Increases the Mean Level of Unemployment.

This prediction gives rise to large welfare benefits of stabilization policy.

The Policy Tradeoff

Benefit of Capital Controls: can address the pecuniary externality

Costs of Capital Controls: Distort the intertemporal allocation of consumption.

Optimal Capital Controls As A Ramsey Problem

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(A(c_t^T, F(h_t)))$$

subject to

$$c_t^T + d_t = y_t^T + \frac{d_{t+1}}{1 + r_t}$$

$$d_{t+1} \leq \bar{d}$$

$$\frac{A_2(c_t^T, F(h_t))}{A_1(c_t^T, F(h_t))} F'(h_t) = w_t$$

$$h_t \leq \bar{h}$$

$$w_t \geq \gamma w_{t-1}$$

Quantitative Results

Evidence on Downward Nominal Wage Rigidity

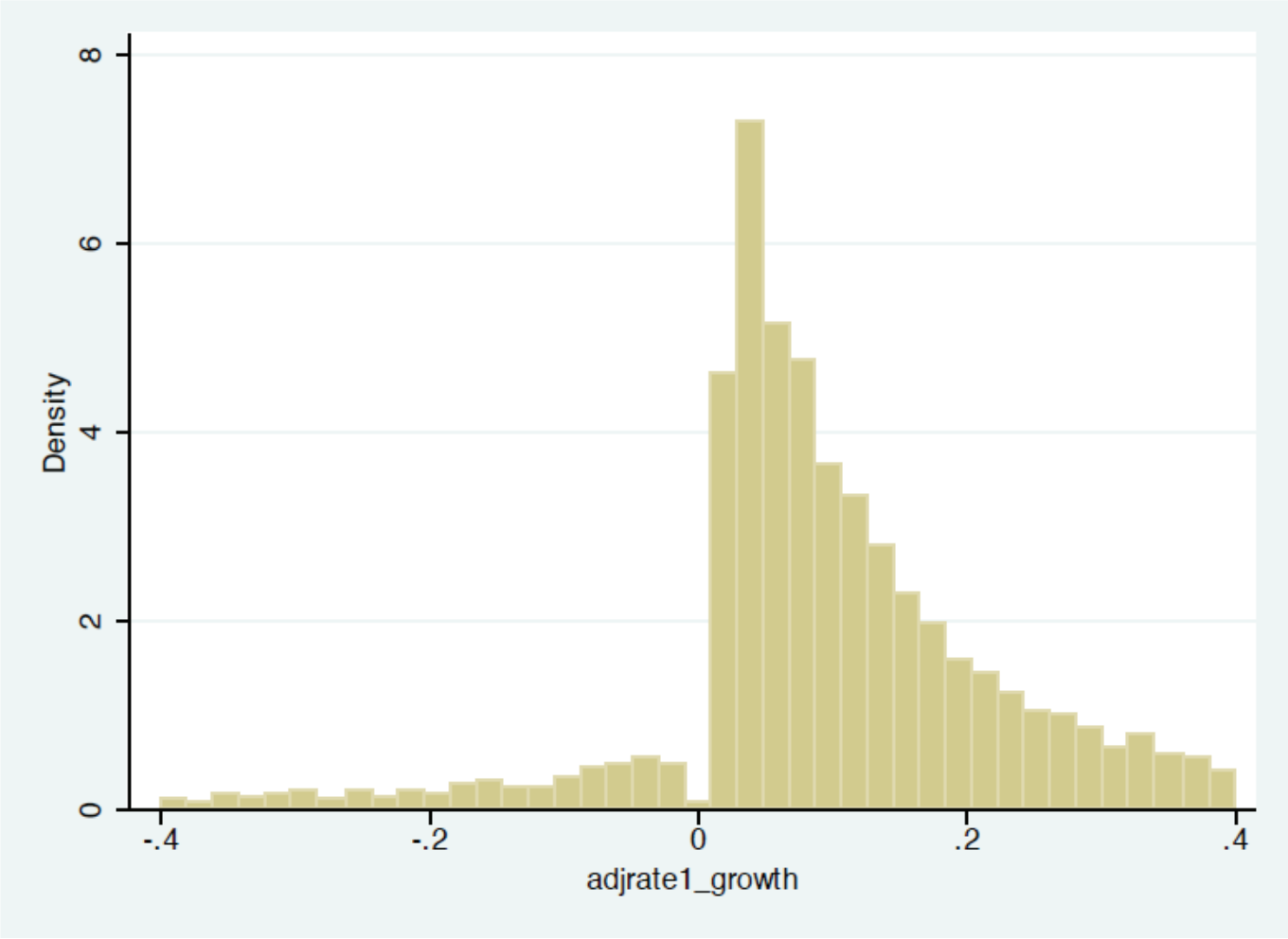
Probability of Decline, Increase, or No Change in Nominal Wages Between Interviews

U.S. data, SIPP panel 1986-1993

	Interviews One Year apart	
	Males	Females
Decline	5.1%	4.3%
Constant	53.7%	49.2%
Increase	41.2%	46.5%

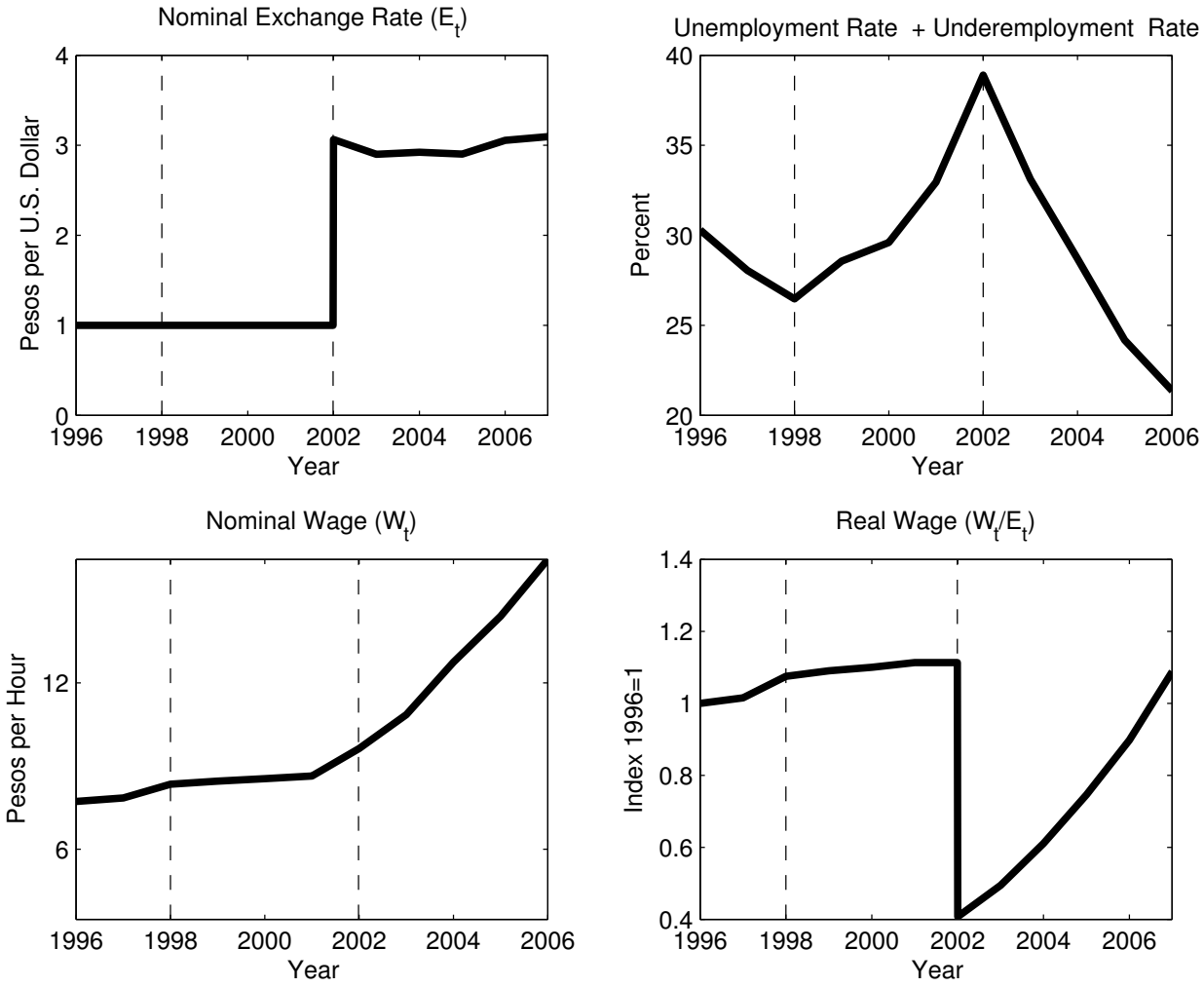
Source: Gottschalk (2005)

Distribution of Non-Zero Wage Changes, Hourly Workers, 1996 F



1996-1999. Source: Barattieri, Basu, and Gottschalk (2010)

Argentina 1996-2006



Implied Value of γ: Around unity.

Unemployment, Nominal Wages, and γ Evidence from the Eurozone

Country	Unemployment Rate 2008Q1 (in percent)	Unemployment Rate 2011Q2 (in percent)	Wage Growth $\frac{W_{2011Q2}}{W_{2008Q1}}$ (in percent)	Implied Value of γ
Bulgaria	6.1	11.3	43.3	1.028
Cyprus	3.8	6.9	10.7	1.008
Estonia	4.1	12.8	2.5	1.002
Greece	7.8	16.7	-2.3	0.9982
Ireland	4.9	14.3	0.5	1.0004
Lithuania	4.1	15.6	-5.1	0.996
Latvia	6.1	16.2	-0.6	0.9995
Portugal	8.3	12.5	1.91	1.001
Spain	9.2	20.8	8.0	1.006
Slovenia	4.7	7.9	12.5	1.009
Slovakia	10.2	13.3	13.4	1.010

Source: EuroStat.

Based on this empirical evidence we set

$$\gamma = \mathbf{0.99}$$

Calibration and Functional Forms

$$U(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}$$

$$A(c^T, c^N) = \left[a(c^T)^{1-\frac{1}{\xi}} + (1-a)(c^N)^{1-\frac{1}{\xi}} \right]^{\frac{\xi}{\xi-1}}$$

$$F(h) = h^{\alpha}$$

Parameter	Value	Description
γ	0.99	Degree of downward nominal wage rigidity
σ^{-1}	1/5	Intertemp. elast. subst. (Reinhart and Végh, 1995)
a	0.26	Share of tradables
ξ	0.44	Intratemp. elast. subst. (González-Rozada et al., 2004)
α	0.75	Labor share in nontraded sector
$\bar{h}$	1	Labor endowment
β	0.9375	Quarterly subjective discount factor

The Driving Process:

$$\begin{bmatrix} \ln y_t^T \\ \ln \frac{1+r_t}{1+r} \end{bmatrix} = A \begin{bmatrix} \ln y_{t-1}^T \\ \ln \frac{1+r_{t-1}}{1+r} \end{bmatrix} + \epsilon_t$$

Two estimates:

1.) Argentina, 1983:Q1—2001:Q3

2.) Greece, 1981:Q1—2011:Q3

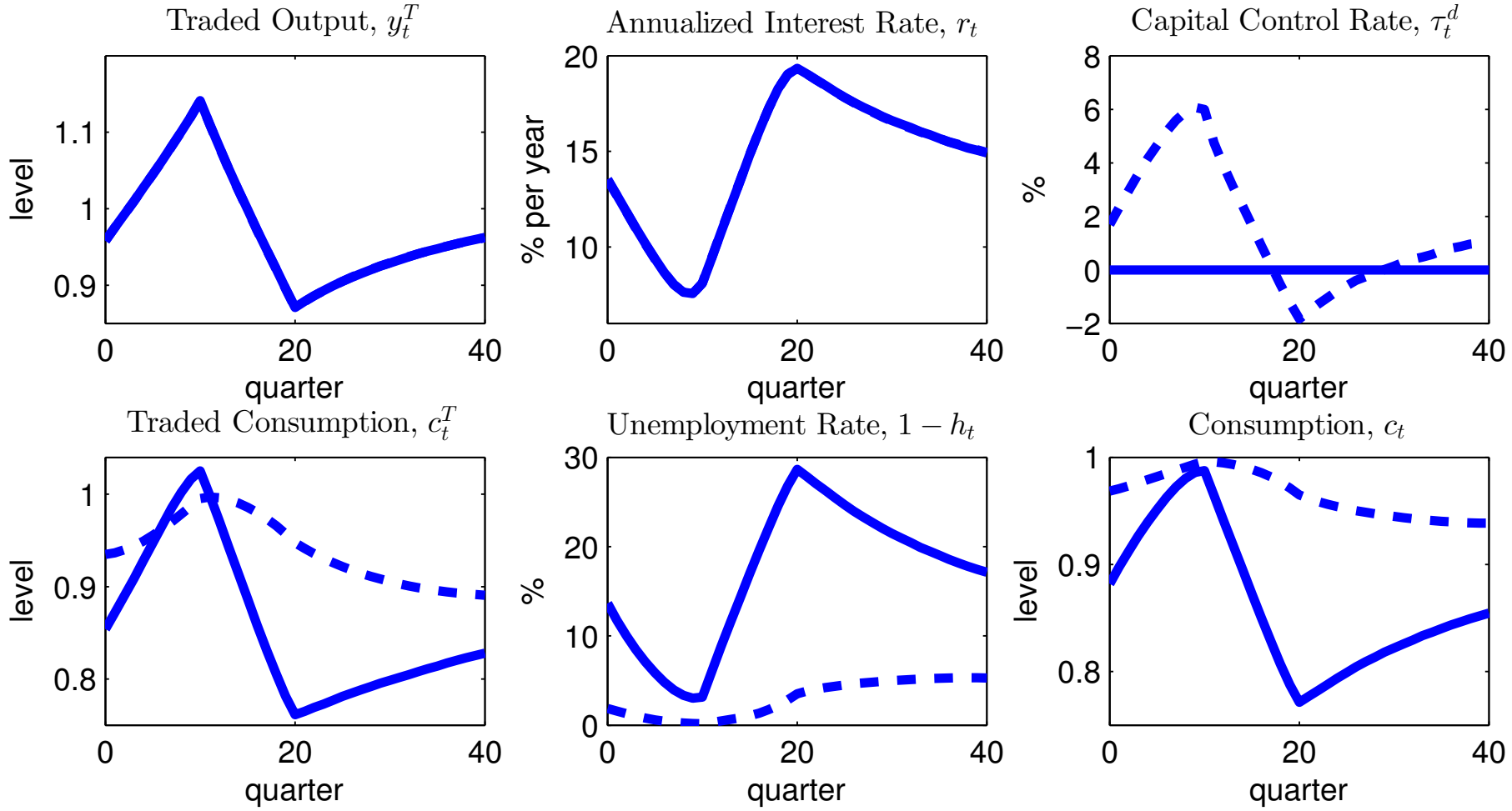
Solution Algorithms

- **Free Capital Mobility:** Policy function iteration.

- **Optimal Capital Control Policy:** Value function iteration.

- **Discretization of state space** $\{d_t, w_{t-1}, y_t^T, r_t\}$:
  - **External Debt,** d_t**:** 501 points.
  - **Real Wage,** w_{t-1}**:** 500 points.
  - **Traded Output,** y_t^T**:** 21 points.
  - **Interest Rate,** r_t**:** 11 points.

Boom-Bust Cycles With and Without Optimal Capital Controls



No Capital Controls

Optimal Capital Controls

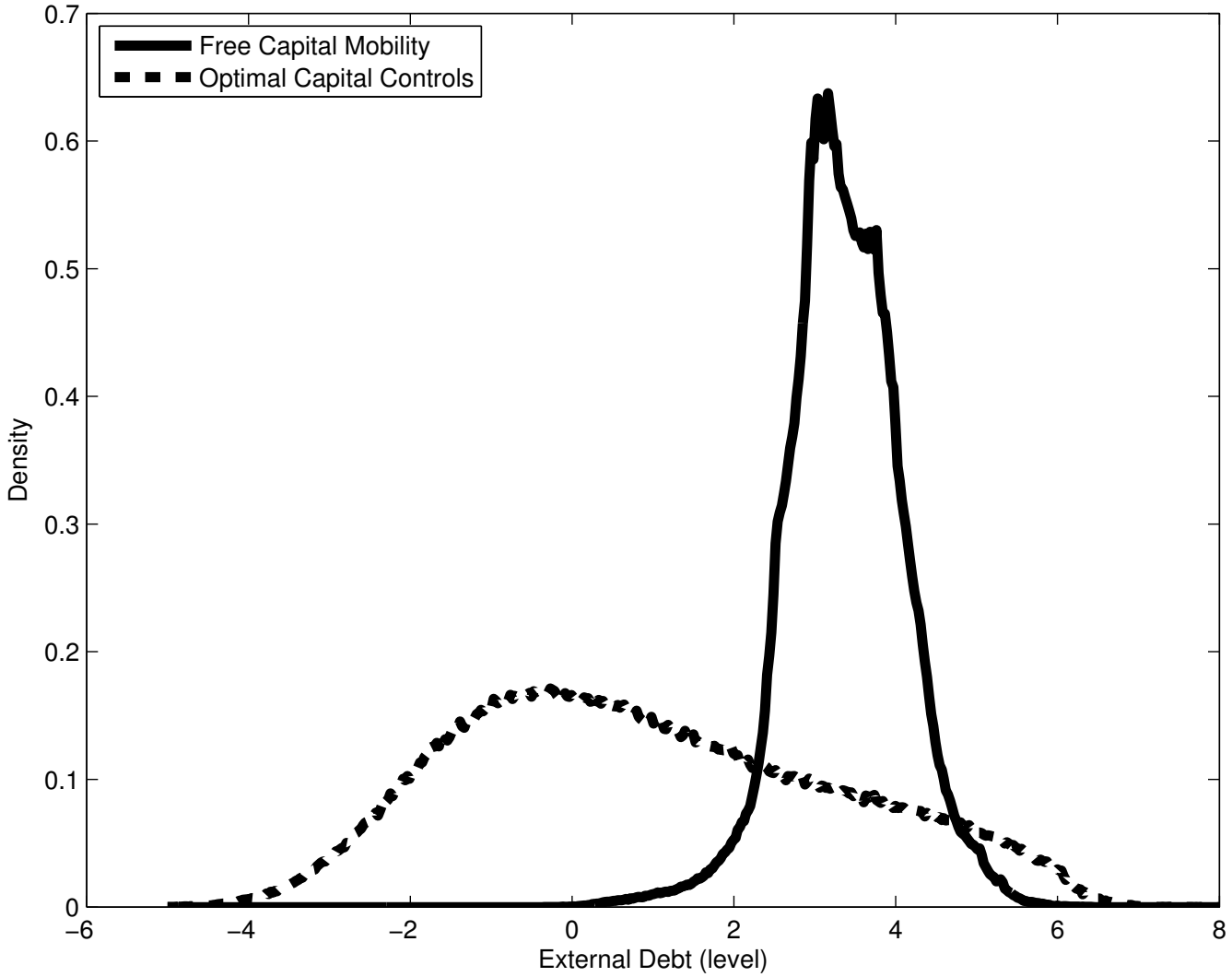
Unconditional Properties of Optimal Capital Controls

Prudential capital control policy is optimal not only during large boom-bust cycles but also during regular business cycles. Here are two key unconditional first and second moments.

• Corr(τ_t^d,y_t^T) = 0.5 $\Rightarrow$ capital control policy is prudential. This reduces the volatility of tradable absorption and the average level of unemployment.

• Mean unemployment is 13.5% under free capital mobility, but only 3.1% under optimal capital controls.

Peg-Induced Overborrowing



- Currency Pegs Cum Free Capital Mobility ⇒ <u>Overborrowing</u>

Welfare Costs of Pegs With Free Capital Mobility

Question: What is the compensation demanded by a household living in the currency-peg economy with free capital mobility to be as well off as a household living in the economy with optimal exchange-rate policy?
Formally, find λ^{FCM} such that

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U\left(c_t^{FCM}(1+\lambda^{FCM})\right) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(c_t^{OPT}),$$

FCM=free capital mobility, and OPT=Optimal exchange-rate policy.

Answer:
- Argentina 11.6 %
- Greece 17.6 %

$\Rightarrow$ Under free capital mobility, the welfare costs of pegs are large.

Welfare Costs of Pegs With Optimal Capital Controls

Question: What is the compensation demanded by a household living in the currency-peg economy with optimal capital controls to be as well off as a household living in the economy with optimal exchange-rate policy?
Formally, find λ^{OCC} such that

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U\left(c_t^{OCC}(1+\lambda^{OCC})\right) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(c_t^{OPT}),$$

OCC=optimal capital controls.

Answer:

- Argentina 3.7 % (compare to 11.6% under FCM)
- Greece 6.0 % (compare to 17.6% under FCM)

$\Rightarrow$ Optimal capital controls reduce significantly the welfare costs of pegs.

Sensitivity Analysis

Economy	Welfare Cost: Peg with No Capital Controls	Welfare Cost: Peg with Optimal Capital Controls	Unemployment Rate: Peg with No Capital Controls	Unemployment Rate: Peg with Optimal Capital Controls
1. Baseline	11.6	3.7	13.5	3.1
2. Prod. in T sector	10.1	5.0	7.8	1.9
3. Greece	17.6	6.0	15.3	3.7
4. $\sigma = 1/\xi = 2.27$	8.4	0.6	12.4	0.5
4.a. $\gamma = 0.98$	6.2	0.4	9.5	0.4
Leisure				
4.b. $\delta = 0.5$	19.0	0.8	33.5	1.3
4.c. $\delta = 0.75$	9.3	0.6	33.5	1.8
4.d. $\delta = 1$	2.1	0.3	33.5	8.4

Note. Welfare costs are relative to the optimal exchange-rate policy.

Conclusions

- The combination of a currency peg and downward nominal wage rigidity creates a negative pecuniary externality.

- The Ramsey optimal capital control policy is prudential: Capital inflows are taxed in good times and subsidized in bad times.

- Large gains: Capital controls lower the average unemployment rate by 10 percentage points.

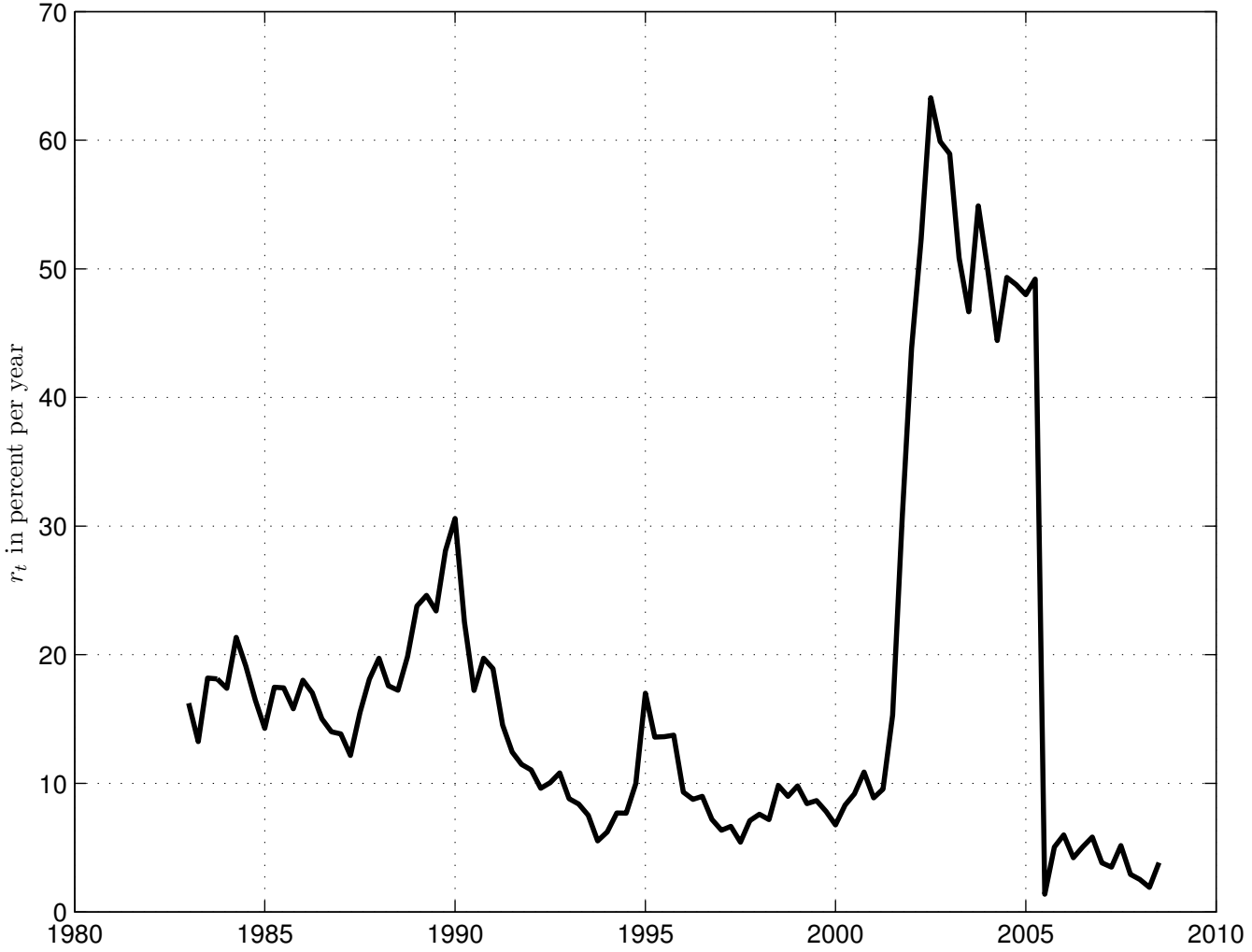
- Peggers overborrow. Under free capital mobility, the average level of external debt is twice as large as under optimal capital controls.

EXTRAS

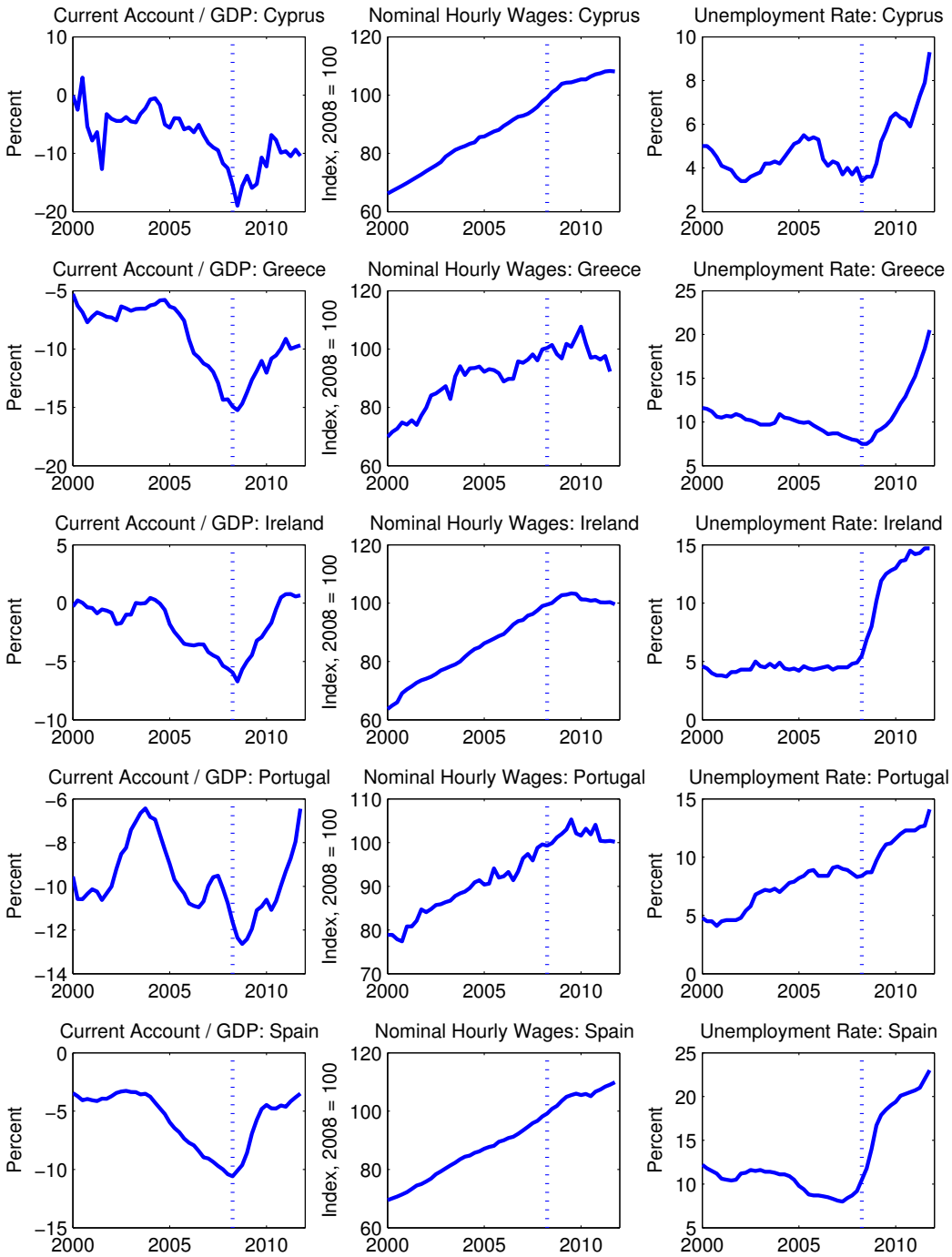
Traded Output in Argentina 1983:Q1-2008:Q3

Note. Detrended and seasonally adjusted.

Interest Rate in Argentina 1983:Q1-2008:Q3



Note. EMBI+ plus US treasury rate minus US expected inflation. Percent per year



Boom-Bust Cycle, Downward Wage Rigidity and Unemployment in the Eurozone

Nominal Wage Rigidity and the Great Depression:

The Gold Standard Hypothesis (Eichengreen and Sachs, 1985)

Countries that left gold early enjoyed much more rapid recoveries than those that stayed on gold. This difference in performance was associated with earlier reflation of price levels in the countries leaving gold

Gold Bloc: France, Belgium, Netherlands, Italy

Sterling Bloc: (left gold early, 1931) : United Kingdom, Denmark, Finland, Sweden, Norway

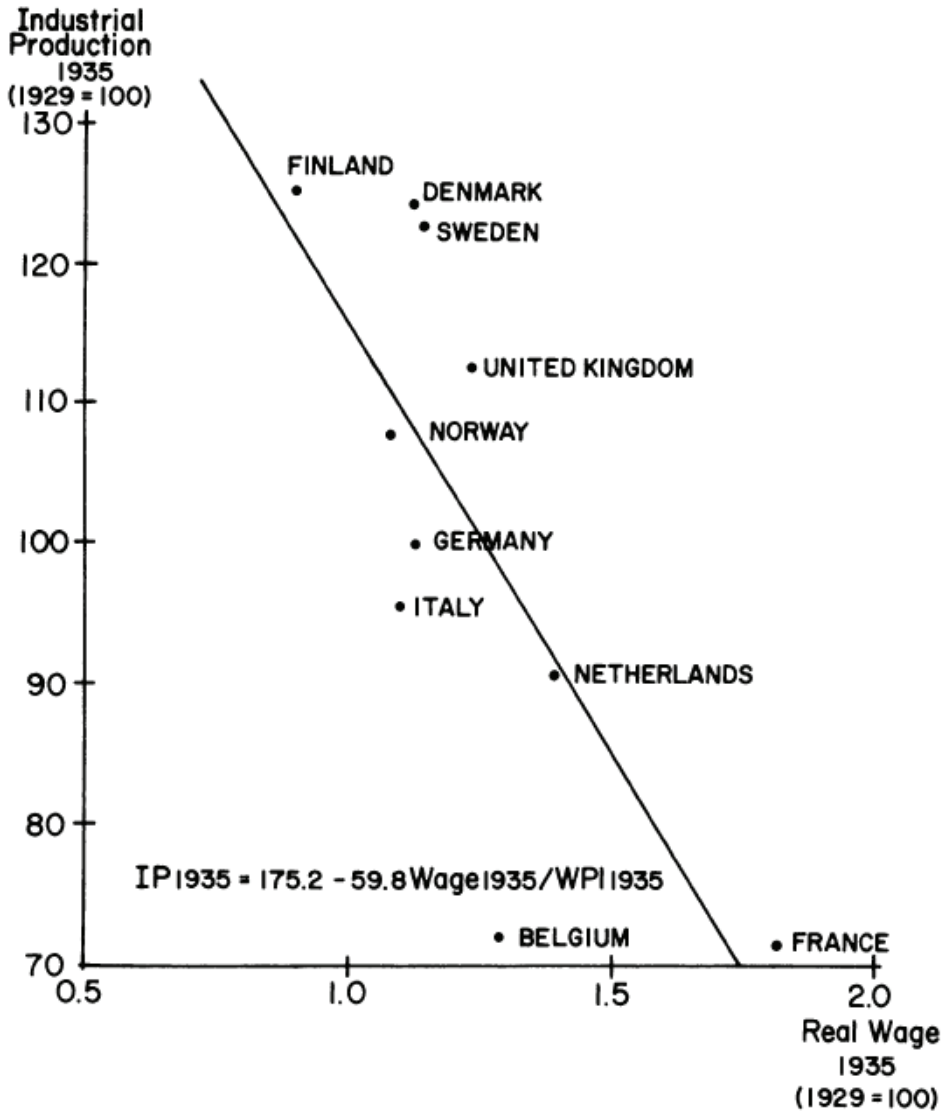


FIGURE 2
CHANGES IN REAL WAGES AND INDUSTRIAL PRODUCTION, 1929–1935

Implied Optimal Capital Control Policy Given processes $\{c_t^T, h_t\}$ derived from the solution to the Ramsey planner's problem, construct

$$\lambda_t = U'(A(c_t^T, F(h_t))A_1(c_t^T, F(h_t))$$

Then, the optimal tax rate on external debt, τ_t^d, satisfies

$$\lambda_t = \frac{1 + r_t}{1 - \tau_t^d} \beta \mathbb{E}_t \lambda_{t+1}$$

• Since 2008:Q1, all countries have been either on or pegged to the Euro with the exception of Slovakia who appreciated against the Euro.

– Bulgaria, not on the Euro, but fixed exchange rate since June 2004.

– Cyprus, on the Euro since 2008, fixed exchange rate since 1999.

– Estonia, on the Euro since 2011, fixed exchange rate since 1999.

– Greece, Portugal, and Spain on the euro.

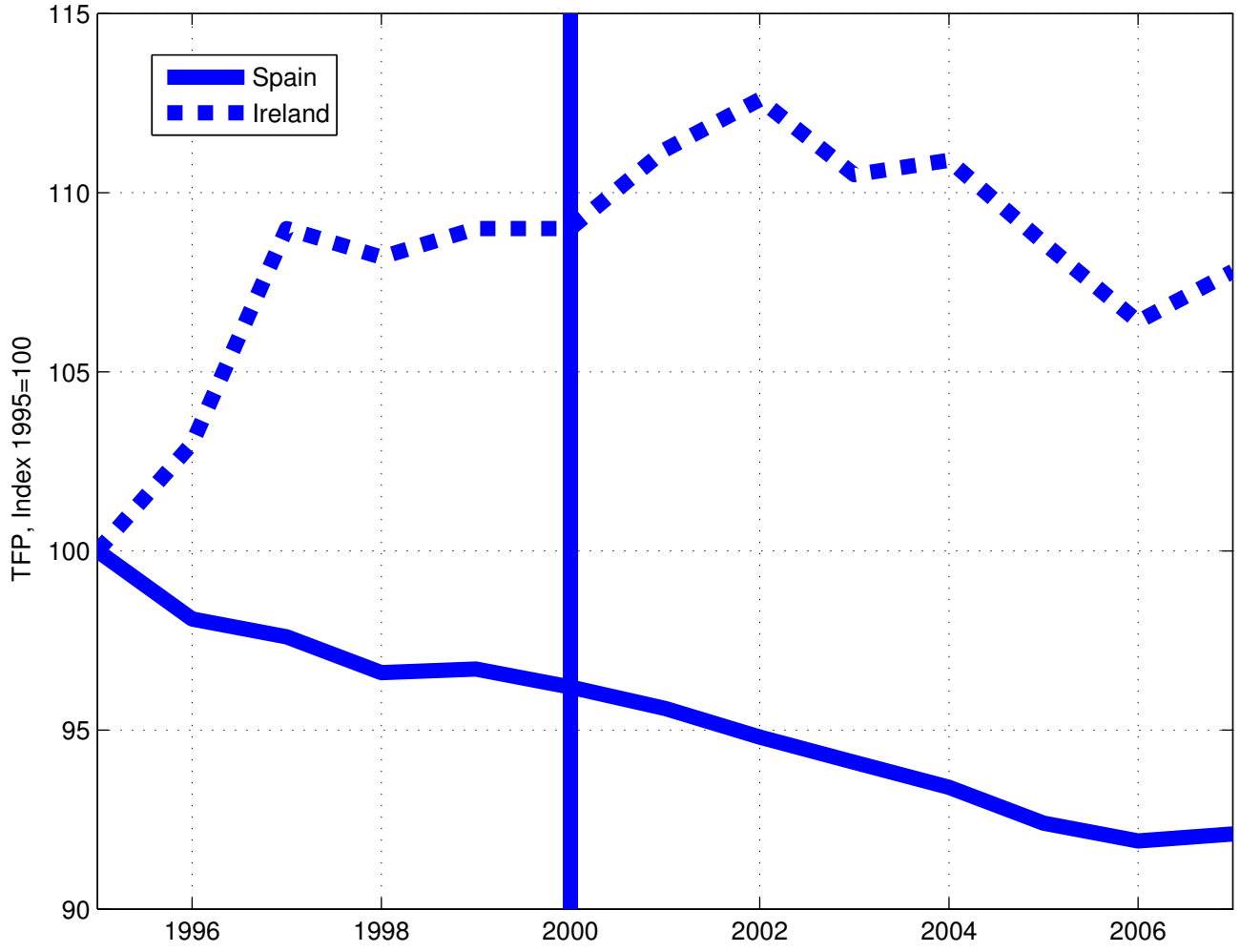
– Lithuania: not on the Euro, but fixed exchange rate since Feb 2002

– Latvia: not on the Euro, but fixed exchange rate since Jan. 2005.

– Slovenia: on the Euro since 2007, pegged to Euro since june 2004

– Slovakia: on the Euro since Jan 2009, but no depreciation between 2008:Q1 and 2009.

Total Factor Productivity



Total Factor Productivity: 2000-2007 (value added based), Index (1995=100)

	2000	2001	2002	2003	2004	2005	2006	2007
Spain	96.2	95.6	94.8	94.1	93.4	92.4	91.9	92.1
Ireland	109.0	111.2	112.6	110.5	110.9	108.6	106.4	107.8

Source: EU KLEMS Growth and Productivity Accounts. This database includes measures of output and input growth, and derived variables such as multifactor productivity at the industry level. The input measures include various categories of capital (K), labour (L), energy (E), material (M) and service inputs (S). The measures are developed for 25 individual EU member states, the US and Japan and cover the period from 1970 to 2007. The variables are organised around the growth accounting methodology, a major advantage of which is that it is rooted in neo-classical production theory. It provides a clear conceptual framework within which the interaction between variables can be analysed in an internally consistent way. The data series are publicly available on http://www.euklems.net. November 2009 release.