THe NK Approach to Exchange Rate Policy Analysis: Looking Forward

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The Transmission of International Shocks to Open Economies
Reserve Bank of New Zealand, December 2010

NK analysis of optimal monetary policy in open economies (OE)

- Fundamentally different from **closed** economy counterpart
- Baseline SOE model has two features

1. complete exchange rate **pass-through**
2. frictionless (domestic/international) **financia**l markets

Optimal Monetary Policy in NK Models

- Closed economy: inflation (markup) stabilization
- **Open** economy: domestic markup stabilization is **not** efficient

1. Via variations in international relative prices (terms of trade and/or real exchange rate), can **improve upon the flexible-price allocation**
2. General nature of **openness**: variations in relative prices can affect consumption **for any given level of output** (and therefore labor effort).

Divine coincidence in the baseline model

- Under log consumption utility, need **special value** of trade elasticity (=1)
- Income and substitution effects of **terms of trade** movements cancel out

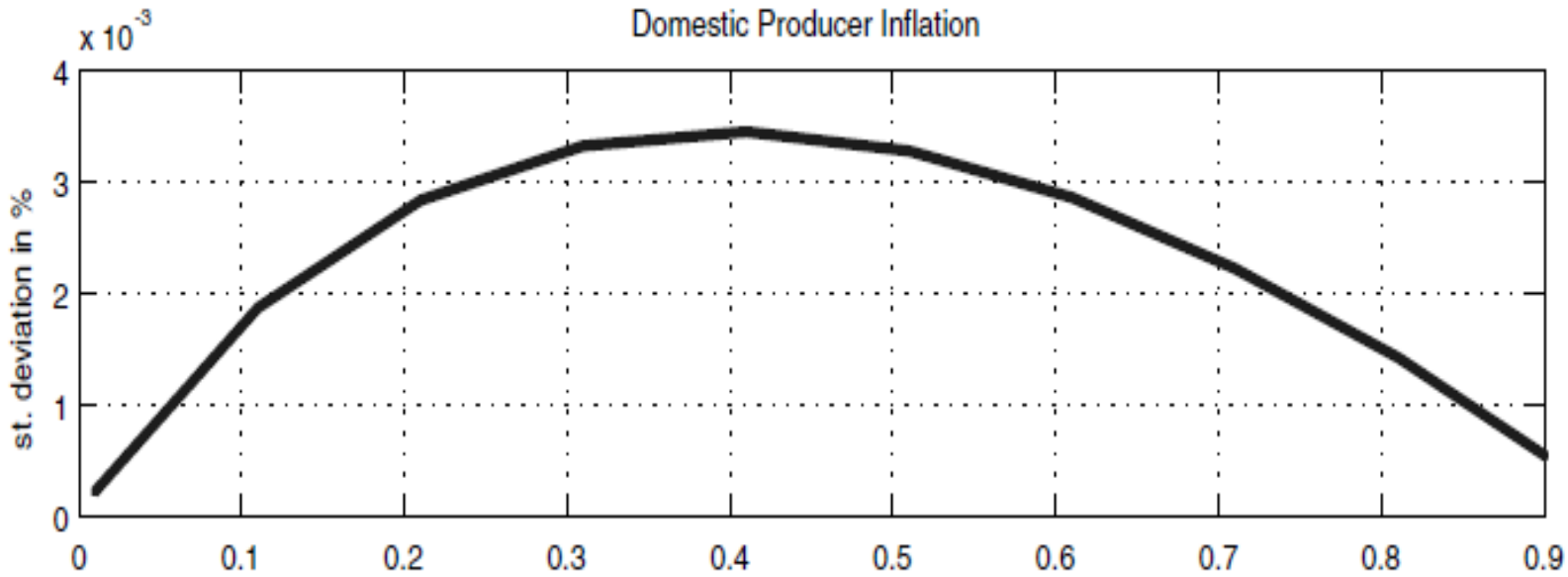
Literature

- Clarida Galí and Gertler (2001), Devereux and Engel (2003), Benigno and Benigno (2003, 2006), Galí and Monacelli (2005), Corsetti and Pesenti (2001, 2005), Faia and Monacelli (2008), Corsetti et al. (2009), De Paoli (2009)
- Recently

1. Engel (AER, 2010)
2. Corsetti, Dedola and Leduc (2010, Handbook chp.)

Openness and optimal PPI inflation volatility

Benchmark model (Faia and Monacelli 2008)



Two deviations from the baseline model

1. Local Currency Pricing
2. Imperfect Financial Markets

Local Currency Pricing

Breaking the divine coincidence in OE: LCP stability of import prices

- Deviations from the **law of one price**

1. At **consumer** level (Engel 010, CDL 010) (*consumer-LCP*)

- Sources: (i) price stickiness ; (ii) local real factors (distribution costs)

2. At the **dock**

Two main implications of "consumer LCP"

1. Should care about "**currency misalignments**" (Engel 2010) / **law of one price gap** (Monacelli, 2006)

$$\psi_t \equiv p_{F,t} - \left(e_t + p^*_{F,t}\right)$$

$$e_t \equiv \log \mathcal{E}_t$$

$\rightarrow$Deviations from the law of one price as **endogenous cost-push shocks**.

$$\pi_{H,t} = \beta \mathbb{E}_t \left\{\pi_{H,t+1}\right\} + \kappa_y \underbrace{\widetilde{y}_t}_{\substack{\text{output} \\ \text{gap}}} + \kappa_\psi \underbrace{\psi_{F,t}}_{\substack{\text{LOP} \\ \text{gap}}}$$

2. Should care about **CPI inflation**

Quasi-divine coincidence? (CDL, 010)

Table 2. Volatilities Under Optimal Policy (Complete Market Economies)

Statistics	With PCP: Productivity and Preference Shocks	With PCP: With Markup Shocks	With LCP: Productivity and Preference Shocks	With LCP: With Markup Shocks
Standard deviation (in percent)				
CPI Inflation	0.11	0.12	0.02	0.03
GDP Deflator Inflation	0.00	0.03	0.03	0.04
Output Gap	0.00	0.16	0.14	0.19
Markup	0.00	0.52	0.14	0.53
Standard deviation (Relative to Output)				
Real Exchange Rate	2.71	2.75	2.99	2.59
Terms of Trade	3.39	3.43	2.56	1.60

But "dock-LCP" even more pervasive

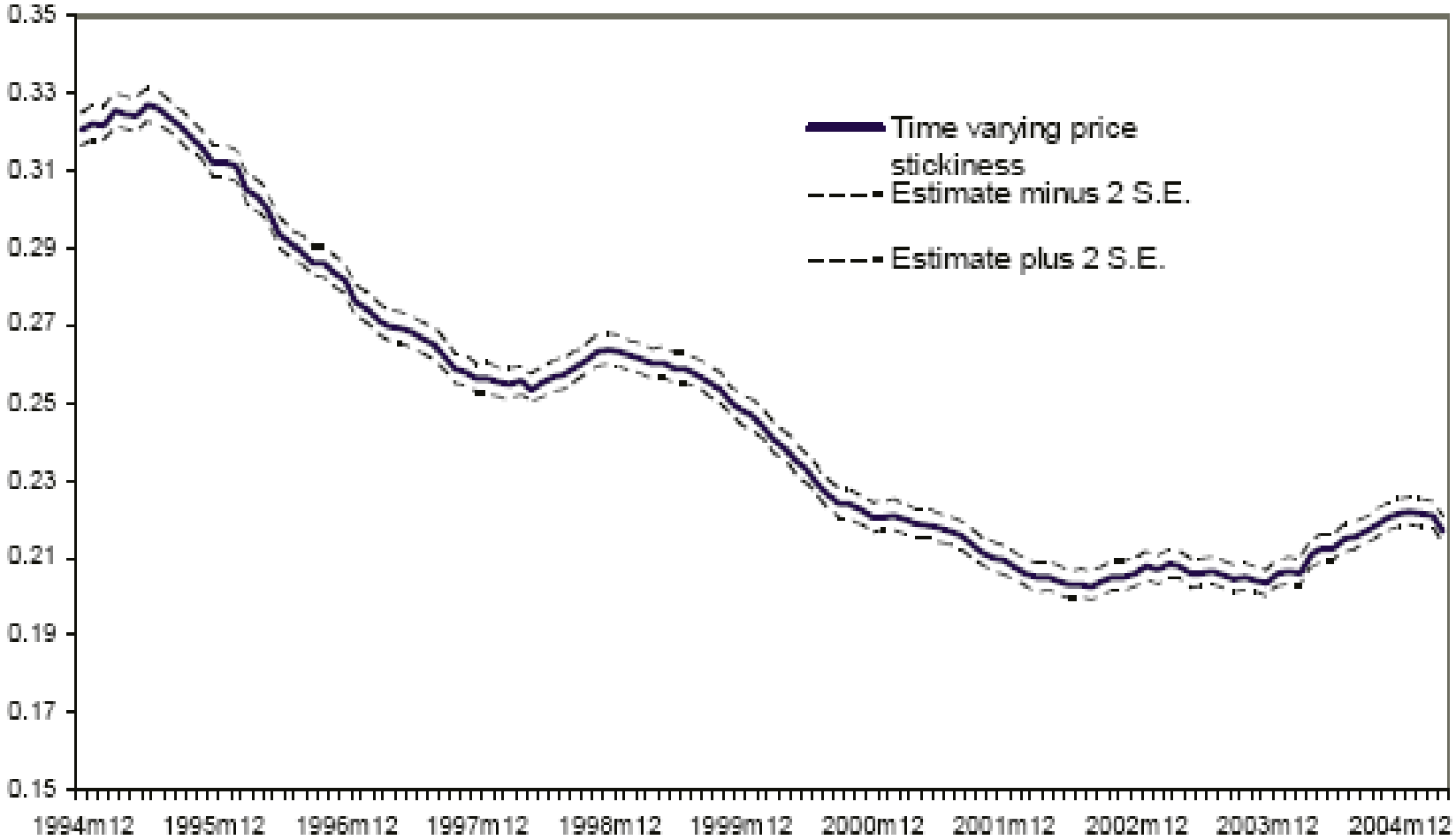
1. Import prices **very** sticky **at the dock** (Gopinath and Rigobon, 2007)
2. Stickiness of import prices higher for more **differentiated** goods (G-R, 2007)
3. Import price rigidity has **increased** by 10 percentage points in 1994-2005 (G-R, 2007)
4. U.S. import prices with **high frequency** of price adjustment have a **higher long-run pass-through** (Gopinath and Itskhoki, 2009)
5. Pass-through of the average good **priced in dollars** is 25% vs. 95% for non-dollar priced

Table 4: Comparing Price Durations in Import Prices, Consumer Prices and Producer Prices

PSL Code	Code Description	Import Prices	Producer Prices	Consumer Prices
P2711	Natural and petrol gases	1.0	1.0	4.7
P2710	Processed petrol	1.0	1.0	1.5
P07	Edible vegetables	1.4	1.1	1.4
P8471	Automatic data processing machines	3.3	6.7	2.0
P20	Vegetable and fruit products	5.0	1.1	5.5
P8528	Reception apparatus for broadcast video media	6.4	10.5	4.6
P8523	Prepared unrecorded media for audiovisual machines	6.4	11.8	13.4
P6204	Women's/Girls's suits, ensembles, pants dresses	7.7	19.6	5.4
P8521	Video recording equipment	8.9	15.4	5.2
P7113	Articles of jewelry containing precious metal	10.0	23.8	8.1
P9401	Seats and parts	11.2	14.5	7.6
P6203	Men's/boys' suits, ensembles, pants	12.0	19.6	10.0
P8708	Parts and accessories for vehicles	12.0	12.0	11.2
P9405	Lamps and light fixtures	12.8	18.9	9.9
P6110	Knit/crochet sweatshirts, pullovers, vests, sweaters	13.0	19.6	8.6
P4202	Leather cases, bags, luggage	13.4	14.5	9.0
P8516	Electric portable heaters, blowdryers, house items	14.0	13.9	10.3
P8703	Passenger vehicles, capacity<10	14.5	3.4	1.3
P2208	Undenatured ethyl alcohol w/ <80 percent concentration	15.2	11.9	7.8
P6402	Partially waterproof footwear	16.8	16.7	9.9
P6403	Footwear with composite material soles and uppers.	17.6	16.7	9.9
P6205	Men's/boys' shirts	20.4	19.6	12.2

Downward Trend in the Frequency of Price Adjustment

Figure 3a: Time Trend in Frequency of Price Adjustment

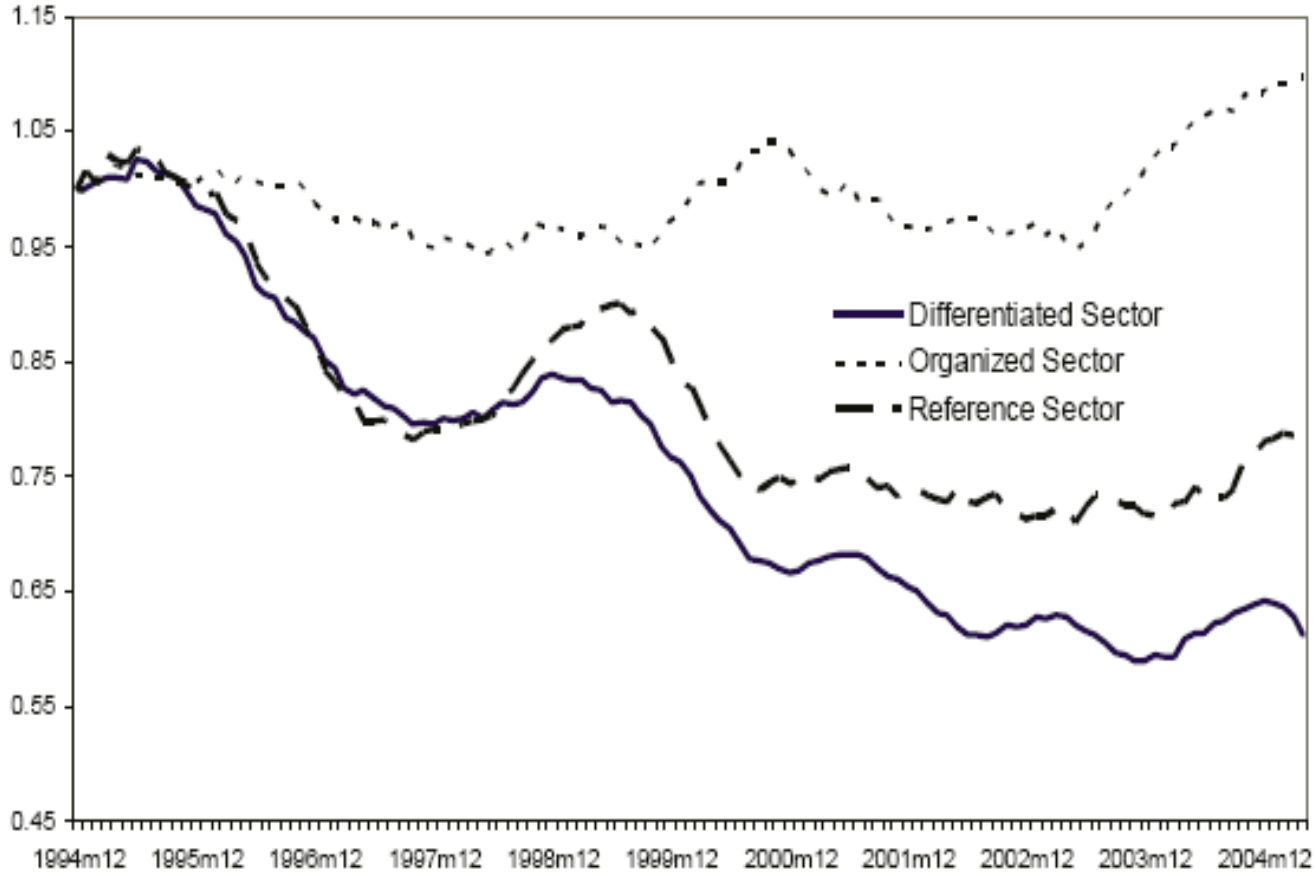


- Decomposition (G-R 07)

$$\Delta \text{P stickiness} = \Delta(N \text{ differ. goods}) + \Delta(\text{P.stickiness differ. goods})$$

It is NOT a Compositional Story

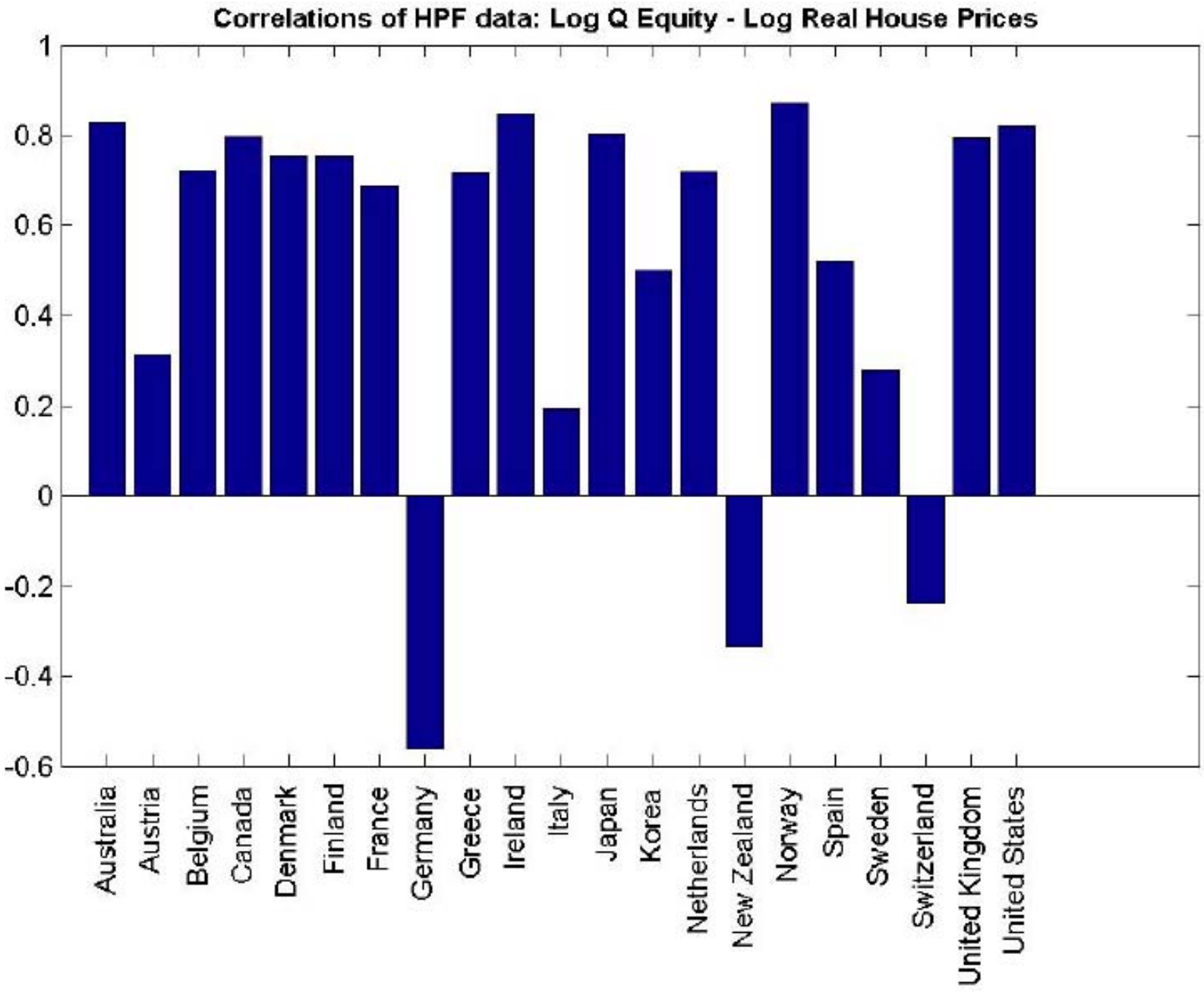
Figure 3b: Time Trend in Frequency of Price Adjustment in Differentiated, Reference and Organized Sectors

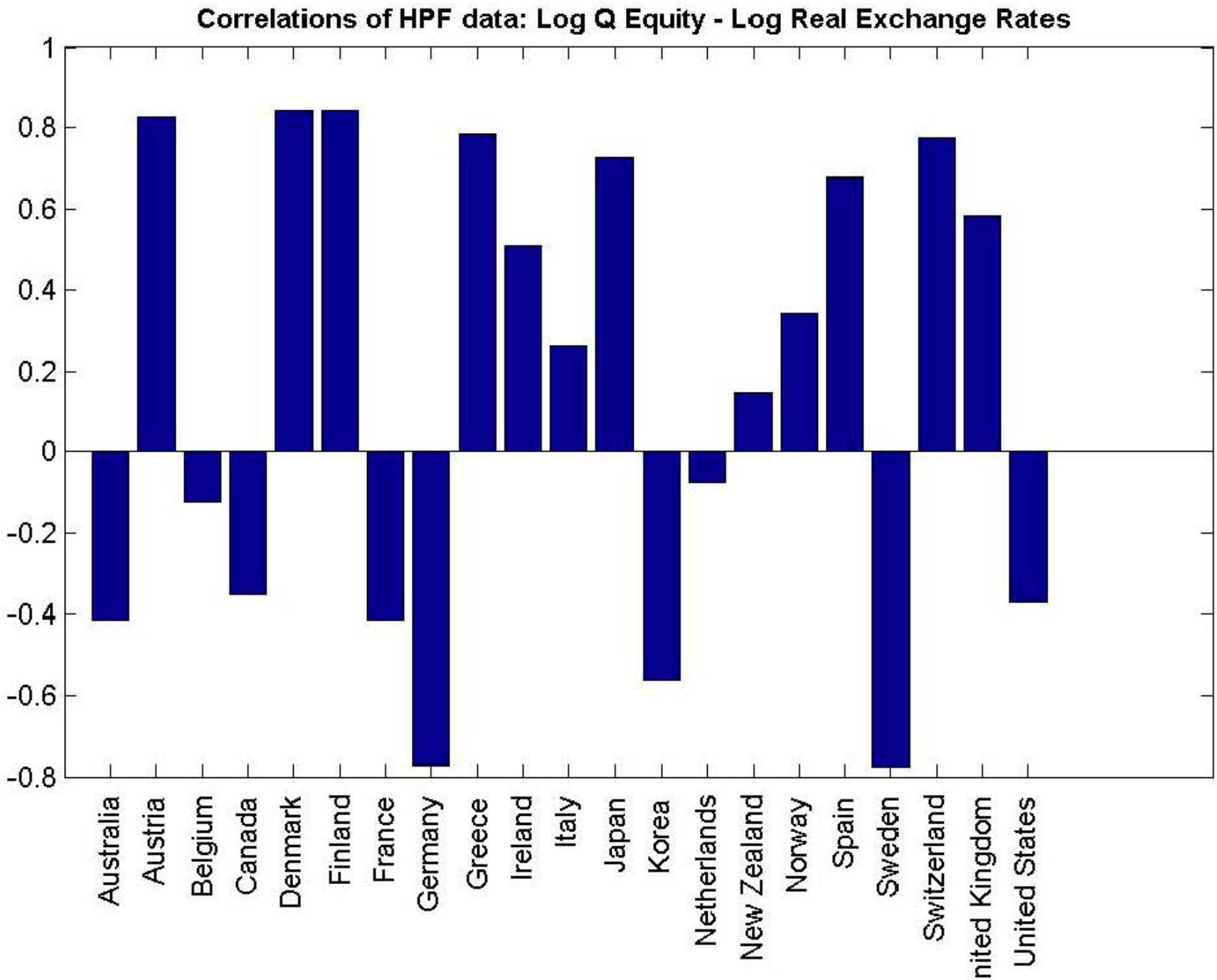


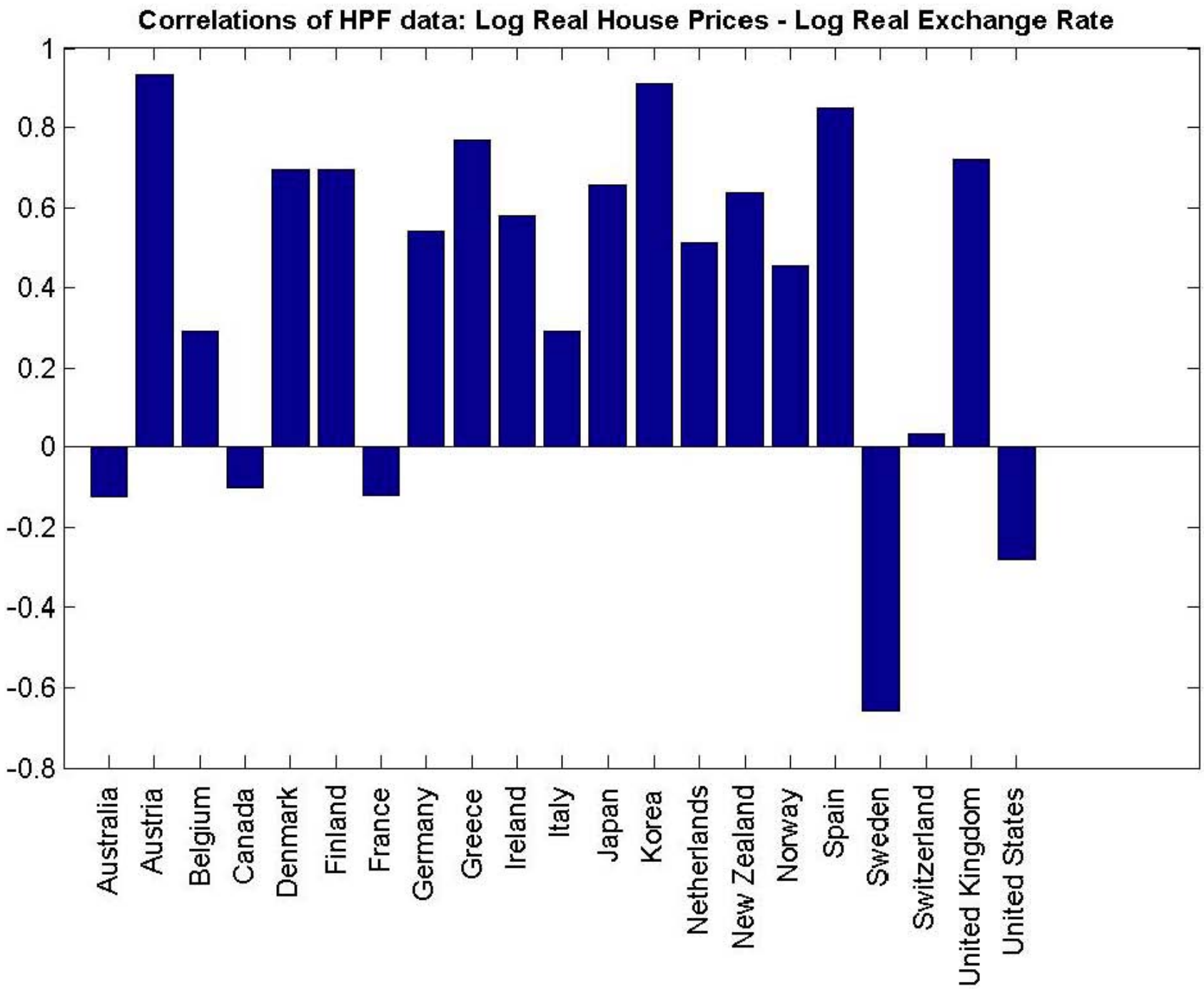
1. Main suspect: **increased degree of stickiness** in prices of differentiated goods
2. Need a **new** story linking: $\uparrow$ trade $\leftrightarrow$ $\uparrow$price stickiness in differentiated goods

Some facts about exchange rates and asset prices in SOEs

1. **Equity** prices and real **housing prices** strongly **co-move**
2. Real ex. rates and **housing** prices (very) positively correlated
3. Real ex. rates and **equity** prices positively correlated, but less obvious across countries


Correlations of HPF data: Log Q Equity - Log Real House Prices
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Ireland
Italy
Japan
Korea
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States


Correlations of HPF data: Log Q Equity - Log Real Exchange Rates
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Ireland
Italy
Japan
Korea
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
nited Kingdom
United States


Correlations of HPF data: Log Real House Prices - Log Real Exchange Rate
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Greece
Ireland
Italy
Japan
Korea
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States

Real Exchange Rate Decomposition

$$
\begin{aligned}
RER_t &= \left(\frac{\mathcal{E}_t P^*_{T,t}}{P_{T,t}}\right) \times \frac{\left(P_{T,t}/P_{N,t}\right)^{1-\omega}}{\left(P^*_{T,t}/P^*_{N,t}\right)^{1-\omega^*}} \\
&= RER_{T,t} \times RER_{N,t}
\end{aligned}
$$

- Mechanical effect of housing price variations on $RER_{N,t}$?
- Role of **credit (booms)**

Imperfect Financial Markets

Recent contributions

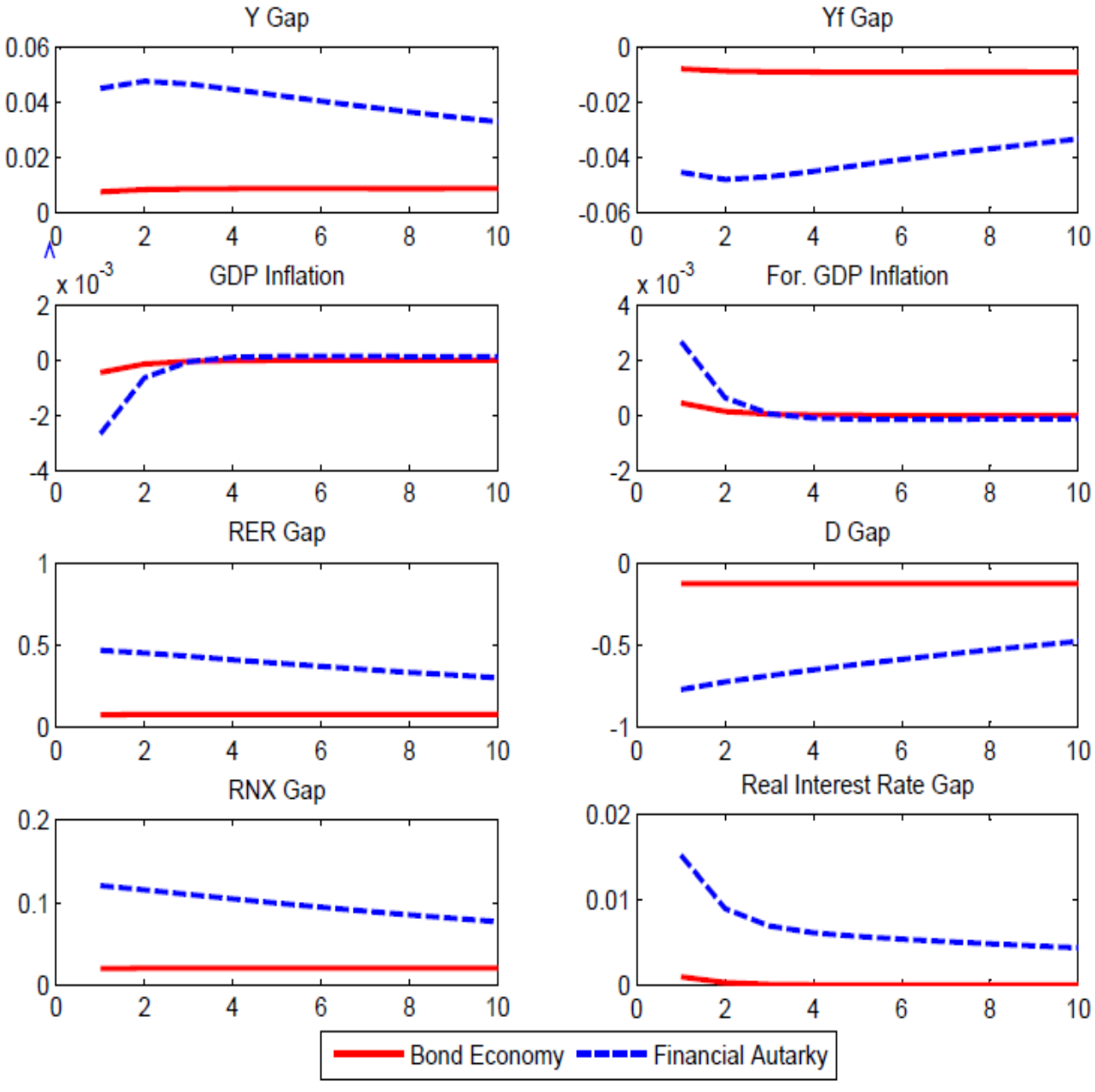
- Benigno (2009), De Paoli (2010), Corsetti, Dedola and Leduc (Handbook chp. 2010), Devereux and Sutherland (2009)

Financial imperfections in these papers

$\longrightarrow$Financial autarky
$\longrightarrow$Bond economy

- Insight: "consumption imbalances" (CDL) generate wedge in the **risk-sharing** condition
- Under some conditions, can exist a **tradeoff** between (i) domestic **markup** stabilization and (ii) **"consumption-wedge"** stabilization

Quasi-divine coincidence again?



- But in all cases, frictions assumed **exogenously**

Looking forward

1. Making financial imperfections **endogenous**
2. An **integrated** approach to optimal policy analysis

Two types of frictions

1. Limited commitment
2. Adverse selection

- Both types of frictions can become **endogenously binding**

Limited commitment

- Typically at the core of models such as Kiyotaki and Moore (1997), Cooley, Marimon and Quadrini, Quadrini and Jermann (2009).
- But also Bernanke and Gertler (1989), Bernanke, Gertler and Gilchrist (1999), Carlstrom and Fuerst
- More recently: Christiano et al. (2008), Gertler and Kiyotaki (2010).

Example for a SOE

- Households

$$\mathbb{E}_t \left\{ \sum_{t=0}^{\infty} \beta^t U(X_{,t}, N_t) \right\}$$

$$X_t = \left(\gamma^{\frac{1}{\theta}} C_t^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} D_t^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}$$

$$C_t = \left(\alpha^{\frac{1}{\eta}} C_{h,t}^{\frac{\eta-1}{\eta}} + (1-\alpha)^{\frac{1}{\eta}} C_{f,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

- Sequence of budget constraints:

$$P_{C,t}C_t + P_{D,t}\left(D_t - D_{t-1}(1-\delta)\right) + \mathcal{E}_t R^*_{t-1} B^*_{t-1} = W_t N_t + \mathcal{E}_t B^*_t + \tau_t$$

- **Limited commitment**

$\rightarrow$Cannot commit today to repay tomorrow more than the expected value of collateral

$$\underbrace{R^*_t B^*_t}_{\substack{\text{in} \\ \text{foreign} \\ \text{currency}}} \leq (1-\chi)\mathbb{E}_t\left\{\frac{P_{D,t+1}D_t}{\mathcal{E}_{t+1}}\right\}$$

A Simple Theory of the Credit Spread

- **Pseudo-Euler** condition

$$\lambda_t = \beta \mathbb{E}_t \left\{ \lambda_{t+1} R_t^* \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \right\} + \frac{\psi_t}{\mathcal{E}_t} \lambda_t R_t^*$$

- Effective real interest rate

$$m_t \equiv \frac{\lambda_{e,t}}{\beta_e \lambda_{e,t+1}}$$

Credit spread s_t

$$
\begin{aligned}
s_t &\equiv \mathbb{E}_t \left\{ m_t - R_t^* \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \right\} \\
&= R_t^* \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \frac{\psi_t (R_t^* / \mathcal{E}_t)}{1 - \psi_t (R_t^* / \mathcal{E}_t)} \\
&= R_t^* \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \frac{\psi_t}{\mathcal{E}_t / R_t^* - \psi_t} \\
&=
\end{aligned}
$$

- Increasing in the shadow value of borrowing ψ_t
- Increasing in the expected **exchange rate** depreciation

Endogeneity of frictions

1. Value of collateral depends on **asset price** / **ex. rate** fluctuations
2. Borrowing constraint only **occasionally binding**

Extensions (1)

- Can add a **portfolio** problem: optimal **share** of borrowing in domestic/foreign currency

$$R_t B_t \leq (1-\chi)\mathbb{E}_t \left\{P_{D,t+1} D_t\right\}$$

$$R_t^* B_t^* \leq (1-\chi^*)\mathbb{E}_t \left\{\frac{P_{D,t+1} D_t}{\mathcal{E}_{t+1}}\right\}$$

- Link to growing literature on portfolio choice in general equilibrium

Devereux and Sutherland (2008), Tille and Van Wincoop (2008), Courdacier and Kollmann (2009).

- Role of **durables** in trade (Engel and Wang 2010)

Table 3: Share of Durable Goods in Trade

	Exclude Energy Products		Exclude Materials and Energy	
Country	Import	Export	Import	Export
Australia	0.70	0.56	0.71	0.45
Austria	0.69	0.67	0.70	0.69
Belgium	0.66	0.66	0.67	0.66
Canada	0.77	0.64	0.77	0.69
Czech Rep	0.72	0.75	0.73	0.77
Denmark	0.60	0.47	0.61	0.48
Finland	0.72	0.61	0.73	0.65
France	0.67	0.68	0.68	0.68
Germany	0.69	0.71	0.70	0.71
Hungary	0.74	0.77	0.75	0.78
Iceland	0.55	0.28	0.56	0.28
Ireland	0.73	0.59	0.73	0.59
Italy	0.65	0.64	0.66	0.64
Japan	0.57	0.89	0.58	0.89
Korea	0.76	0.78	0.77	0.78
Mexico	0.73	0.78	0.74	0.78
Netherland	0.68	0.60	0.69	0.61
New Zealand	0.66	0.26	0.66	0.26
Norway	0.70	0.59	0.71	0.61
Portugal	0.65	0.53	0.66	0.54
Spain	0.68	0.65	0.69	0.66
Sweden	0.68	0.73	0.69	0.76
Switzerland	0.65	0.69	0.66	0.69
UK	0.69	0.74	0.70	0.74
US	0.69	0.75	0.70	0.77
Mean	0.68	0.64	0.69	0.65
Median	0.69	0.66	0.70	0.68

Integrated approach to optimal policy

- Current approach: optimal stabilization policy **conditional** on financial imperfections being in place

$\rightarrow$Idea: there is an optimal policy for **normal** times vs. optimal policy for **turbulent** times

- But optimal policy in normal times should internalize that financial imperfections may become binding **in the future**
- Avoid **bening neglect** of asset price booms + credit booms + bubbles

- Business cycle literature of the crisis should learn more from the **sudden stops** literature

- References: Mendoza (2010), Mendoza and Smith (2006)

Adverse Selection

- Especially relevant during the crisis
- Focus: debt and liquidity in **interbank** markets

Debt overhang

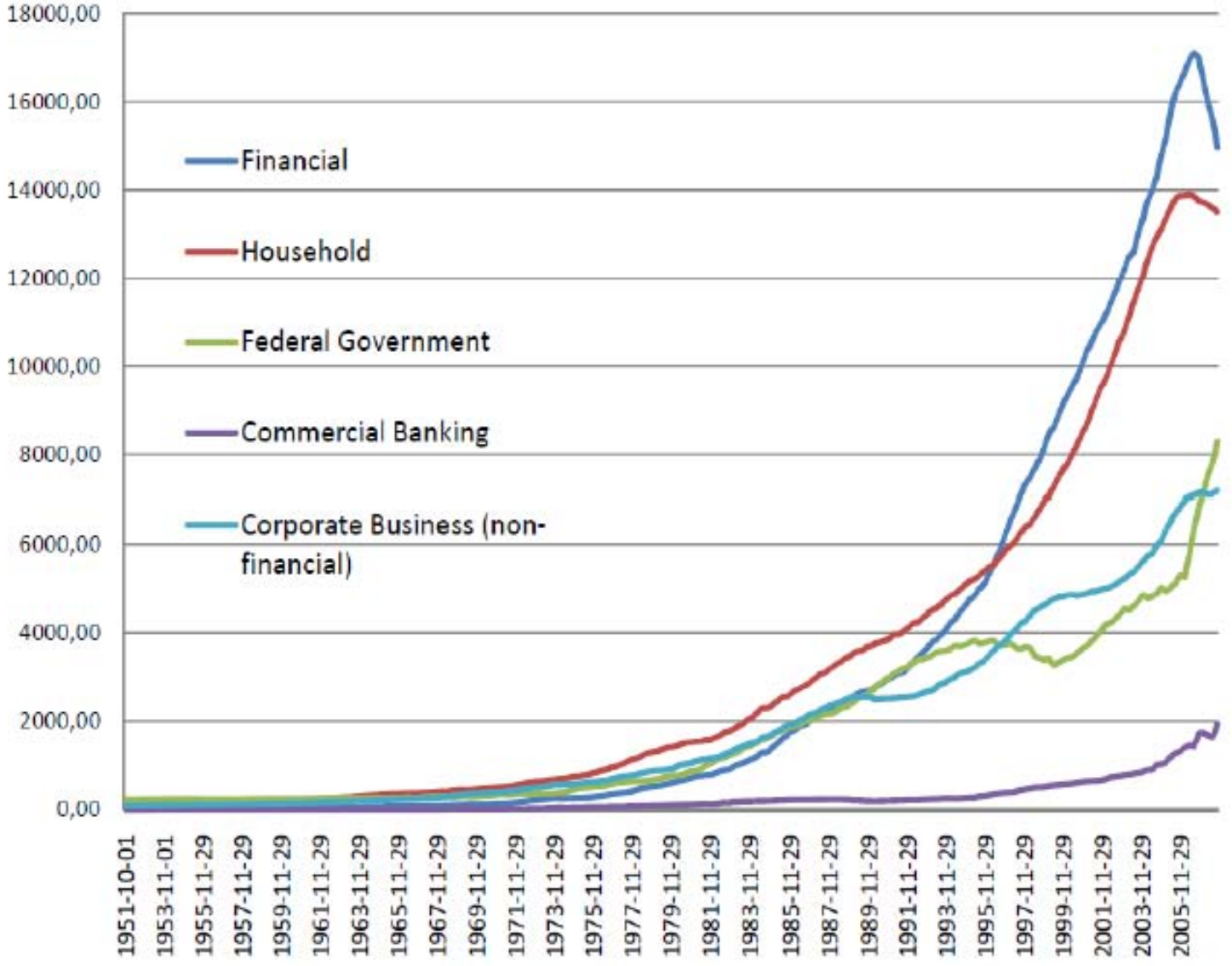
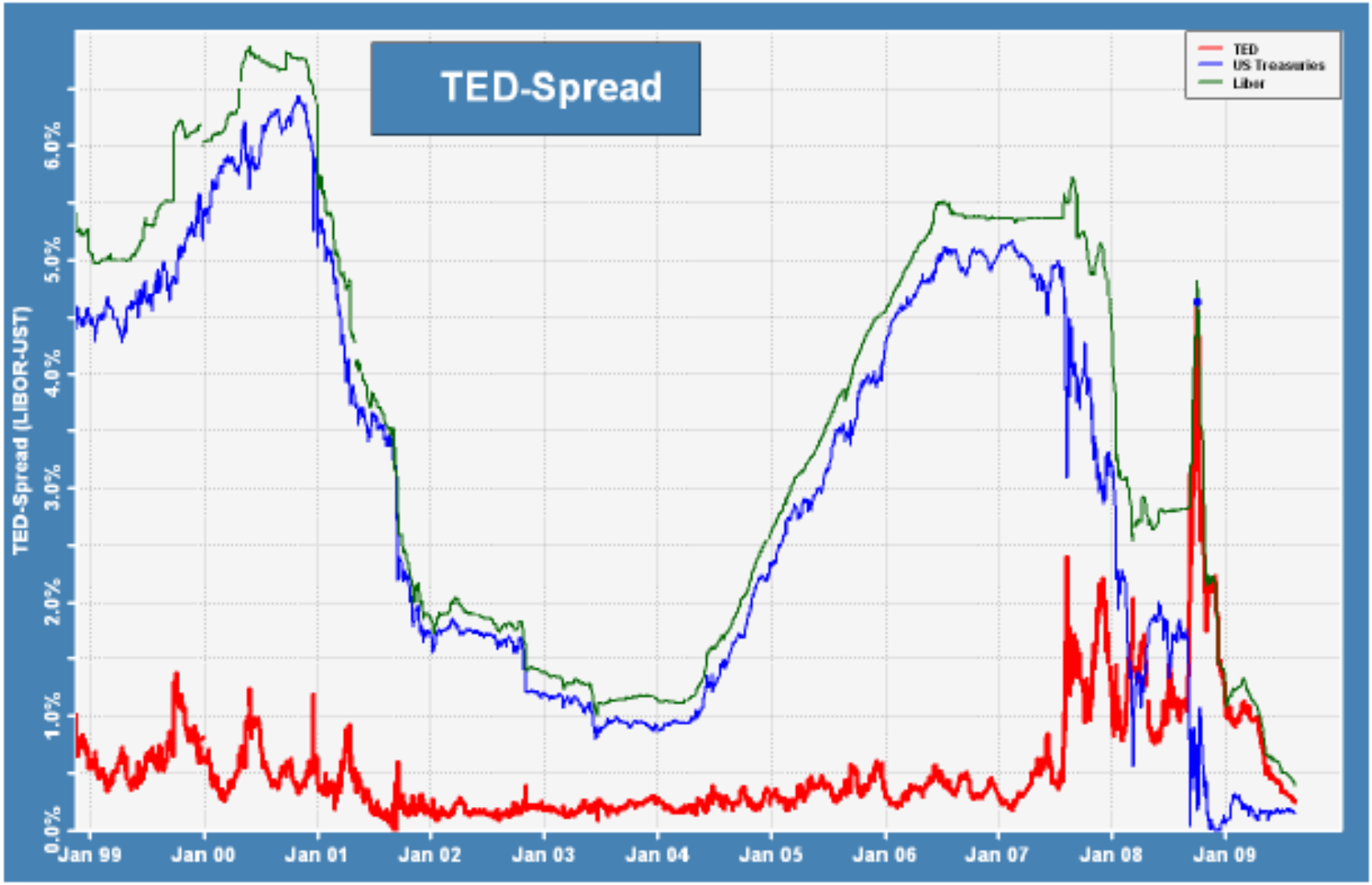


Figure: Total Credit Market Debt Owed: US Sectors

Debt markets subject to spirals



Liquidity and cost of finance

- Spirals involve **feedback effects** between the cost of finance and **liquidity** in the interbank market
- Liquidity = **perceived safety** of the assets traded in the market.
- Holmstrom (2008): necessary condition for asset to be **liquid** is that market participants **know its value**.

Amplification

- Bad news hit $\longrightarrow$ **informational asymmetries** become more acute $\longrightarrow$ Market participants cast **doubts** on the value of the assets
- **Two effects**

1. Asset prices fall
2. Asset liquidity shrinks

$\Longrightarrow$Debt markets become "**markets for lemons**" (Tirole 2010)
$\Longrightarrow$It's **adverse selection**

Banks

- Some important elements

1. **"Shadow banks"** and interbank/repo market

2. Maturity **mismatch** and liquidity problem

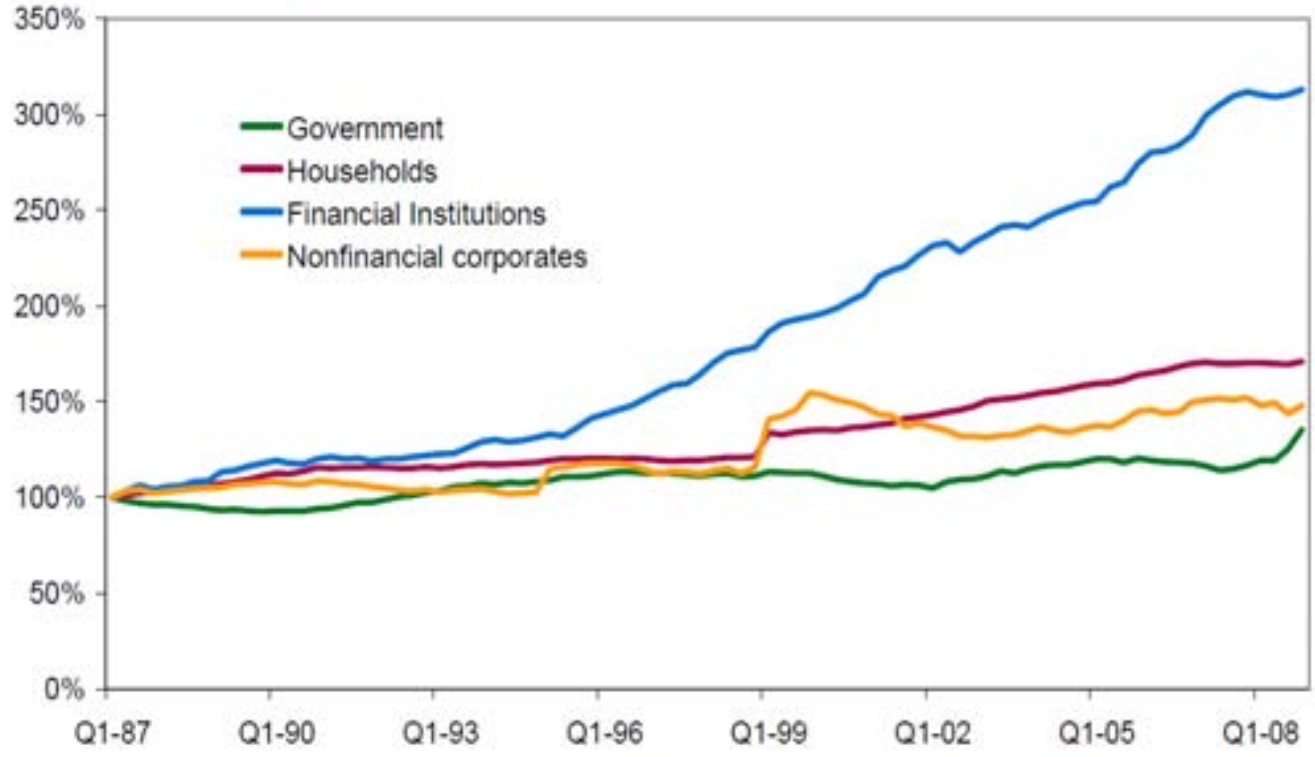
3. The "right" financial **shock**

Financial intermediaries

$\longrightarrow$ Current crisis: key role of **balance-sheet** effects of banks

Figure 1.3. Ratio of Debt to GDP Among Select Advanced Economies

(In percent, GDP-weighted, 1987 = 100)



Key element in the crisis

- **Liquidity** problem for "new" financial intermediaries

	Assets	**Liabilities**
traditional banks	long-term loans	deposits
"investment" banks	MBS	short-term debt

Boom of securitized products

- Used as collateral in interbank/repo markets

Fraction of **AAA rated securities**	
securitized products	60%
corporate bonds	1%

(source Fitch, 2007)

Gigantic maturity mismatch

- Banks held **long-term** assets (e.g., MBS) financed via **short-term** debt (e.g., commercial paper)
- When things deteriorate it is the **liquidity** problem that matters

The role of securitization

- Diversifies **idiosyncratic** risk, but increases sensitivity to **aggregate** risk

The magic of securitization

Coval, Jurek, and Stafford (2010)

- Suppose **two** identical bonds, each with probability of **NOT** default $= 0.9 \rightarrow$ prob. default $= 1- 0.9 = 0.1$
- NB: prob. default **uncorrelated**

- Combine them in a **CDO** (collateralized debt obligation)

1. *Junior* tranche: pay if **both** tranches do **not** default
2. *Senior* tranche: defaults only if **both** default

	PAY	DEFAULT
junior	$0.9^2 = 0.81$	$1 - 0.81 = 0.19$
senior	0.99	$(1 - 0.9)^2 = 0.01$

- Result: **credit enhancement** for the senior tranche
- "Side effect": tranches become **correlated** even if underlying assets are not

Dynamics of crisis

Bad shock (*what is this?*)
$\Longrightarrow$Financial conditions deteriorate
$\Longrightarrow$Lenders reduce exposure $\rightarrow$Ask to service debt
$\Longrightarrow$Banks try to **fire sale** long-term illiquid assets

Liquidity friction

- At least as crucial as borrowing friction
- Is it "fire-sale per se" or is it "fire sale" of long-term illiquid assets"?

$\longrightarrow$ Requires modelling of:
(i) **Interbank** market
(ii) **Maturity** of assets

Sketch of a model with two ingredients

- "Banks sudden stop"
- Shock to haircut margins

Agents

- Savers

$$c_{s,t} + \underbrace{d_t}_{\text{deposits}} = r^d_{t-1} d_{t-1} + w_t$$

- Entrepreneurs

$$c_{e,t} + q_t \left(k_{e,t} - k_{e,t-1}\right) + \frac{1}{m} \sum_{k=1}^{m} r^l_{t-k}(m) l_{t-k}(m) = \underbrace{l_t(m)}_{\text{long-term loans}} + y_t$$

$$\underbrace{r^l_t(m) l_t(m) \leq (1-\chi) \mathbb{E}_t \left\{k_{e,t+m-1} q_{t+m}\right\}}_{\text{collateral constraint}}$$

Banks

- **Commercial** banks

$$b_t + \Phi(b_t) = d_t$$

Banks (con't)

- **Investment** banks

$$V\left(b_{t-1}, l_{t-k}, \gamma_t\right) = \max_{x_t, b_t, l_t} \left[x_t + \beta_x \mathbb{E}_t \left\{V\left(b_t, l_t, \gamma_{t+1}\right)\right\}\right]$$

$$x_t = b_t + \frac{1}{m} \sum_{k=1}^{m} r^l_{t-k}(m) l_{t-k}(m) - l_t(m)$$

s.t. **haircut constraint:**

$$\underbrace{r^b_t b_t}_{\text{short-term borrowing}} \leq \underbrace{(1-\gamma_t)}_{\text{haircut shock}} l_t(m)$$

- Banks' **sudden stop**: haircut constraint becomes (endogenously) binding