Obstfeld and Rogoff's International Macro Puzzles: A Quantitative Assessment

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Introduction

- "Puzzle": Gap between fact and textbook model prediction
- Obstfeld and Rogoff (Macro Annual 2001, "OR") see international macro as replete with puzzles:
  1. Home Bias in Absorption
  2. Feldstein-Horioka Puzzle
  3. Home Bias in Equities
  4. Low Consumption Correlation
  5. Failure of Relative Purchasing Power Parity
  6. Exchange Rate Disconnect
- These are so-called "OR 6 Puzzles"

Obstfeld and Rogoff's Proposition

- All these puzzles can be accounted for by trade frictions
- Killing 6 birds with one stone! Plus, trade frictions are easier to measure than capital market imperfections
- OR's story is provocative, but does it have quantitative bite?
- OR explored it only in stylized two-country examples

Initial Skepticism

- Charles Engel (Macro Annual Discussant):

  "OR provide us with extraordinary intuition for why goods markets move things in the right direction, but we need more study to be able to reconcile their compelling but simplified examples with the results that emerge from simulation of more fully specified dynamic models."

- John Leahy (Macro Annual General Discussion):

  "...the effects identified in this paper might turn out to be quantitatively small in a realistically calibrated model."

How We Enter

- EKNR (2011, ..., AER 2016) develop a dynamic quantitative multi-country and multi-sector model
- Structural accounting approach: the shocks/wedges (trivially) "explain" the data
- There, used it to isolate drivers of 2008-2009 trade collapse
- Here, use it to imagine an (otherwise realistic) world without manufacturing trade frictions

What We Do

- Simulate data from a counterfactual that eliminates trade frictions but preserves all other shocks as extracted from data
- If puzzles disappear (or much reduced) in simulated data, then we conclude OR's proposition has quantitative bite.
- If puzzles remain stark in counterfactual, then something else is going on.
- We evaluate 5 of the 6 puzzles – we have nothing to say about home bias in equity portfolios

Related Literature

- **International Macro Puzzles**: Vast literature including Backus, Kehoe, and Kydland (1992), Backus and Smith (1993), Bai and Zhang (2010), Baxter and Crucini (1993), Heathcote and Perri (2013), Stockman and Tesar (1995)

- **OR Agenda**: Obstfeld and Rogoff (2001), Corsetti, Dedola, and Leduc (2008), Coeurdacier (2009), Fitzgerald (2012), Reyes-Heroles (2015), Alessandria and Choi (2015)

- **Methods**: Chari, Kehoe, McGrattan (2007), Deckle, Eaton, and Kortum (2008), Kehoe, Ruhl, and Steinberg (2014)

Agenda

- The OR Puzzles in Baseline
- Simplified Version of Our Model
- Change Formulation
- Backing Out Shocks
- Counterfactuals
- The OR Puzzles with Frictionless Trade

Our Data

- Quarterly data on manufacturing trade, GDP, production, and prices from 2000:Q1 to 2012:Q4
- 4 sectors: Construction, Durable Manufactures, Nondurable Manufactures, Services
- 18 countries + plus ROW which aggregates rest of world

Puzzle 1: Home Bias in Absorption

Ratio of Domestic Purchases to Imports in 2005:Q4

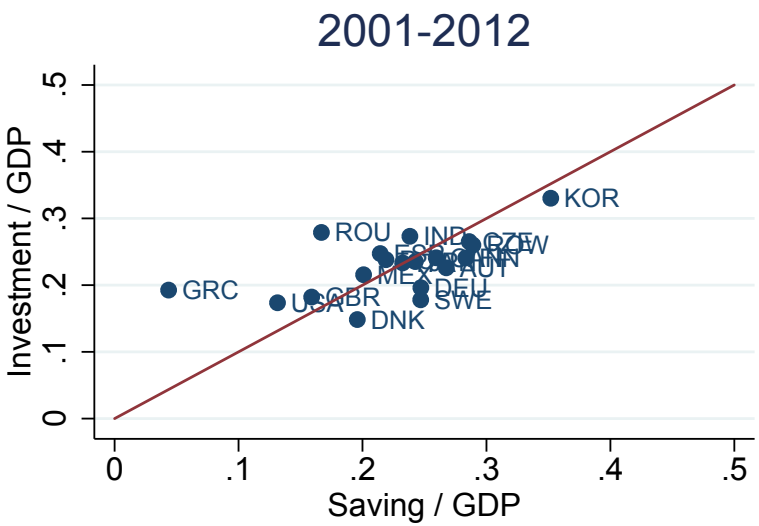
Country	Baseline		Frictionless Trade	
	Durables	Nondurables	Durables	Nondurables
Austria	0.30	0.50		
Canada	0.75	1.99		
Czech Republic	0.62	1.15		
Denmark	0.17	0.42		
Finland	1.19	2.14		
Germany	1.16	1.37		
Greece	1.12	1.84		
India	3.24	8.00		
Italy	2.42	3.14		
Japan	6.39	6.50		
Mexico	0.77	3.39		
Poland	0.88	2.04		
Romania	0.61	1.11		
South Korea	3.30	4.56		
Spain	1.50	2.56		
Sweden	0.86	1.12		
United Kingdom	0.63	1.67		
United States	2.18	5.13		
Rest of World	2.54	4.82		

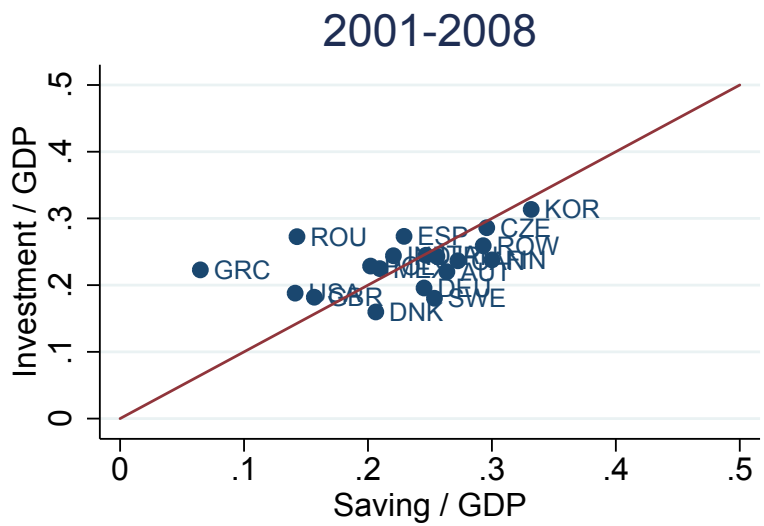
Puzzle 1: Home Bias in Absorption

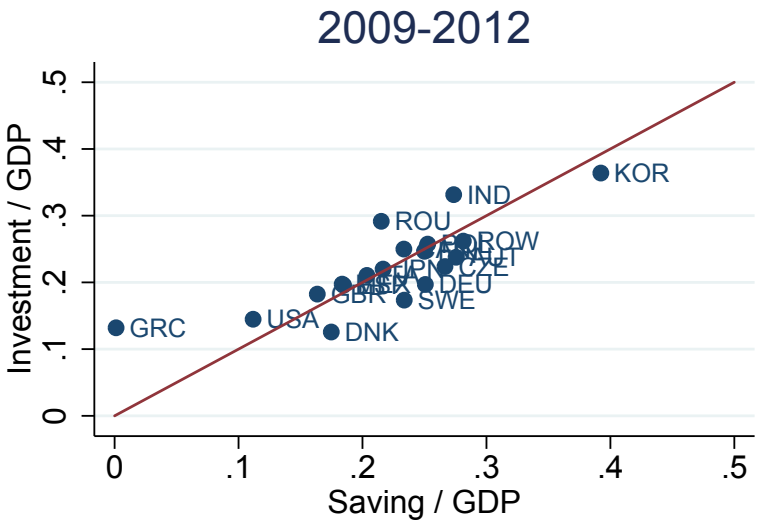
Gravity Regressions in 2005:Q4

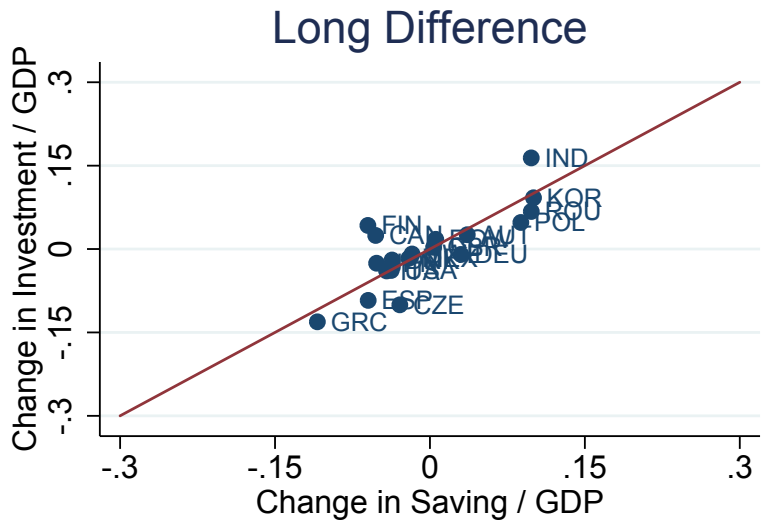
Country	**Baseline**		**Frictionless Trade**	
	Durables	**Nondurables**	**Durables**	**Nondurables**
Distance	-1.301***	-1.432***		
	(0.113)	(0.105)		
Contiguous	0.073	0.148		
	(0.200)	(0.210)		
Common Language	0.508***	0.554***		
	(0.163)	(0.120)		
Constant	-3.217***	-4.188***		
	(0.187)	(0.167)		
Importer FE	YES	YES		
Exporter FE	YES	YES		
Observations	306	306		
R-squared	0.93	0.92		

Puzzle 2: Feldstein-Horioka







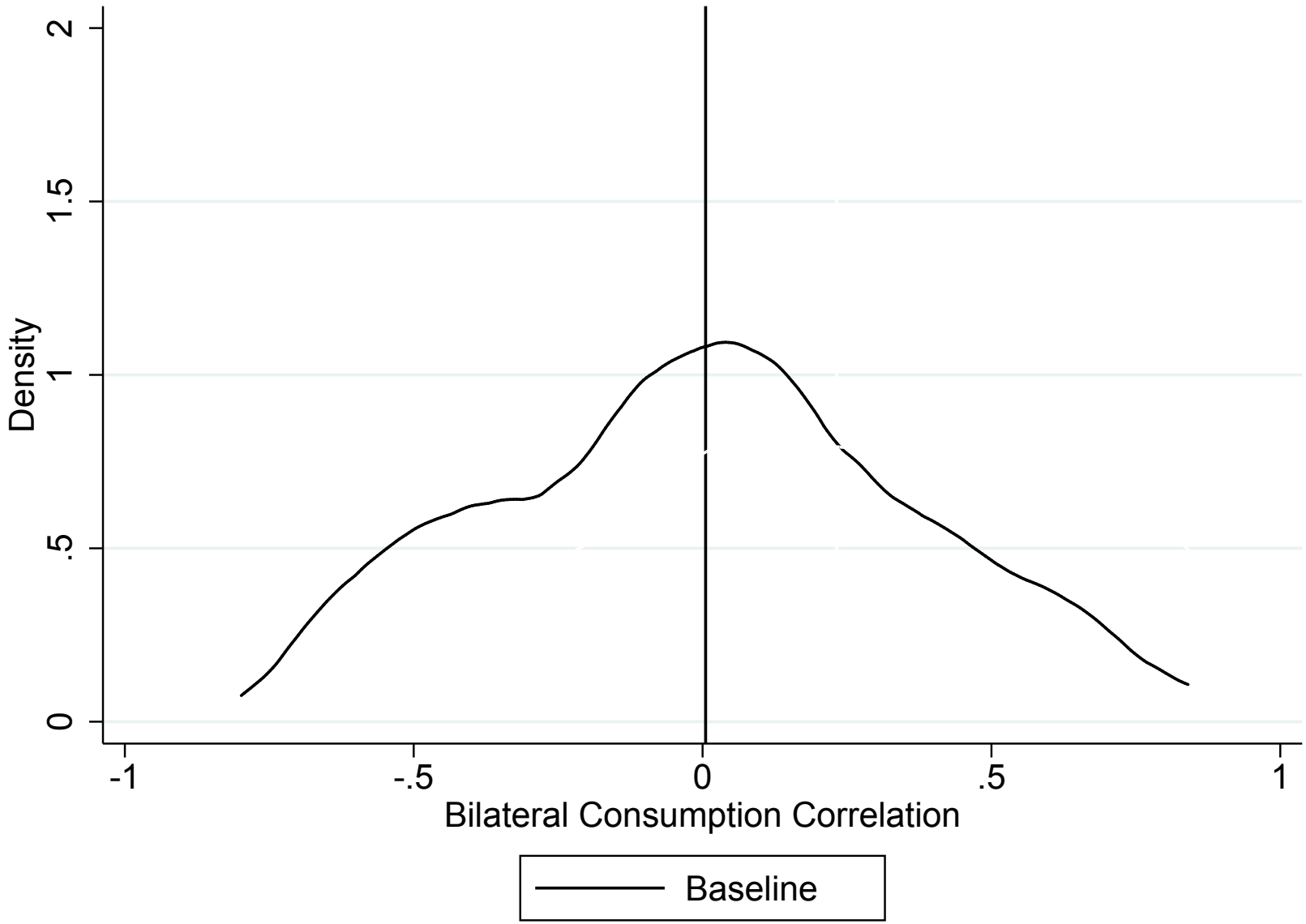


Puzzle 2: Feldstein-Horioka

Dependent Variable: Investment

	Baseline				Frictionless Trade			
	2001-12	**2001-08**	**2009-12**	**Long Difference**	**2001-12**	**2001-08**	**2009-12**	**Long Difference**
Saving	0.378**	0.254*	0.630***	0.881***				
	(0.134)	(0.142)	(0.120)	(0.179)				
Constant	0.144***	0.174***	0.0852***	0.003				
	(0.032)	(0.034)	(0.028)	(0.010)				
Observations	19	19	19	19				
R-squared	0.34	0.18	0.63	0.63				

Puzzle 4: Low International Consumption Correlations



Puzzle 4: Low International Consumption Correlations

Moments of Distribution of Bilateral Pairs

	Quarterly		Annual	
	Baseline	**Frictionless Trade**	**Baseline**	**Frictionless Trade**
Mean	0.03		0.01	
Median	0.04		0.01	
Maximum	0.45		0.84	
Minimum	-0.55		-0.80	

Puzzle 5: Relative Purchasing Power Parity

Standard Deviation of Inflation Across Countries

	Quarterly		Annual	
	Baseline	**Frictionless Trade**	**Baseline**	**Frictionless Trade**
Construction	0.177		0.073	
Durables	0.095		0.048	
Nondurables	0.100		0.051	
Services	0.124		0.063	
CPI	**0.114**		**0.059**	

Puzzle 6: Exchange Rate Disconnect

Variation in Nominal GDP, Real GDP, Real Exchange Rate

	Quarterly						Annual					
	Baseline			Frictionless Trade			Baseline			Frictionless Trade		
	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER
Austria	0.066	0.026	0.066				0.031	0.008	0.031			
Canada	0.109	0.021	0.107				0.046	0.011	0.044			
Czech Republic	0.102	0.020	0.100				0.062	0.014	0.057			
Denmark	0.068	0.031	0.059				0.025	0.007	0.029			
Finland	0.057	0.037	0.068				0.032	0.016	0.033			
Germany	0.057	0.024	0.064				0.029	0.017	0.036			
Greece	0.119	0.060	0.097				0.079	0.046	0.042			
India	0.120	0.043	0.112				0.065	0.018	0.051			
Italy	0.066	0.014	0.066				0.038	0.006	0.039			
Japan	0.209	0.034	0.207				0.093	0.015	0.088			
Mexico	0.164	0.027	0.164				0.084	0.016	0.072			
Poland	0.152	0.031	0.167				0.070	0.018	0.076			
Romania	0.179	0.066	0.170				0.095	0.032	0.075			
South Korea	0.147	0.032	0.133				0.085	0.016	0.081			
Spain	0.075	0.020	0.064				0.052	0.013	0.042			
Sweden	0.086	0.028	0.079				0.049	0.012	0.041			
United Kingdom	0.091	0.020	0.090				0.053	0.010	0.049			
United States	0.153	0.020	0.147				0.067	0.012	0.060			
Rest of World	0.050	0.007	0.050				0.030	0.003	0.029			
Pooled	**0.120**	**0.042**	**0.115**				**0.064**	**0.033**	**0.056**			

Puzzle 6: Exchange Rate Disconnect

Dependent Variable: Log Change in Real GDP

	Quarterly				Annual			
	Baseline		Frictionless Trade		Baseline		Frictionless Trade	
Log Change in Nominal GDP	0.099***	0.064***			0.257***	0.146***		
	(0.019)	(0.017)			(0.045)	(0.027)		
Constant	0.019*	0.007			0.019***	0.013***		
	(0.006)	(0.008)			(0.007)	(0.004)		
Country FE	NO	YES	NO	YES	NO	YES	NO	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	893	893			209	209		
R-squared	0.37	0.63			0.48	0.86		

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Simplified Economy: Technology and Preferences

- Multiple countries $n = 1, ..., \mathcal{N}$.
- Good S ("Services") is a CES bundle of varieties $z \in [0, 1]$. Nontraded and used for consumption.
- Good D ("Durables") is a CES bundle of varieties $z \in [0, 1]$. Traded and used for investment.
- Country n may import durable variety from i, subject to $d_{ni,t}$.
- Complete markets, no uncertainty, perfect competition

Simplified Economy: Technology and Preferences

- Production in country n of variety z in sector $j \in \{D, S\}$:

$$y^j_{n,t}(z) = a^j_{n,t}(z) B \left(L^j_{n,t}(z) \right)^{\beta^L} \left(K^j_{n,t}(z) \right)^{\beta^K}$$

- Efficiencies $a^j_{n,t}(z)$ drawn from:

$$\Pr \left[a^j_{n,t}(z) \leq a \right] = exp \left(- \left(\frac{a}{\gamma A^j_{n,t}} \right)^{-\theta} \right)$$

- Factors of production are constrained by:

$$\begin{aligned} K_{n,t} &= \int_0^1 K^D_{n,t}(z) dz + \int_0^1 K^S_{n,t}(z) dz \\ L_{n,t} &= \int_0^1 L^D_{n,t}(z) dz + \int_0^1 L^S_{nt}(z) dz \end{aligned}$$

Simplified Economy: Technology and Preferences

- Investment:

$$I_{n,t} = \left(\int_0^1 x_{n,t}^D(z)^{(\sigma-1)/\sigma} dz \right)^{\sigma/(\sigma-1)},$$

where $x_{n,t}^D(z)$ is absorption in n of variety z of good D.

- Capital accumulation:

$$K_{n,t+1} = \chi_{n,t} \left(\frac{I_{n,t}}{K_{n,t}} \right)^{\alpha} K_{n,t} + (1-\delta) K_{nt}$$

Simplified Economy: Technology and Preferences

- Consumption:

$$C_{n,t} = \left(\int_0^1 x_{n,t}^S(z)^{(\sigma-1)/\sigma} dz \right)^{\sigma/(\sigma-1)},$$

where $x_{n,t}^S(z) = y_{n,t}^S(z)$ is absorption in n on vty z of good S.

- Demand shocks allow for changes in relative spending:

$$U_n = \sum_{t=0}^{\infty} \rho^t \phi_{n,t} \ln C_{n,t}$$

Simplified Economy: Planner's Problem

- We solve Planner's problem. Planner uses weights ω_n.
- We impose a restriction so demand has no global component:

$$\sum_{n=1}^{\mathcal{N}} \omega_n \phi_{n,t} = 1$$

- We interpret shadow prices as competitive prices. For example, we replace $\lambda_{n,t}^K$ with $r_{n,t}$.

Simplified Economy: Consumption and Investment

- Investment Euler ($X^D_{n,t} = p^D_{n,t} I_{n,t}$):

$$\frac{p^D_{n,t}}{\alpha \chi_{n,t}} \left(\frac{X^D_{n,t}}{p^D_{n,t} K_{n,t}} \right)^{1-\alpha} = \rho r_{n,t+1} + \rho \frac{p^D_{n,t+1}}{\alpha \chi_{n,t+1}} \left(\frac{X^D_{n,t+1}}{p^D_{n,t+1} K_{n,t+1}} \right)^{1-\alpha} \times \left[\chi_{n,t+1} (1-\alpha) \left(\frac{X^D_{n,t+1}}{p^D_{n,t+1} K_{n,t+1}} \right)^{\alpha} + (1-\delta) \right]$$

- Numeraire is world consumption expenditure:

$$\sum_{n=1}^{\mathcal{N}} p^S_{n,t} C_{n,t} = \sum_{n=1}^{\mathcal{N}} X^S_{n,t} = \sum_{n=1}^{\mathcal{N}} Y^S_{n,t} = \sum_{n=1}^{\mathcal{N}} \omega_n \phi_{n,t} = 1$$

Simplified Economy: Production, GDP, Factor Payments

- Durable production $Y^D_{n,t}$ must be globally absorbed $X^D_{n,t}$:

$$Y^D_{i,t} = \sum_{n=1}^{\mathcal{N}} \pi_{ni,t} X^D_{n,t}$$

- GDP:

$$Y_{n,t} = Y^D_{n,t} + Y^S_{n,t}$$

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Simplified Economy: System in Changes

- Now, imagine we have data on levels of GDP $Y_{n,s}$, Consumption $Y^S_{n,s}$, and trade shares $\pi_{ni,s}$ at some $s = t^I$
- Assume the path of shocks $\{\hat{\chi}_{n,s}, \hat{A}^D_{n,s}, \hat{L}_{n,s}, \hat{\phi}_{n,s}, \hat{d}_{ni,s}\}_{s=t^I+1}^{s=\infty}$ *in changes* (i.e. where $\hat{x}_{t+1} = x_{t+1}/x_t$)
- With the vector $\hat{K}_{n,t^I+1}$, we can iterate system forward. No need to know K_{n,t^I} or $\{\chi_{n,t^I}, A^D_{n,t^I}, L_{n,t^I}, \phi_{n,t^I}, d_{ni,t^I}\}$
- 4 equations x 4 unknowns: $\hat{Y}_{n,t+1}$, $\hat{Y}^S_{n,t+1}$, $\hat{\pi}_{n,t+1}$, $\hat{p}^D_{n,t+1}$.

Simplified Economy: System in Changes

- So, given:
  1. Data on Y_{n,t^I}, Consumption Y^S_{n,t^I}, and trade shares π_{ni,t^I},
  2. Assumed shock values in changes, and
  3. A guess of $\hat{K}_{n,t^I+1}$,

  we get $\{\hat{Y}_{n,t^I+1}, \hat{Y}^S_{n,t^I+1}, \hat{\pi}_{ni,t^I+1}\}$ and generate t^I+1 levels.

- We update capital growth with:

$$\hat{K}_{n,t^I+2} - (1-\delta) = \hat{\chi}_{n,t^I+1} \left(\frac{\hat{X}^D_{n,t^I+1}}{\hat{p}^D_{n,t^I+1} \hat{K}_{n,t^I+1}} \right)^{\alpha} \left[\hat{K}_{n,t^I+1} - (1-\delta) \right]$$

- Repeat for the change from t^I+1 to t^I+2 and march forward

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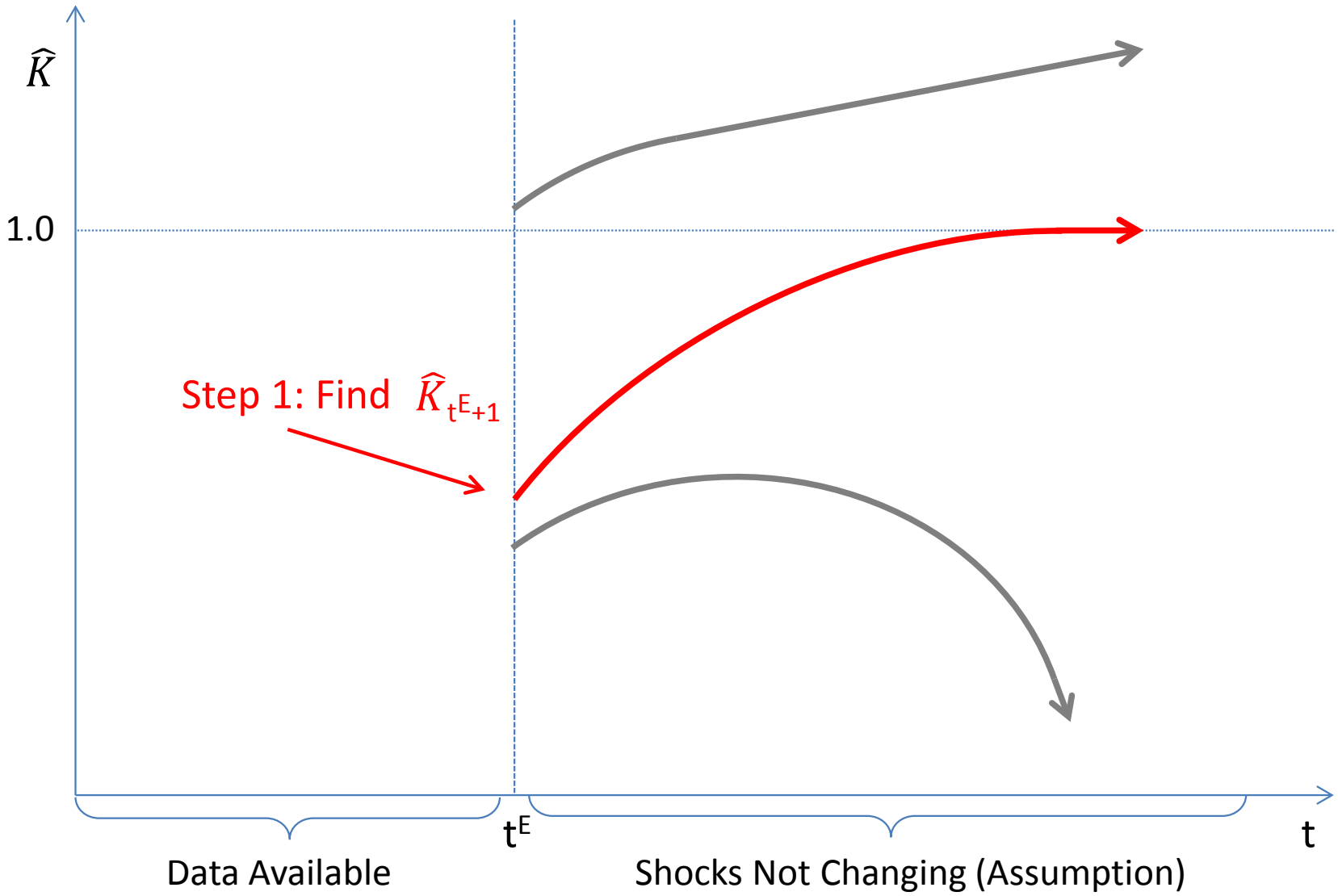
Simplified Economy: Backing Out Shocks

- Where do shocks and capital (in changes) come from?
- **Step 1:** Imagine all shocks stop changing after t^E, i.e. $\{\hat{\chi}_s, \hat{A}^D_s, \hat{L}_s, \hat{\phi}_{n,s}, \hat{d}_{ni,s}\} = \{1, 1, 1, 1, 1\}$ for $s > t^E$

  We solve for the vector $\hat{K}_{n,t^E+1}$ which – together with data on Y_{n,t^E}, Y^S_{n,t^E}, π_{ni,t^E} – leads to a steady state with:

$$\hat{K}_n = \hat{Y}_n = \hat{Y}^S_n = \hat{\pi}_{ni} = 1$$

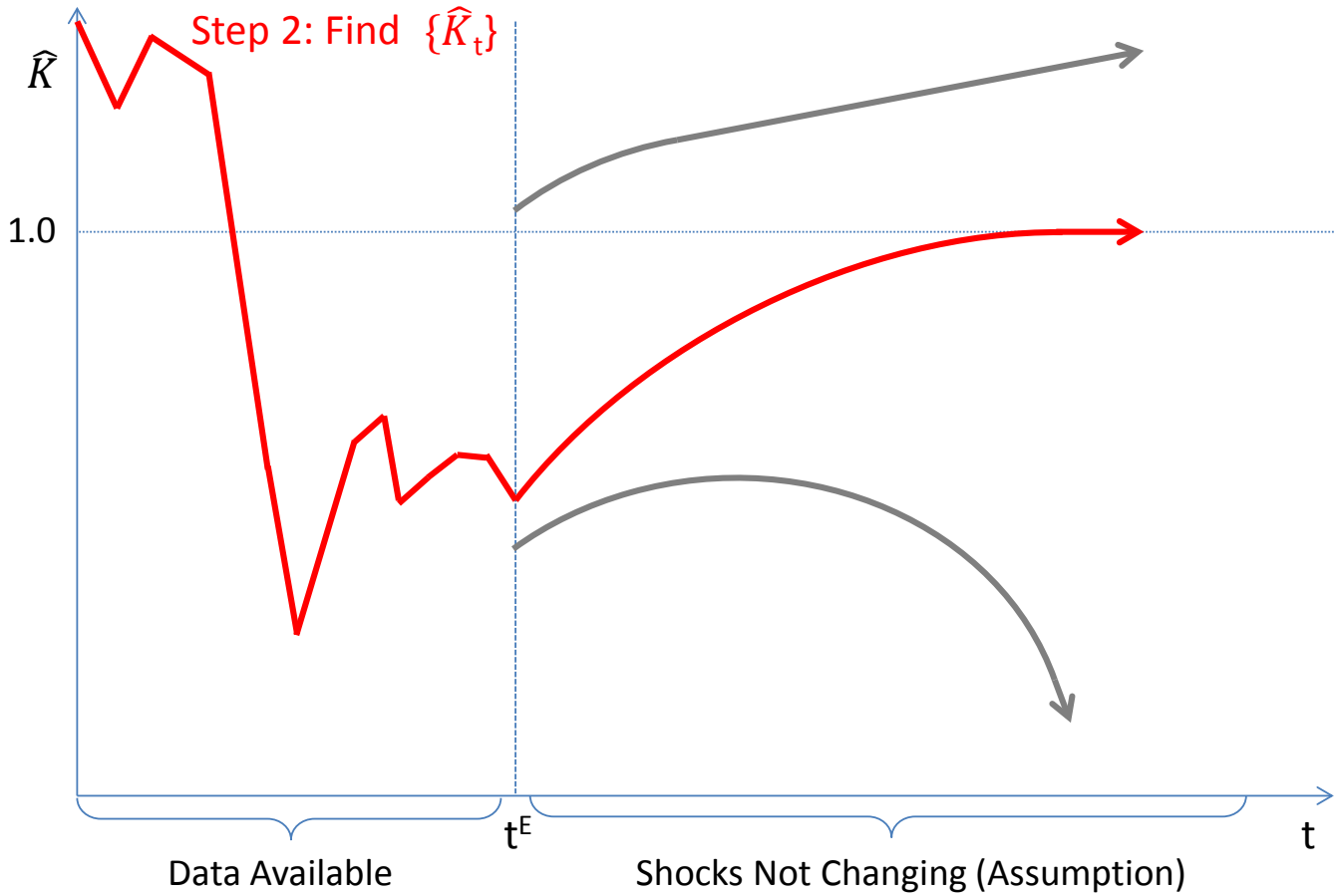
Simplified Economy: Backing Out Shocks



Simplified Economy: Backing Out Shocks

- **Step 2:** Iterate backwards by substituting LOM for K into Euler (χ cancels!) to get $\hat{K}_{s+1}$ for $s < t^E$:

$$\frac{\hat{K}_{i,t}}{\hat{K}_{i,t} - (1-\delta)} = \rho\beta^K \alpha \frac{Y_{i,t-1}\hat{Y}_{i,t}}{X^D_{i,t-1}} + \rho\hat{X}^D_{i,t}\left((1-\alpha) + \frac{1-\delta}{\hat{K}_{i,t+1} - (1-\delta)}\right)$$



Simplified Economy: Backing Out Shocks

- **Step 3:** Given paths of $\hat{K}_{n,t+1}$, $\hat{Y}_{n,t+1}$, $\hat{Y}^S_{n,t+1}$, $\hat{p}^D_{n,t+1}$, and $\hat{\pi}_{ni,t+1}$, can back out five shocks to fit data

  1. Labor Shocks $\hat{L}_{n,t+1}$ from the data

  2. Demand Shocks from consumption spending growth:

$$\hat{\phi}_{n,t+1} = \hat{X}^C_{n,t+1} = \hat{Y}^C_{n,t+1}$$

  3. Productivity Shocks from the Dual:

$$\hat{A}^D_{n,t+1} = \frac{\left(\frac{\hat{Y}_{n,t+1}}{\hat{L}_{n,t+1}}\right)^{\beta^L}\left(\frac{\hat{Y}_{n,t+1}}{\hat{K}_{n,t+1}}\right)^{\beta^K}}{\hat{p}^D_{n,t+1}}\left(\hat{\pi}_{nn,t+1}\right)^{1/\theta}$$

Simplified Economy: Backing Out Shocks

- **Step 3 Cont'd:** Given paths of $\hat{K}_{n,t+1}$, $\hat{Y}_{n,t+1}$, $\hat{Y}^S_{n,t+1}$, $\hat{p}^D_{n,t+1}$, and $\hat{\pi}_{ni,t+1}$, can back out all other shocks to fit data

  4. We back out trade frictions as:

$$\hat{d}_{ni,t+1} = \left(\frac{\hat{\pi}_{ni,t+1}}{\hat{\pi}_{ii,t+1}} \right)^{-1/\theta} \frac{\hat{p}^D_{n,t+1}}{\hat{p}^D_{i,t+1}}$$

  5. We can then back out investment efficiencies as:

$$\hat{\chi}_{n,t+1} = \frac{\hat{K}_{n,t+2} - (1-\delta)}{\hat{K}_{n,t+1} - (1-\delta)} \left(\frac{\hat{X}^D_{n,t+1}}{\hat{p}^D_{n,t+1} \hat{K}_{n,t+1}} \right)^{-\alpha},$$

- Note: we don't need $\chi_{n,t}$, $A^D_{n,t}$, $L_{n,t}$, $\phi_{n,t}$, $d_{ni,t}$, or $K_{n,t}$.

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Full Model

- Same basic model but more detail for realistic calibration:
  1. $\mathcal{N} = 19$ (including ROW), four sectors $j \in \Omega = \{C, D, N, S\}$
  2. Output from sectors C and D accumulate into capital stocks
  3. Output from sectors N and S can be consumed
  4. Sectors D and N are tradable, sectors C and S are not
  5. Production combines factors K^C, K^D, and L with intermediates from $j \in \Omega$
  6. Input shares are country-sector specific: $\beta_i^{K,jk}$, $\beta_i^{L,j}$, and $\beta_i^{M,jl}$
  7. Feed in exogenous deficits in the S sector
  8. Relative demand for N and S impacted by $\psi_{n,t}^N$

Generate World Without Trade Costs

- Remember we extract trade costs from data with:

$$\hat{d}^j_{ni,t+1} = \left(\frac{\pi^j_{ni,t+1}/\pi^j_{ni,t}}{\pi^j_{ii,t+1}/\pi^j_{ii,t}} \right)^{-1/\theta} \frac{p^j_{n,t+1}/p^j_{n,t}}{p^j_{i,t+1}/p^j_{i,t}}$$

- But trade cost reductions that hypothetically bring free trade would result in $\pi^j_{ni,t+1} = \pi^j_{ii,t+1}$ and in $p^j_{n,t+1} = p^j_{i,t+1}$

- So we can implement a counterfactual with:

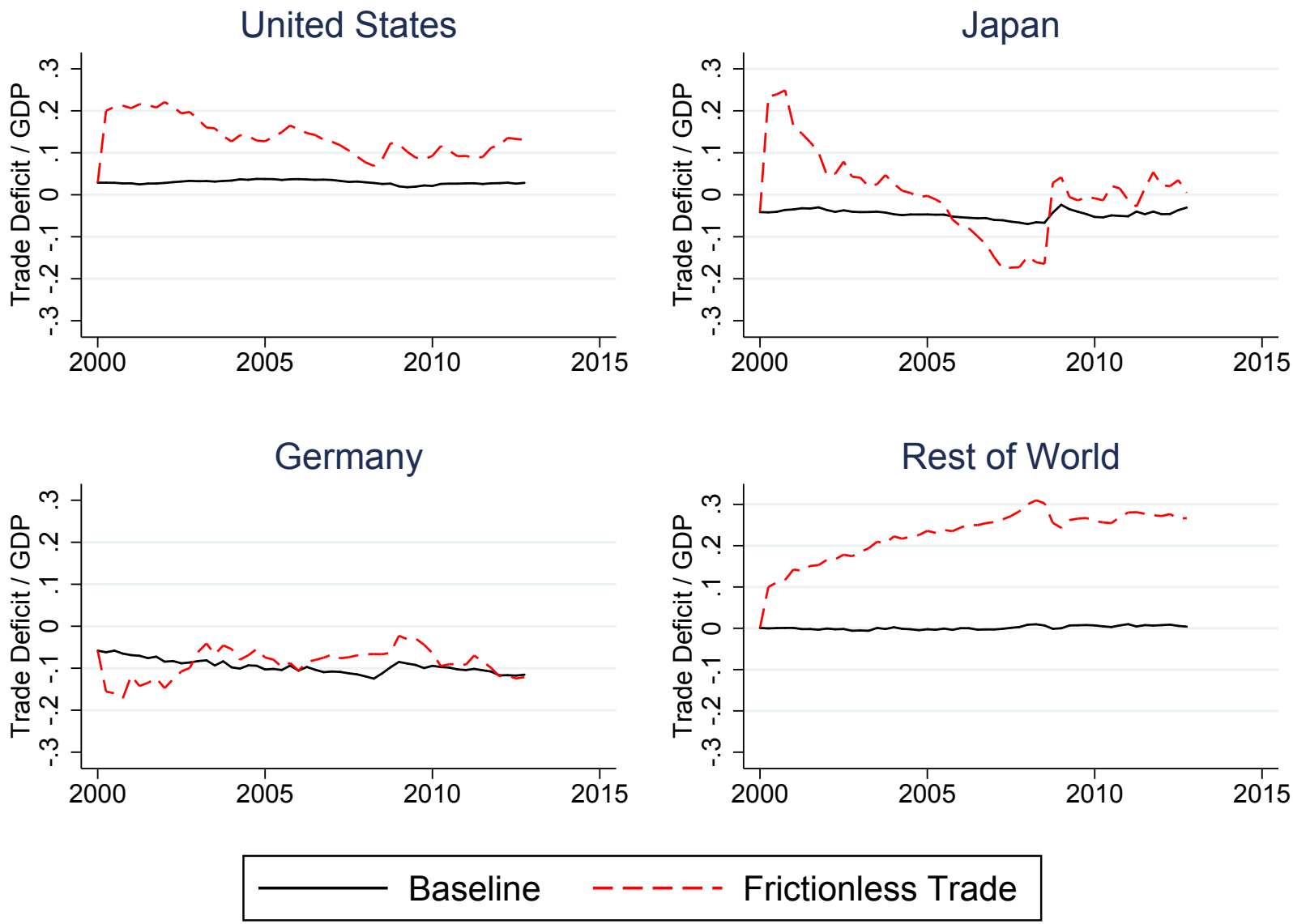
$$\hat{d}^{j,FT}_{ni,t+1} = \left(\frac{\pi^j_{ii,t}}{\pi^j_{ni,t}} \right)^{-1/\theta} \frac{p^j_{i,t}}{p^j_{n,t}}$$

Generate World Without Trade Costs

- We have data on $\pi_{ni,t}$ as before
- We obtain $(p^j_{i,t}/p^j_{n,t})$ from the World Bank's ICP, using "Machinery and Equipment" for durables and "Food and beverages" and "Clothing and Footwear" for nondurables.
- We run counterfactuals from initial levels in 2000:Q1, where all shocks are taken from the data except that $\hat{d}^j_{ni,t+1} = \hat{d}^{j,FT}_{ni,t+1}$ for 2000:Q2 and $\hat{d}^j_{ni,t+1} = 1$ thereafter
- After transition, think of system as behaving as if it had no trade frictions but was otherwise identical

Counterfactual World Trade

Counterfactual Deficits



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	Durables	Nondurables	Durables	Nondurables
Austria	0.30	0.50	0.02	0.02
Canada	0.75	1.99	0.05	0.04
Czech Republic	0.62	1.15	0.03	0.05
Denmark	0.17	0.42	0.01	0.01
Finland	1.19	2.14	0.03	0.02
Germany	1.16	1.37	0.07	0.05
Greece	1.12	1.84	0.02	0.02
India	3.24	8.00	0.06	0.12
Italy	2.42	3.14	0.07	0.07
Japan	6.39	6.50	0.13	0.06
Mexico	0.77	3.39	0.05	0.08
Poland	0.88	2.04	0.03	0.05
Romania	0.61	1.11	0.01	0.02
South Korea	3.30	4.56	0.14	0.06
Spain	1.50	2.56	0.06	0.06
Sweden	0.86	1.12	0.03	0.02
United Kingdom	0.63	1.67	0.04	0.04
United States	2.18	5.13	0.11	0.12
Rest of World	2.54	4.82	0.14	0.18

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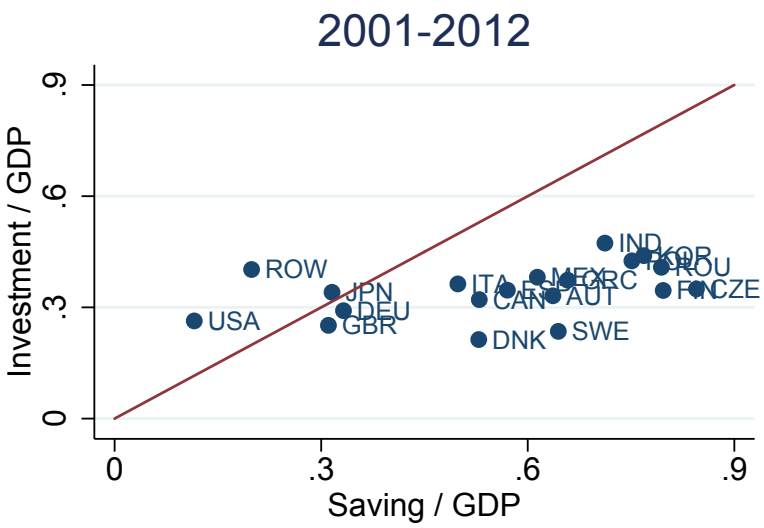
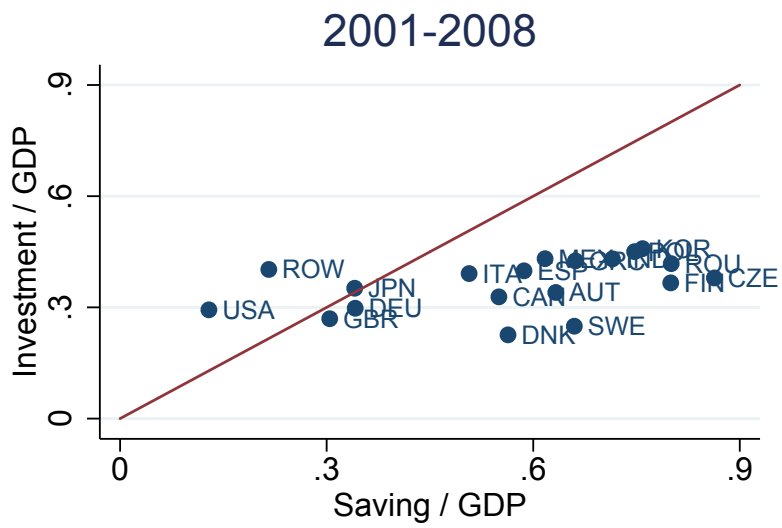
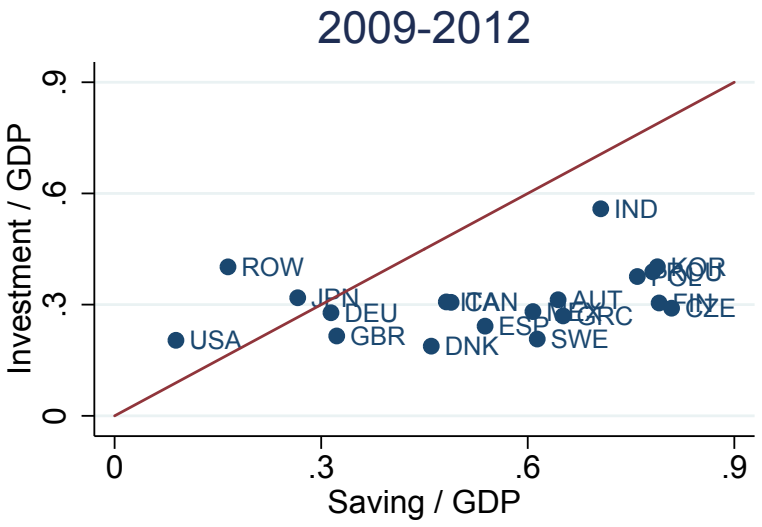
Gravity Regressions in 2005:Q4

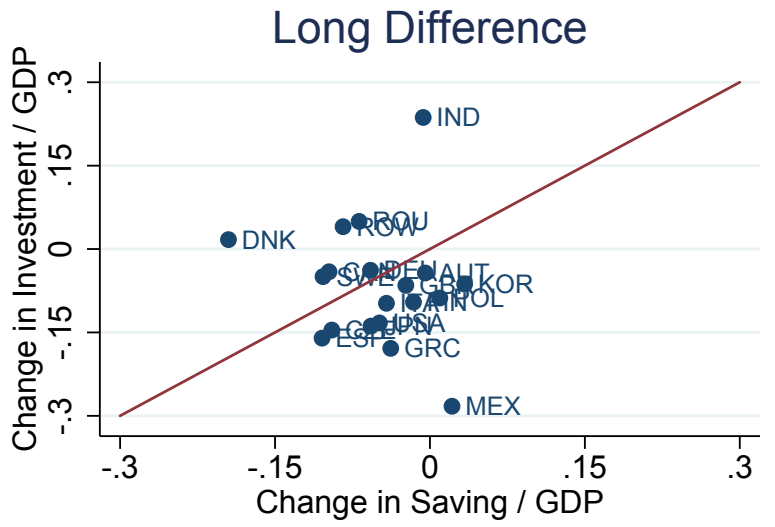
Country	**Baseline**		**Frictionless Trade**	
	Durables	**Nondurables**	**Durables**	**Nondurables**
Distance	-1.301***	-1.432***	0.000	0.000
	(0.113)	(0.105)	(0.000)	(0.000)
Contiguous	0.073	0.148	0.000	0.000
	(0.200)	(0.210)	(0.000)	(0.000)
Common Language	0.508***	0.554***	0.000	0.000
	(0.163)	(0.120)	(0.000)	(0.000)
Constant	-3.217***	-4.188***	0.000	0.000
	(0.187)	(0.167)	(0.000)	(0.000)
Importer FE	YES	YES	YES	YES
Exporter FE	YES	YES	YES	YES
Observations	306	306	306	306
R-squared	0.93	0.92	1.00	1.00

Puzzle 2: Feldstein-Horioka







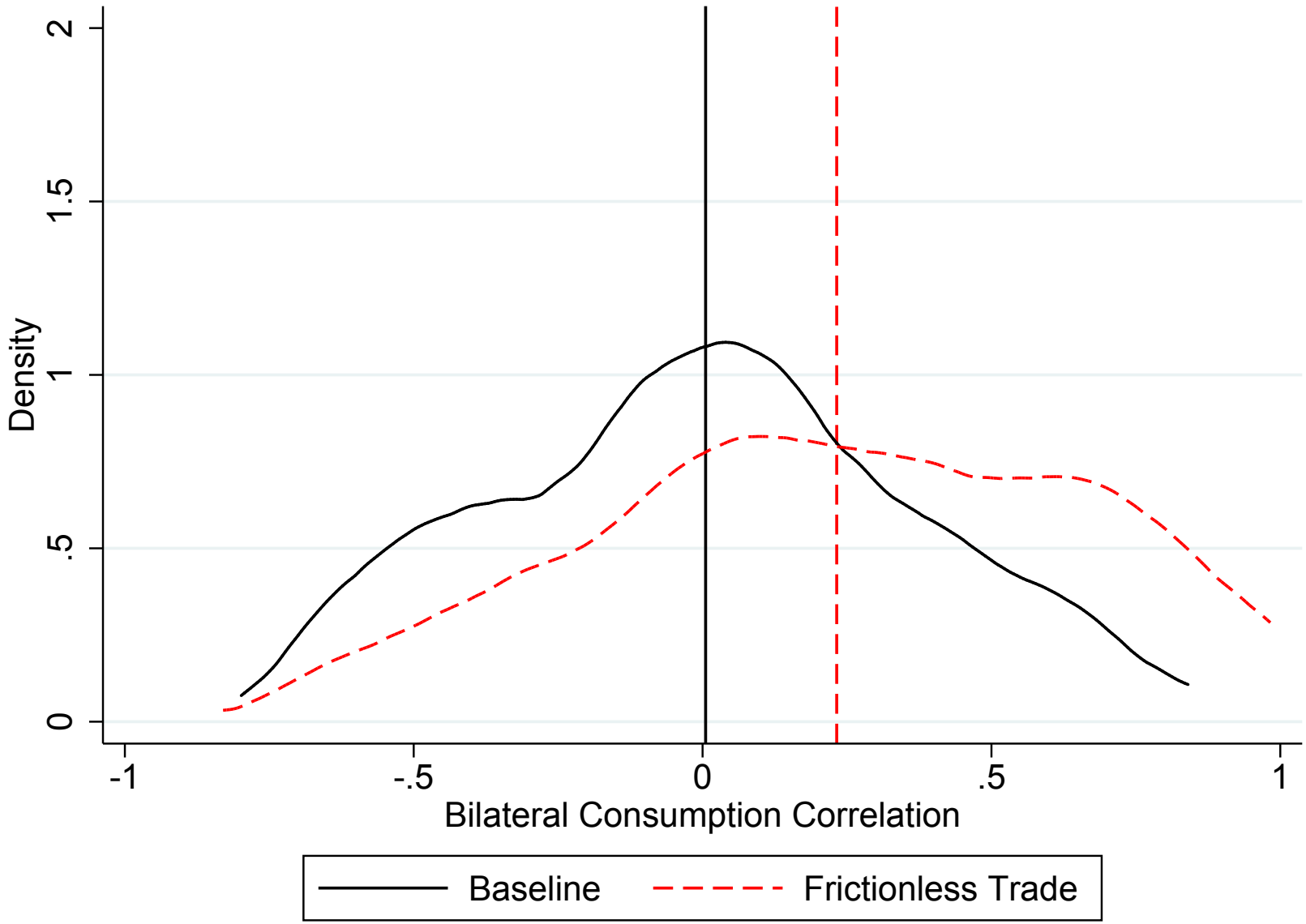


Puzzle 2: Feldstein-Horioka

Dependent Variable: Investment

	Baseline				Frictionless Trade			
	2001-12	**2001-08**	**2009-12**	**Long Difference**	**2001-12**	**2001-08**	**2009-12**	**Long Difference**
Saving	0.378**	0.254*	0.630***	0.881***	0.146**	0.148**	0.141	-0.292
	(0.134)	(0.142)	(0.120)	(0.179)	(0.068)	(0.058)	(0.092)	(0.441)
Constant	0.144***	0.174***	0.0852***	0.003	0.263***	0.280***	0.232***	-0.0822*
	(0.032)	(0.034)	(0.028)	(0.010)	(0.041)	(0.036)	(0.053)	(0.042)
Observations	19	19	19	19	19	19	19	19
R-squared	0.34	0.18	0.63	0.63	0.20	0.20	0.12	0.02

Puzzle 4: Low International Consumption Correlations



Puzzle 4: Low International Consumption Correlations

Moments of Distribution of Bilateral Pairs

	Quarterly		Annual	
	Baseline	**Frictionless Trade**	**Baseline**	**Frictionless Trade**
Mean	0.03	0.10	0.01	0.24
Median	0.04	0.10	0.01	0.23
Maximum	0.45	0.74	0.84	0.98
Minimum	-0.55	-0.45	-0.80	-0.83

Puzzle 5: Relative Purchasing Power Parity

Standard Deviation of Inflation Across Countries

	Quarterly		Annual	
	Baseline	**Frictionless Trade**	**Baseline**	**Frictionless Trade**
Construction	0.177	0.147	0.073	0.049
Durables	0.095	0.000	0.048	0.000
Nondurables	0.100	0.000	0.051	0.000
Services	0.124	0.088	0.063	0.039
CPI	**0.114**	**0.060**	**0.059**	**0.030**

Puzzle 6: Exchange Rate Disconnect

Variation in Nominal GDP, Real GDP, Real Exchange Rate

	Quarterly						Annual					
	Baseline			Frictionless Trade			Baseline			Frictionless Trade		
	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER	Nominal GDP	Real GDP	RER
Austria	0.066	0.026	0.066	0.095	0.044	0.056	0.031	0.008	0.031	0.028	0.014	0.015
Canada	0.109	0.021	0.107	0.077	0.028	0.062	0.046	0.011	0.044	0.026	0.015	0.021
Czech Republic	0.102	0.020	0.100	0.117	0.073	0.050	0.062	0.014	0.057	0.043	0.028	0.018
Denmark	0.068	0.031	0.059	0.163	0.060	0.112	0.025	0.007	0.029	0.047	0.019	0.033
Finland	0.057	0.037	0.068	0.052	0.039	0.033	0.032	0.016	0.033	0.018	0.017	0.011
Germany	0.057	0.024	0.064	0.045	0.023	0.040	0.029	0.017	0.036	0.024	0.013	0.023
Greece	0.119	0.060	0.097	0.081	0.063	0.055	0.079	0.046	0.042	0.032	0.045	0.020
India	0.120	0.043	0.112	0.068	0.051	0.046	0.065	0.018	0.051	0.041	0.035	0.014
Italy	0.066	0.014	0.066	0.038	0.018	0.028	0.038	0.006	0.039	0.021	0.010	0.015
Japan	0.209	0.034	0.207	0.125	0.048	0.092	0.093	0.015	0.088	0.054	0.024	0.037
Mexico	0.164	0.027	0.164	0.082	0.029	0.062	0.084	0.016	0.072	0.034	0.016	0.022
Poland	0.152	0.031	0.167	0.070	0.031	0.063	0.070	0.018	0.076	0.033	0.022	0.026
Romania	0.179	0.066	0.170	0.104	0.067	0.085	0.095	0.032	0.075	0.052	0.043	0.019
South Korea	0.147	0.032	0.133	0.072	0.038	0.044	0.085	0.016	0.081	0.041	0.019	0.025
Spain	0.075	0.020	0.064	0.045	0.028	0.020	0.052	0.013	0.042	0.031	0.021	0.012
Sweden	0.086	0.028	0.079	0.061	0.032	0.039	0.049	0.012	0.041	0.032	0.019	0.015
United Kingdom	0.091	0.020	0.090	0.086	0.031	0.065	0.053	0.010	0.049	0.045	0.019	0.030
United States	0.153	0.020	0.147	0.119	0.033	0.096	0.067	0.012	0.060	0.053	0.020	0.040
Rest of World	0.050	0.007	0.050	0.048	0.019	0.040	0.030	0.003	0.029	0.025	0.009	0.019
Pooled	**0.120**	**0.042**	**0.115**	**0.089**	**0.051**	**0.065**	**0.064**	**0.033**	**0.056**	**0.042**	**0.037**	**0.030**

Puzzle 6: Exchange Rate Disconnect

Dependent Variable: Log Change in Real GDP

	Quarterly				Annual			
	Baseline		Frictionless Trade		Baseline		Frictionless Trade	
Log Change in Nominal GDP	0.099***	0.064***	0.401***	0.369***	0.257***	0.146***	0.627***	0.505***
	(0.019)	(0.017)	(0.024)	(0.021)	(0.045)	(0.027)	(0.062)	(0.041)
Constant	0.019*	0.007	0.142***	0.138***	0.019***	0.013***	0.108***	0.100***
	(0.006)	(0.008)	(0.007)	(0.007)	(0.007)	(0.004)	(0.005)	(0.003)
Country FE	NO	YES	NO	YES	NO	YES	NO	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	893	893	893	893	209	209	209	209
R-squared	0.37	0.63	0.70	0.82	0.48	0.86	0.70	0.92

Conclusions

- Obstfeld and Rogoff's proposition has quantitative bite
- We knew we needed trade frictions to explain bilateral trade
- Eliminating trade frictions large enough to explain home bias and gravity goes far in open-economy macro puzzles
- Next steps for model include incorporating:
  - Uncertainty
  - Imperfect Competition
  - Financial Market Frictions