



Not everything that counts can be counted, and
not everything that can be counted counts.

— ALBERT EINSTEIN



TECHNOLOGY CAPITAL AND THE US CURRENT ACCOUNT

ELLEN R. MCGRATTAN AND EDWARD C. PRESCOTT

APRIL 2008

[www.minneapolisfed.org/research /economists/emcgrattan.html](http://www.minneapolisfed.org/research/economists/emcgrattan.html)

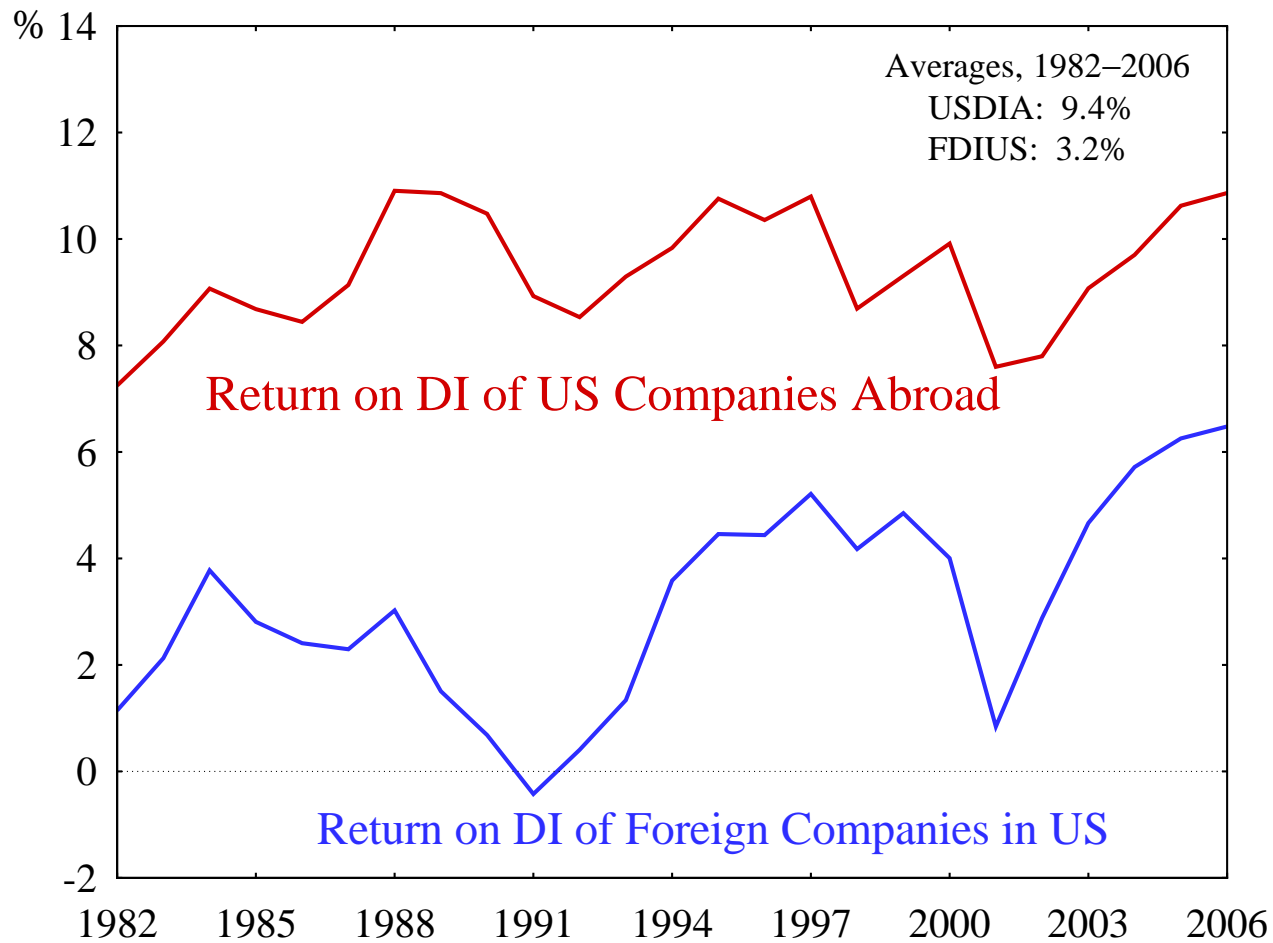


A DIRECT INVESTMENT (DI) PUZZLE

- BEA reports for 1982–2006:
 - US companies earned 9.4% average returns
 - Foreign companies earned 3.2% average returns
- on their foreign direct investment abroad



A DIRECT INVESTMENT (DI) PUZZLE



Why is the return differential so large and persistent?



OUR ANSWER HAS TWO PARTS

1. Measurement

2. Timing



OUR ANSWER

1. Multinationals have large intangible capital stocks

2. Timing



OUR ANSWER

1. Multinationals have large intangible capital stocks
 - DI profits include intangible rents (+) and expenses (−)

2. Timing



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1. Multinationals have large intangible capital stocks
 - DI profits include intangible rents (+) and expenses (−)
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⇒ BEA returns not equal economic

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⇒ BEA returns not equal economic

2. Different timing of DI by US and DI in US

⇒ US and foreign reported returns not equal



TWO TYPES OF INTANGIBLE CAPITAL

1. Intangible capital that is plant-specific
2. *Technology capital* that is not plant-specific



TECHNOLOGY CAPITAL

- Is accumulated know-how from investments in
 - R&D
 - Brands
 - Organization know-how

which can be used in as many *locations* as firms choose



REPORTED FDI RETURN (r_{BEA})

- With no intangible capitals,

$$r_{BEA} =$$

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REPORTED FDI RETURN (r_{BEA})

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REPORTED FDI RETURN (r_{BEA})

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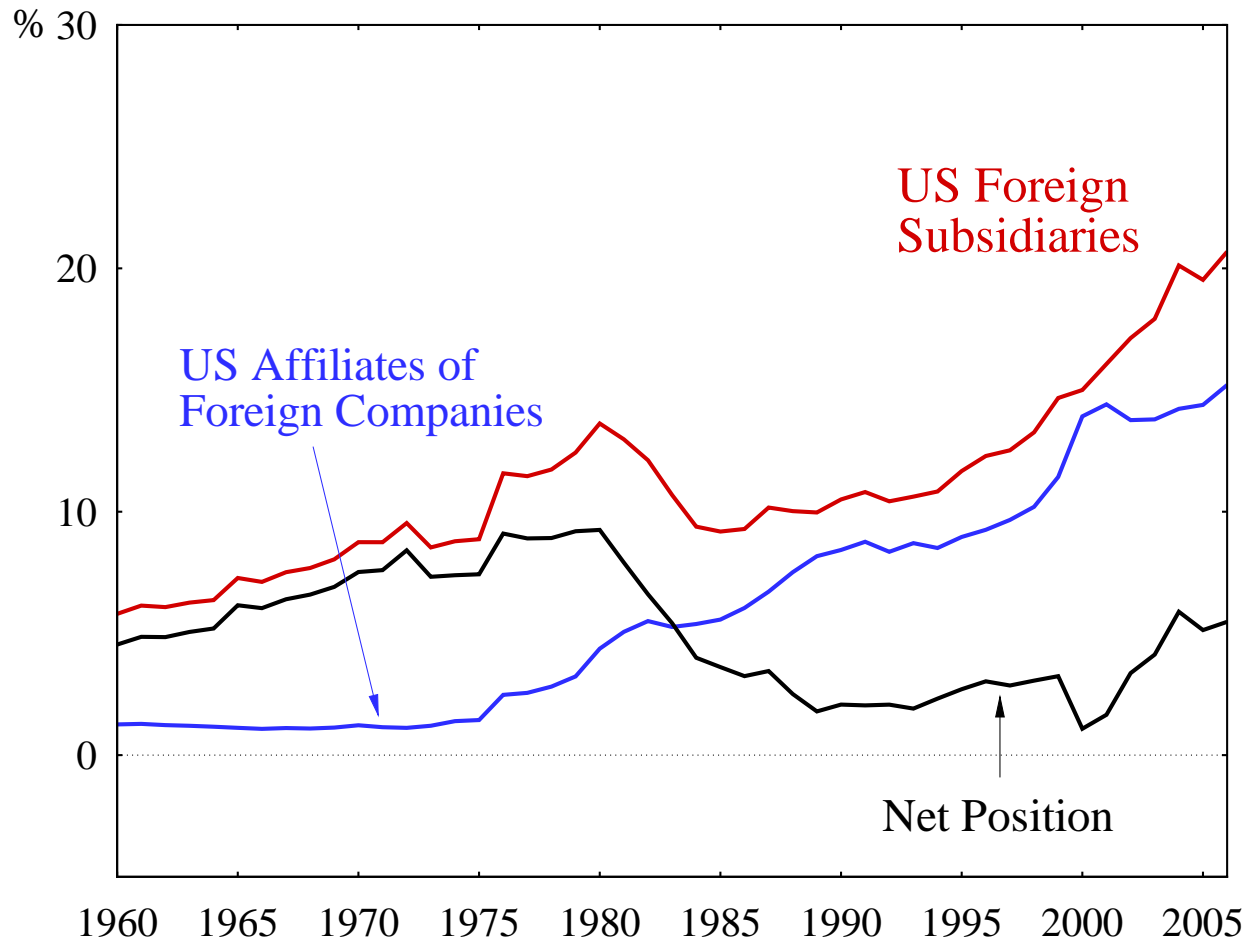
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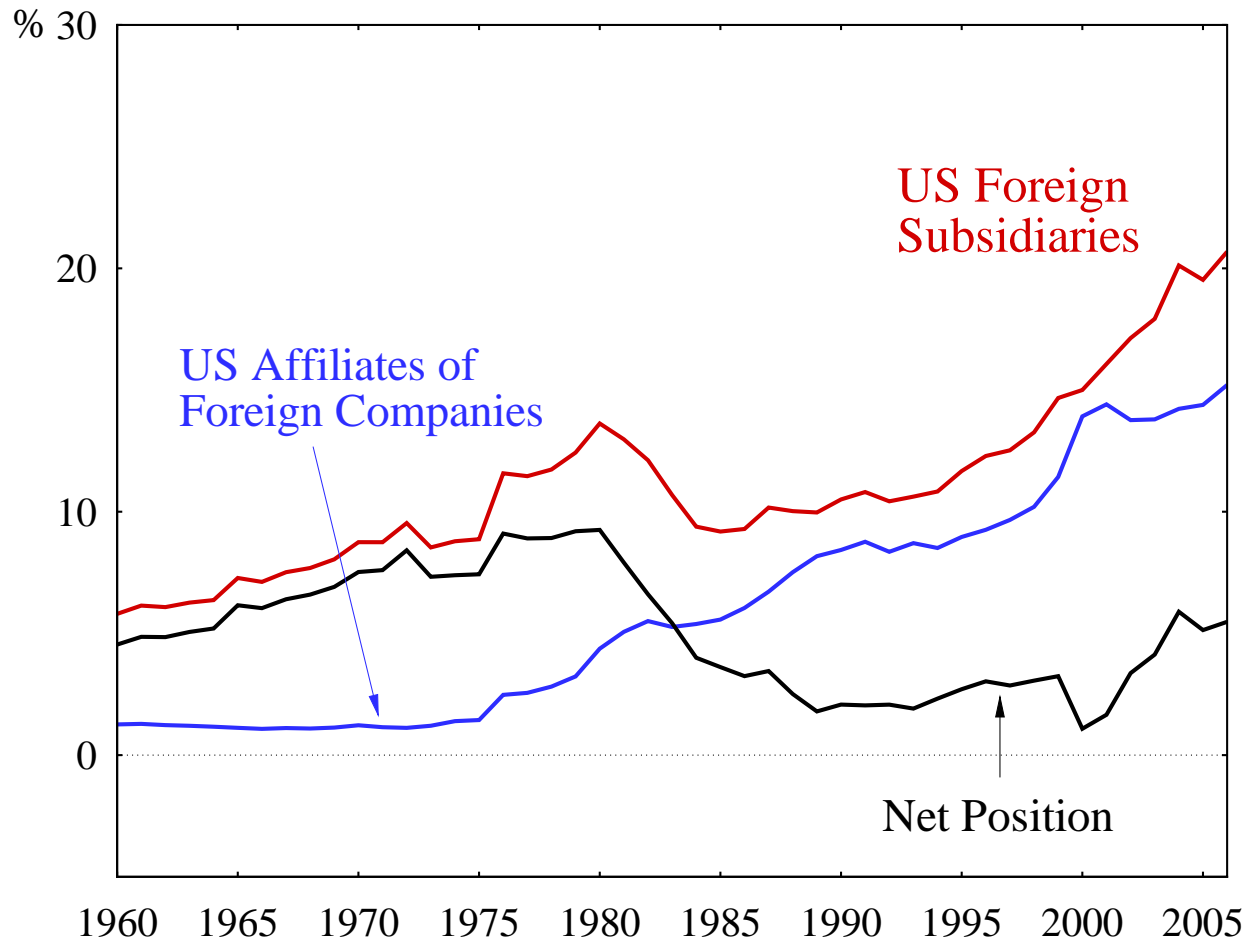
SUBSIDIARY ASSETS AT CURRENT COST (% OF US GNI)



FDI in US starts late, implying different timing of unmeasured investment and profits



SUBSIDIARY ASSETS AT CURRENT COST (% OF US GNI)



Policymakers are concerned about fall in net asset position



FINDINGS

- Use model where each investment earns 4.6% on average
- We find average *BEA* returns on DI, 1982–2006:
 - of US = 7.1%
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 - of US = 7.1% *BEA* reports 9.4%
 - in US = 3.1% *BEA* reports 3.2%
- ⇒ Mismeasurement accounts for over 60% of return gap
- Also show: “net asset position” not a meaningful concept



THEORY



PRODUCTION IN ONE-COUNTRY WORLD

$$Y = A(NM)^\phi Z^{1-\phi}$$

M = units of *technology capital*

Z = composite of other factors

N = number of production *locations*

A = the technology parameter

ϕ = the income share parameter

which is the result of maximizing plant-level output



A MICRO FOUNDATION FOR AGGREGATE FUNCTION

- $n \in \{1, \dots, N\}, m \in \{1, \dots, M\}$

$$F(N, M, Z) = \max_{z_{nm}} \sum_{n,m} g(z_{nm})$$

$$\text{subject to } \sum_{n,m} z_{nm} \leq Z$$

We assume $g(z) = Az^{1-\phi}$, increasing and strictly concave



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\Rightarrow organizational span of control limits



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\Rightarrow optimal to split Z evenly across location-technologies



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$$\Rightarrow F(N, M, Z) = NMg(Z/NM) = A(NM)^\phi Z^{1-\phi}$$



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$$\text{subject to } \sum_{n,m} z_{nm} \leq Z$$

$$\Rightarrow F(N, \lambda M, \lambda Z) = \lambda F(N, M, Z)$$



PRODUCTION IN MULTI-COUNTRY WORLD

- The degree of openness of country i is $\sigma_i \in [0, 1]$
- Aggregate output in i is

$$\max_{z_d, z_f} M^i N_i A_i z_d^{1-\phi} + \sigma_i \sum_{j \neq i} M^j N_i A_i z_f^{1-\phi}$$

subject to
$$M^i N_i z_d + \sum_{j \neq i} M^j N_i z_f \leq Z_i$$

d, f indexes allocations to domestic and foreign operations



PRODUCTION IN MULTI-COUNTRY WORLD

- Aggregate output in i is

$$Y_i = A_i N_i^\phi (M^i + \omega_i \sum_{j \neq i} M^j)^\phi Z_i^{1-\phi}$$

where $\omega_i = \sigma_i^{\frac{1}{\phi}}$

- Alternative interpretation of openness: fraction of M^j let in



PRODUCTION IN MULTI-COUNTRY WORLD

- Aggregate output in i is

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- Key result provided $\omega_i > 0$:

Each i has constant returns, but summing over i results in a *bigger* aggregate production set.



PRODUCTION IN MULTI-COUNTRY WORLD

- Aggregate output in i is

$$Y_i = A_i N_i^\phi (M^i + \omega_i \sum_{j \neq i} M^j)^\phi Z_i^{1-\phi}$$

- Key result:

It is *as if* there were increasing returns,
when in fact there are none.



PRODUCTION IN MULTI-COUNTRY WORLD

- Aggregate output in i is

$$Y_i = A_i N_i^\phi (M^i + \omega_i \sum_{j \neq i} M^j)^\phi Z_i^{1-\phi}$$

- Key result:

We partially endogenize measured TFP since locations and technology capital affect measured TFP.



IMPLICATIONS OF ADDING TECHNOLOGY CAPITAL

- If $\phi = 0$ in $Y_i = A_i(N_i[M^i + \omega_i \sum_j M^j])^\phi (Z_i)^{1-\phi}$
- If $\phi > 0$ and $\omega_i = 0$,
- If $\phi > 0$ and $\omega_i > 0$,



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 - More locations implies higher Y/N and Y/L
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- If $\phi > 0$ and $\omega_i = 0$,
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 - More locations implies higher Y/N and Y/L
- If $\phi > 0$ and $\omega_i > 0$,
 - Foreign subsidiaries if ω_i not too small
 - More done by big (high A, N), closed (low ω) countries



ADDING LABOR AND OTHER CAPITALS

- $Z_i^j = (K_{T,i}^j)^{\alpha_T} (K_{I,i}^j)^{\alpha_I} (L_i^j)^{1-\alpha_T-\alpha_I}$

$K_{T,i}^j =$ *tangible* capital of companies from j in i

$K_{I,i}^j =$ plant-specific *intangible* capital of j in i

$L_i^j =$ labor input to companies j in i

- With capital accumulation,

$$K_{T,i,t+1}^j = (1 - \delta_T)K_{T,it}^j + X_{T,it}^j$$

$$K_{I,i,t+1}^j = (1 - \delta_I)K_{I,it}^j + X_{I,it}^j$$

$$M_{t+1}^j = (1 - \delta_M)M_t^j + X_{M,it}$$



A DECENTRALIZATION TO MATCH TO BEA ACCOUNTS



MULTINATIONALS INCORPORATED IN COUNTRY j SOLVE

$$\max \sum_t p_t (1 - \tau_{d,t}) D_t^j$$

given definition of dividends,

$$\begin{aligned} D_t^j + \underbrace{\sum_i K_{T,i,t+1}^j - K_{T,it}^j}_{\text{Reported reinvested earnings}} \\ = \underbrace{\sum_i \{(1 - \tau_{p,it}) (Y_{it}^j - W_{it} L_{it}^j - \delta_T K_{T,it}^j - X_{I,it}^j - \chi_i^j X_{M,t}^j)\}}_{\text{Reported profits less expensed investments and taxes}} \end{aligned}$$

where $\chi_i^i = 1$ and $\chi_i^j = 0$, $j \neq i$



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\Rightarrow expensing done at home



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Key result: accounting profits are not equal to true profits



HOUSEHOLDS IN i SOLVE

$$\max \sum_t \beta^t U \left(\frac{C_{it}}{N_{it}}, \frac{L_{it}}{N_{it}} \right) N_{it}$$

subject to budget constraint

$$\begin{aligned} \sum_t p_t \left[(1 + \tau_{c,it}) C_{it} + \sum_j V_t^j (S_{i,t+1}^j - S_{it}^j) + B_{i,t+1} - B_{it} \right] \\ \leq \sum_t p_t \left[(1 - \tau_{l,it}) W_{it} L_{it} + (1 - \tau_{d,t}) \sum_j S_{it}^j D_t^j + r_{b,t} B_{it} + \kappa_{it} \right] \end{aligned}$$

S_i^j = equity shares of companies from j

B_i = foreign debt



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Note that measure of locations is proportional to population

\Rightarrow same notation N



USING THE THEORY

- Two economies:
 - US
 - FDI-relevant ROW
 - Canada
 - Europe
 - Latin America
 - Part of Asia doing FDI with US
- Period is 1960–2006



USING THE THEORY

- Two economies:
 - US
 - FDI-relevant ROW
 - Canada
 - Europe
 - Latin America
 - Part of Asia doing FDI with US
- Period is 1960–2006
- Need data and model inputs



DATA, 1960–2006

- US
 - Population
 - National income and product accounts
 - Flow of funds accounts
 - International accounts and investment positions
 - Internal revenue statistics of income

- ROW
 - Population
 - Total GDP



MODEL CONSTANTS (THAT DON'T MATTER)

- Trend growth rates

$$(\gamma_A = 1.2\%, \gamma_N = 1.0\%)$$

- Preferences

$$(\beta = .98, u(c, l) = \log(c) + 1.32 \log(1 - l))$$

- Fixed tax rates

$$(\tau_{li} = 29\%, \tau_{ci} = 7.3\%, \text{ all } i)$$

- Depreciation rates

$$(\delta_T = 6\%, \delta_M = 8\%)$$



MODEL CONSTANTS (THAT DO MATTER)

- Chose:
 - Technology capital income share: $\phi = 7\%$
 - Tangible capital income share: $(1 - \phi)\alpha_T = 21.4\%$
 - Plant-specific intangible capital, joint choice of:
 - Income share: $(1 - \phi)\alpha_I = 6.5\%$
 - Depreciation rate: $\delta_I = 0\%$
- So model generates:
 - Technology capital investment/GNP $\in [5.3\%, 6\%]$
 - Business tangible investment/GNP $\approx 11.3\%$
 - Business total value/GNP ≈ 1.5 in 1960s



INITIAL BUSINESS CAPITAL STOCKS

- Consistent with

- US GDP, 1960 = 1

- ROW GDP, 1960 = 2.2

- No initial jumps in investment $\left(\frac{\dot{X}_{\cdot, i1}^j}{X_{\cdot, i1}^j} = \frac{\dot{X}_{\cdot, i2}^j}{X_{\cdot, i2}^j} \right)$

$$\Rightarrow K_{T,u,1960} = 1.30, \quad K_{I,u,1960} = 1.17, \quad M_{1960}^u = 0.52$$



TIME-VARYING INPUTS

- Tax rates on capital
- Portfolio composition
- Paths of openness and relative size



TIME-VARYING INPUTS

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TIME-VARYING INPUTS

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 - Debt/equity split matched to US data
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TIME-VARYING INPUTS

- Tax rates on capital: smoothed US rates
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 - Debt/equity split matched to US data
 - Net portfolio income endogenous
- Paths of openness and relative size to match:
 - US DI income from abroad
 - Foreign DI income in US
 - US trade balance

trends in US current accounts (Size= $N_i A_i^{1-(1-\phi)(\alpha_T+\alpha_I)}$)



TO MATCH, NEED US INITIALLY LESS OPEN

- 4 reasons why this is reasonable:



TO MATCH, NEED US INITIALLY LESS OPEN

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1. Overvalued dollar under Bretton Woods System

“Currency undervaluation acted as a strong disincentive to FDI in the US, both because it placed an artificially high price on dollar-denominated assets, and because it gave foreign producers an inherent cost advantage in selling in U.S. markets through exports.”

— 1976 Report of Commerce Secretary on FDI



TO MATCH, NEED US INITIALLY LESS OPEN

- 4 reasons why this is reasonable:

1. Overvalued dollar under Bretton Woods System

Between 1971 and 1973 the dollar depreciated

35% relative to the German mark

26% relative to the Japanese yen

27% relative to the French franc

28% relative to the Dutch guilder

35% relative to the Swiss franc



TO MATCH, NEED US INITIALLY LESS OPEN

- 4 reasons why this is reasonable:
 1. Overvalued dollar under Bretton Woods System
 2. High cost of financing with Interest Equalization Tax
 - Starting 1963,
 - 15% tax on interest from foreign borrowing
 - ⇒ US capital markets effectively closed
 - Removed in 1974



TO MATCH, NEED US INITIALLY LESS OPEN

- 4 reasons why this is reasonable:
 1. Overvalued dollar under Bretton Woods System
 2. High cost of financing with Interest Equalization Tax
 3. Extraterritorial application of US regulations
 - Especially, antitrust laws
 - Some governments made it illegal to comply



TO MATCH, NEED US INITIALLY LESS OPEN

- 4 reasons why this is reasonable:
 1. Overvalued dollar under Bretton Woods System
 2. High cost of financing with Interest Equalization Tax
 3. Extraterritorial application of US regulations
 4. National security concerns used to block FDI
 - Trading with the Enemy Act, 1917
 - ⇒ broad powers to block or seize FDI
 - Amended in 1976

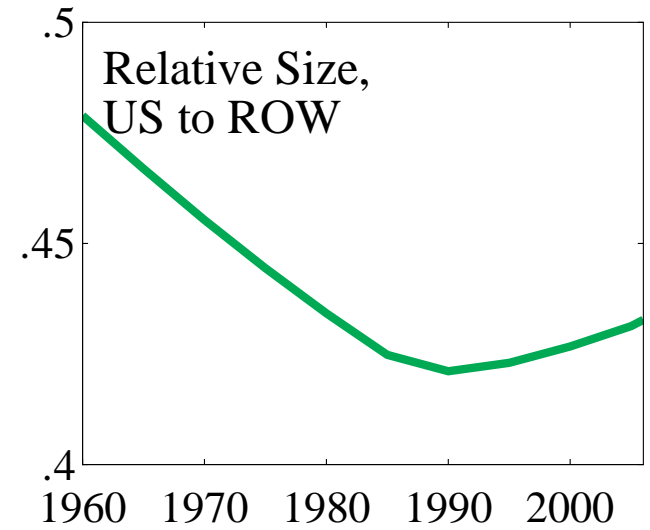
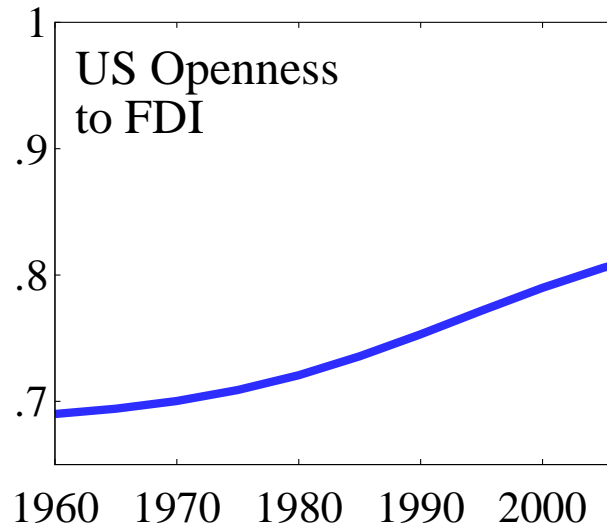
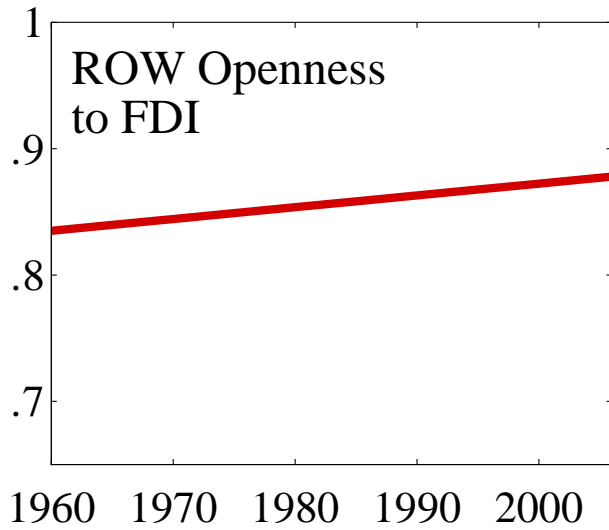


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 4. National security concerns used to block FDI
- Next, consider the inputs we use

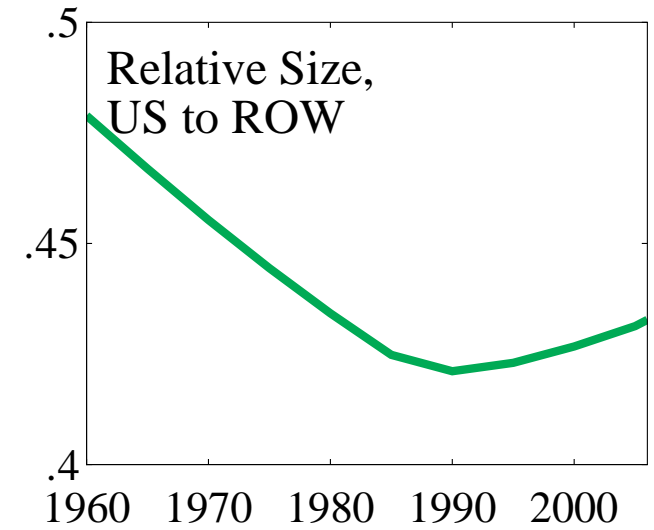
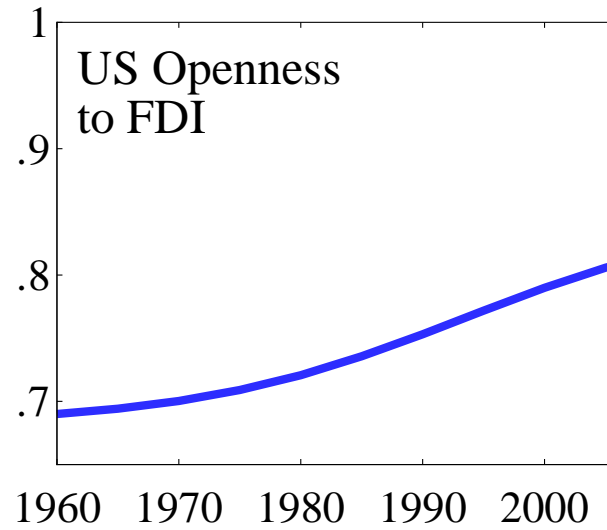
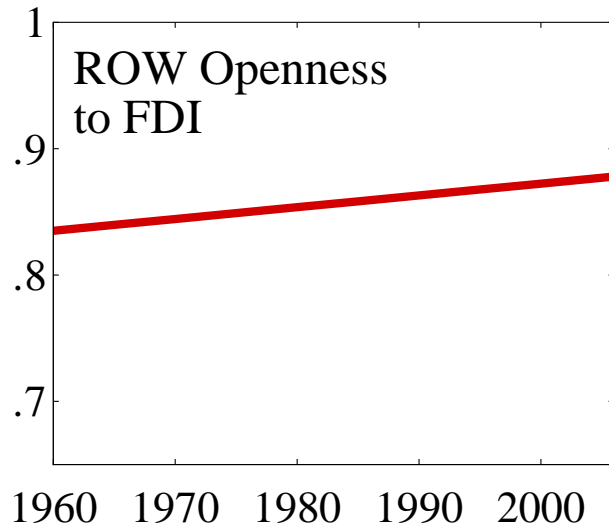


OPENNESS AND RELATIVE SIZE





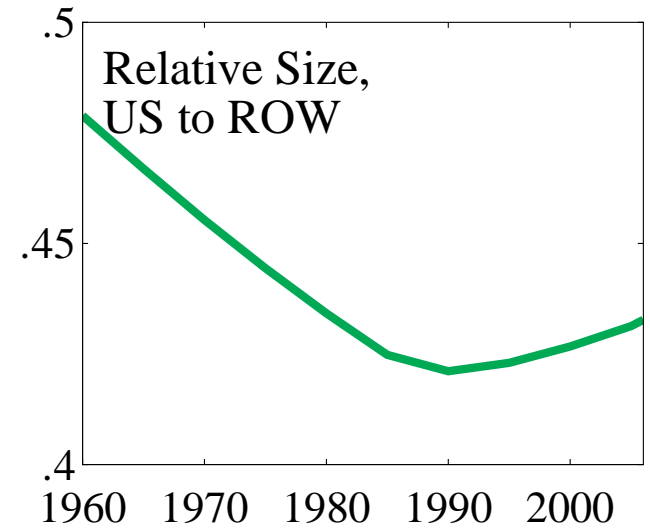
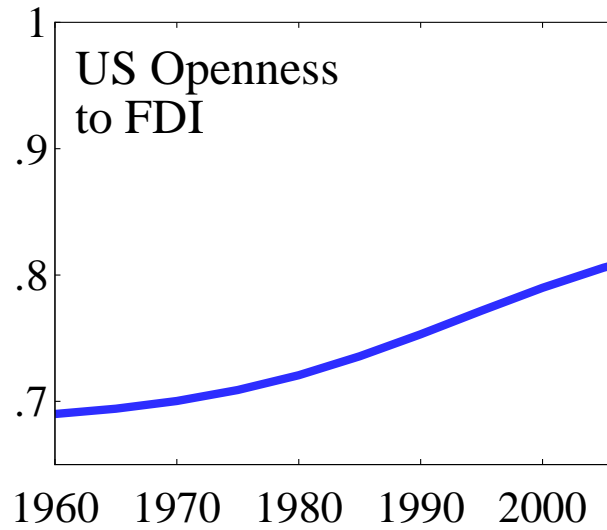
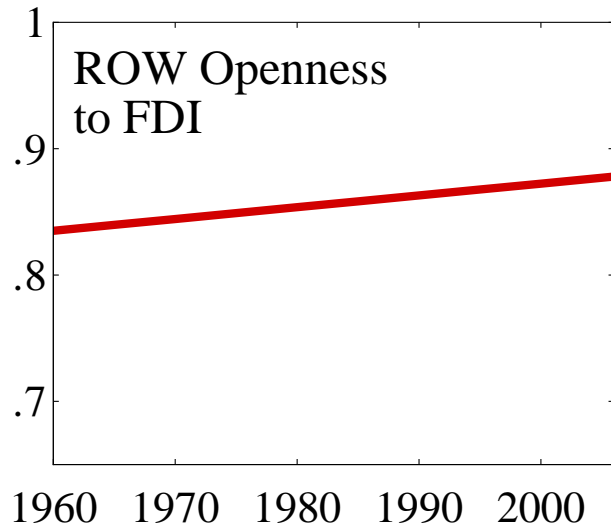
OPENNESS AND RELATIVE SIZE



Note that ROW is more open than US....



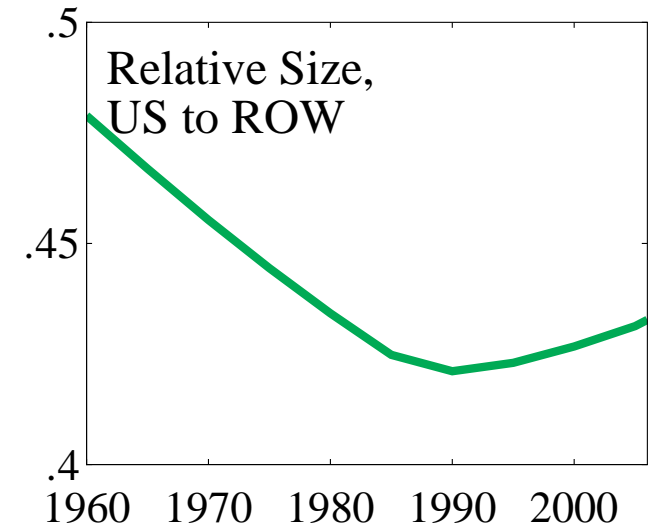
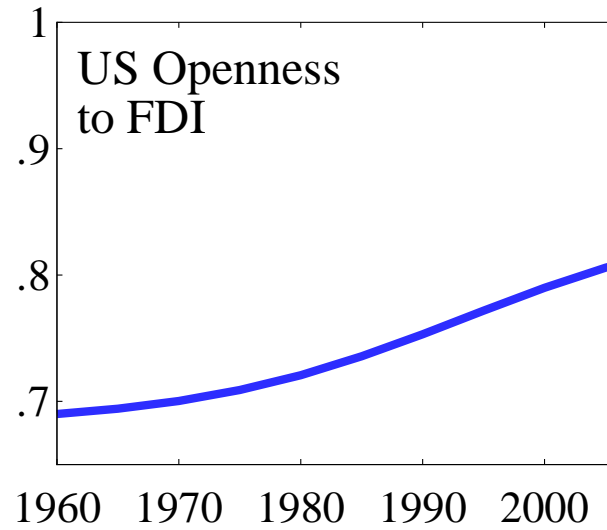
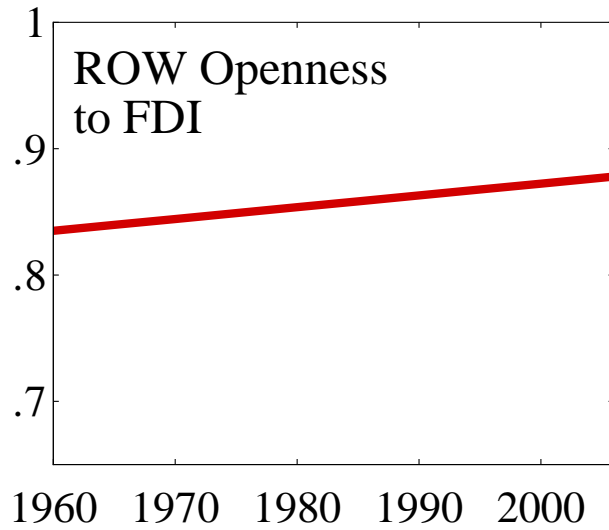
OPENNESS AND RELATIVE SIZE



Also note fall in size



OPENNESS AND RELATIVE SIZE



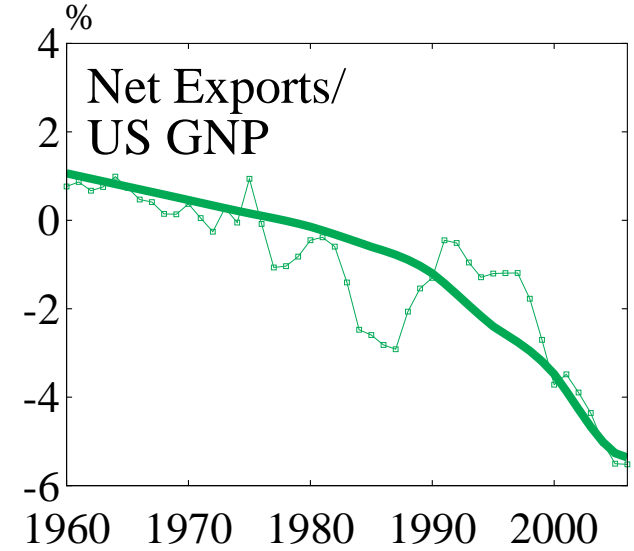
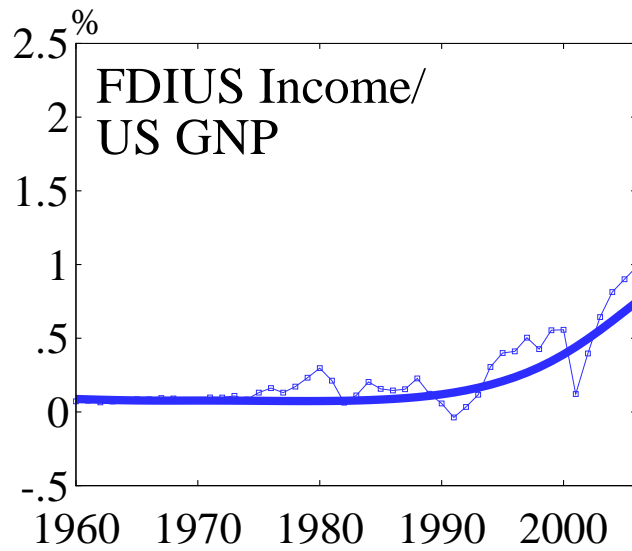
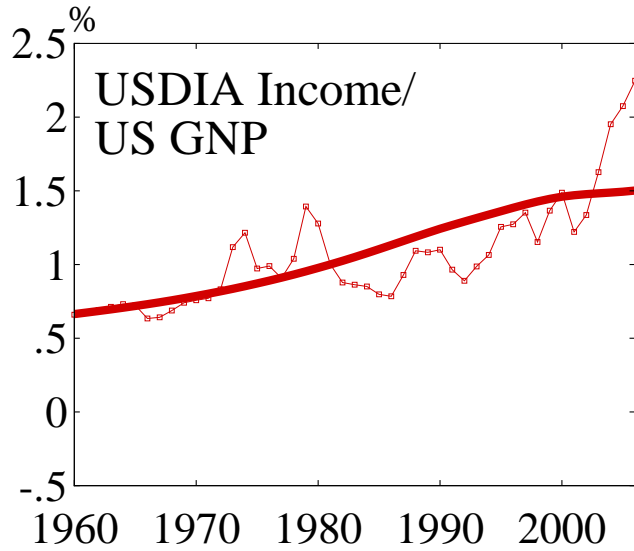
Also note fall in size ... due mostly to relative populations



PREDICTIONS



PREDICTED FDI INCOMES AND TRADE BALANCE



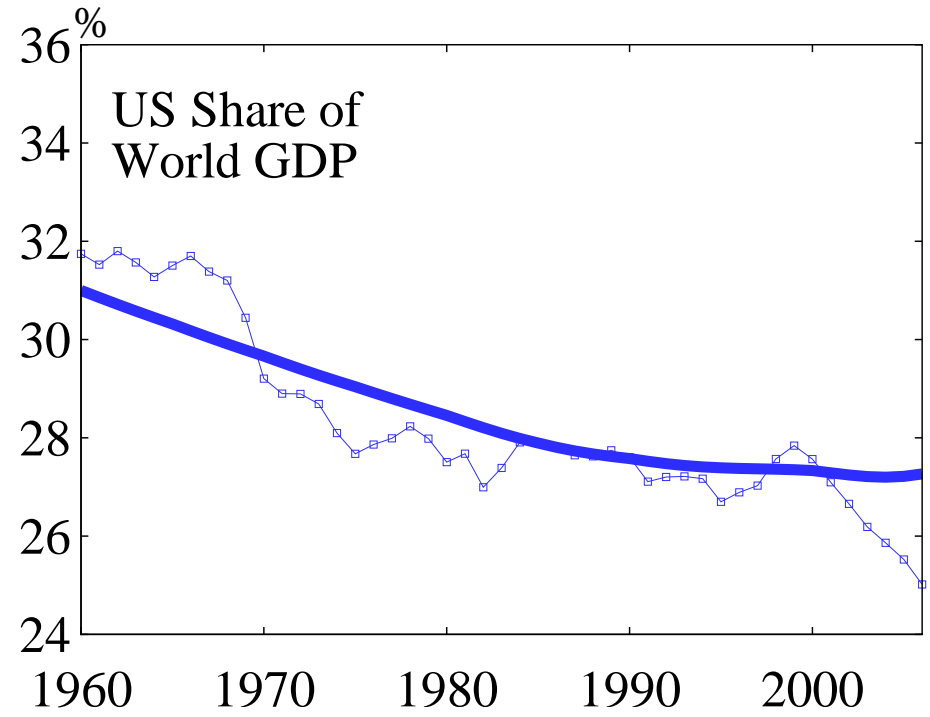
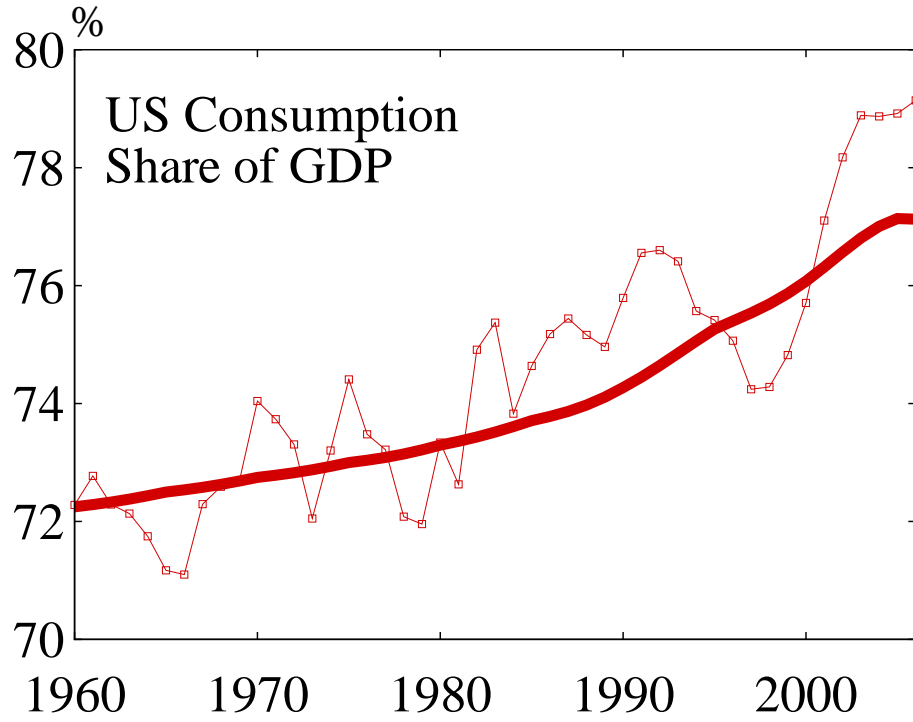
— Model
—□— Data



EXTERNAL CONFORMITY



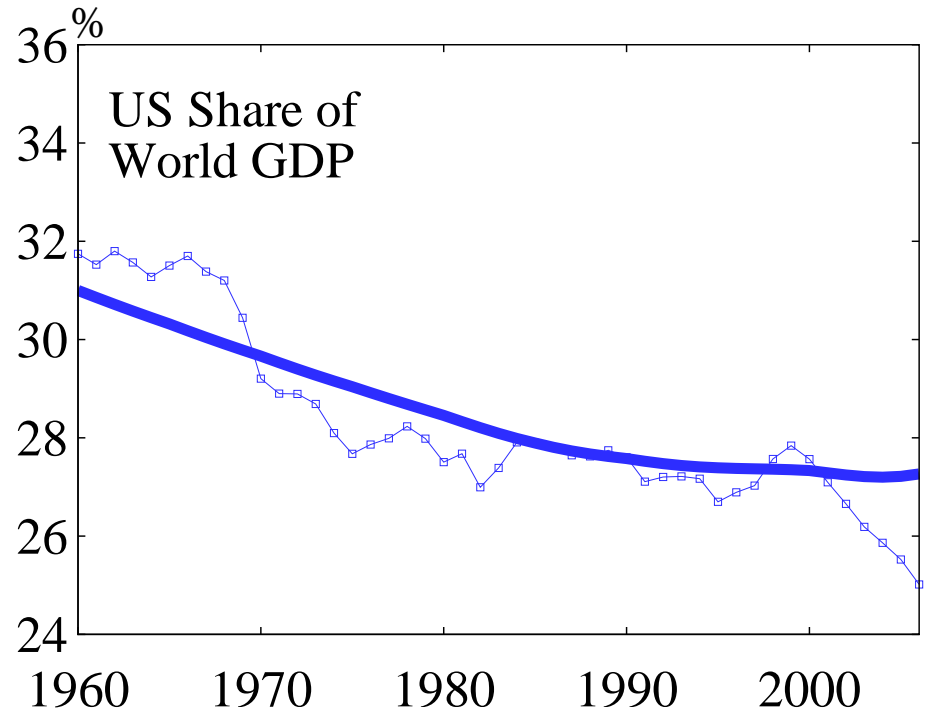
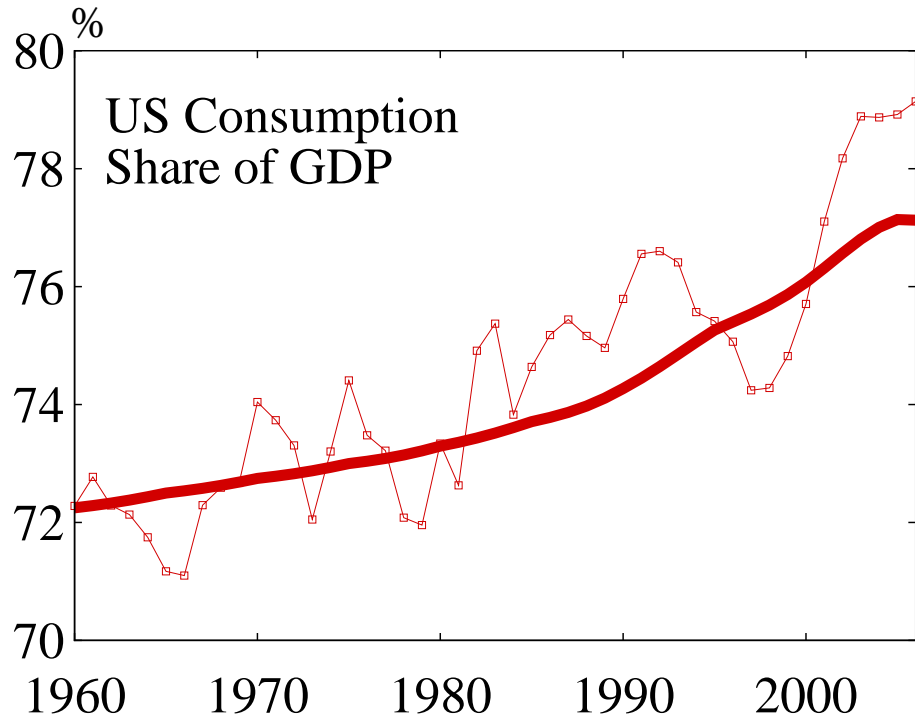
ARE OTHER TRENDS CONSISTENT?



— Model
—□— Data



ARE OTHER TRENDS CONSISTENT? **YES**



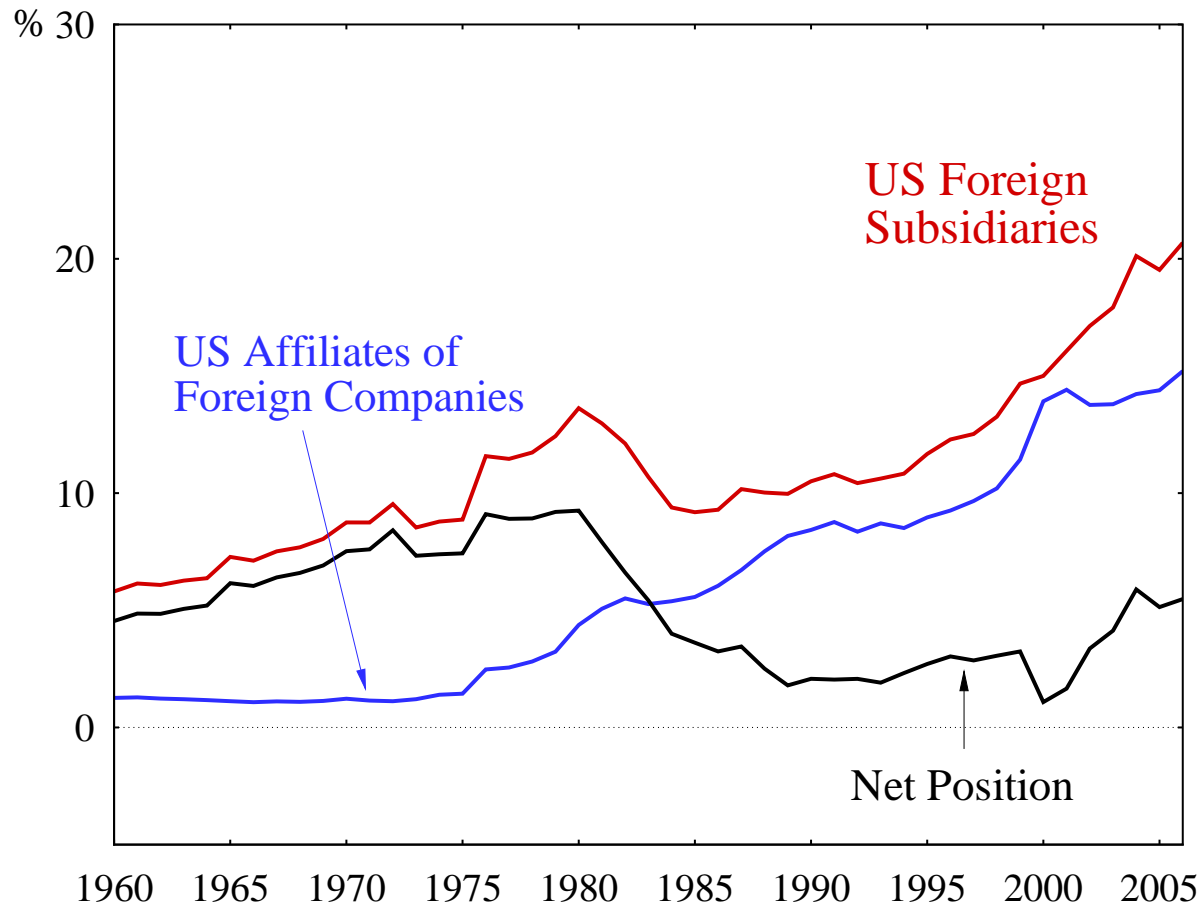
— Model
—□— Data



USING THE THEORY TO PREDICT FDI STOCKS AND RETURNS



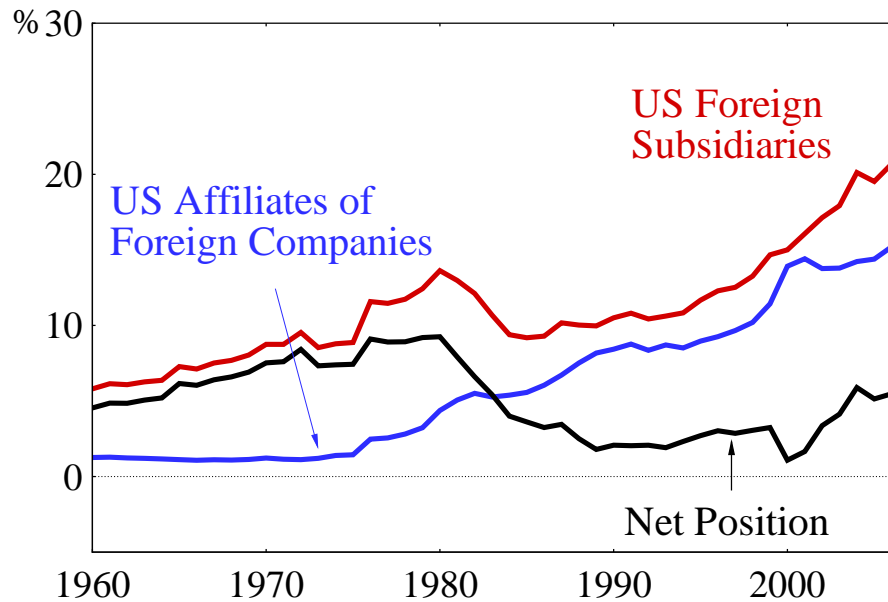
RECALL: FDI STOCKS AT CURRENT COST



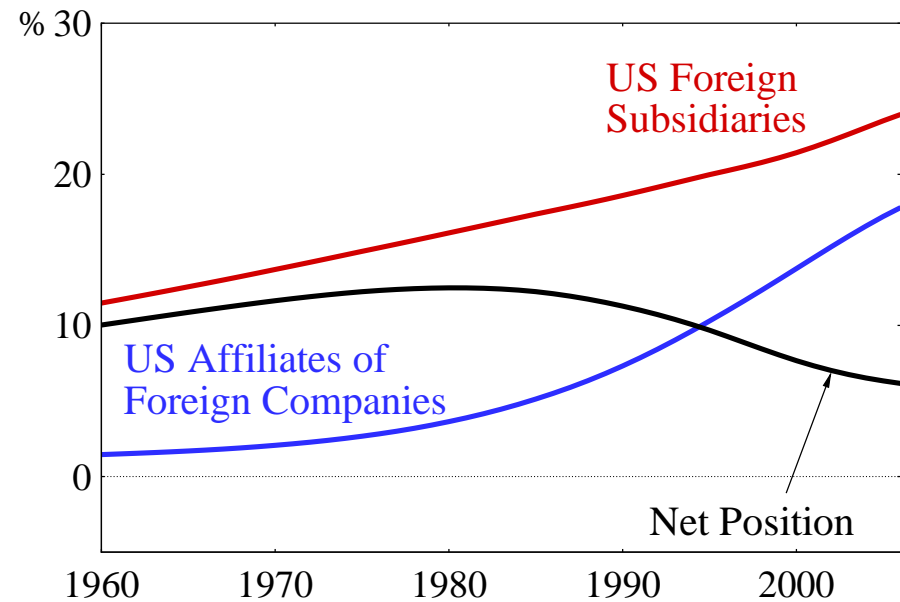
FDI net income rising while net position falling



BEA STOCKS—DATA AND MODEL



BEA

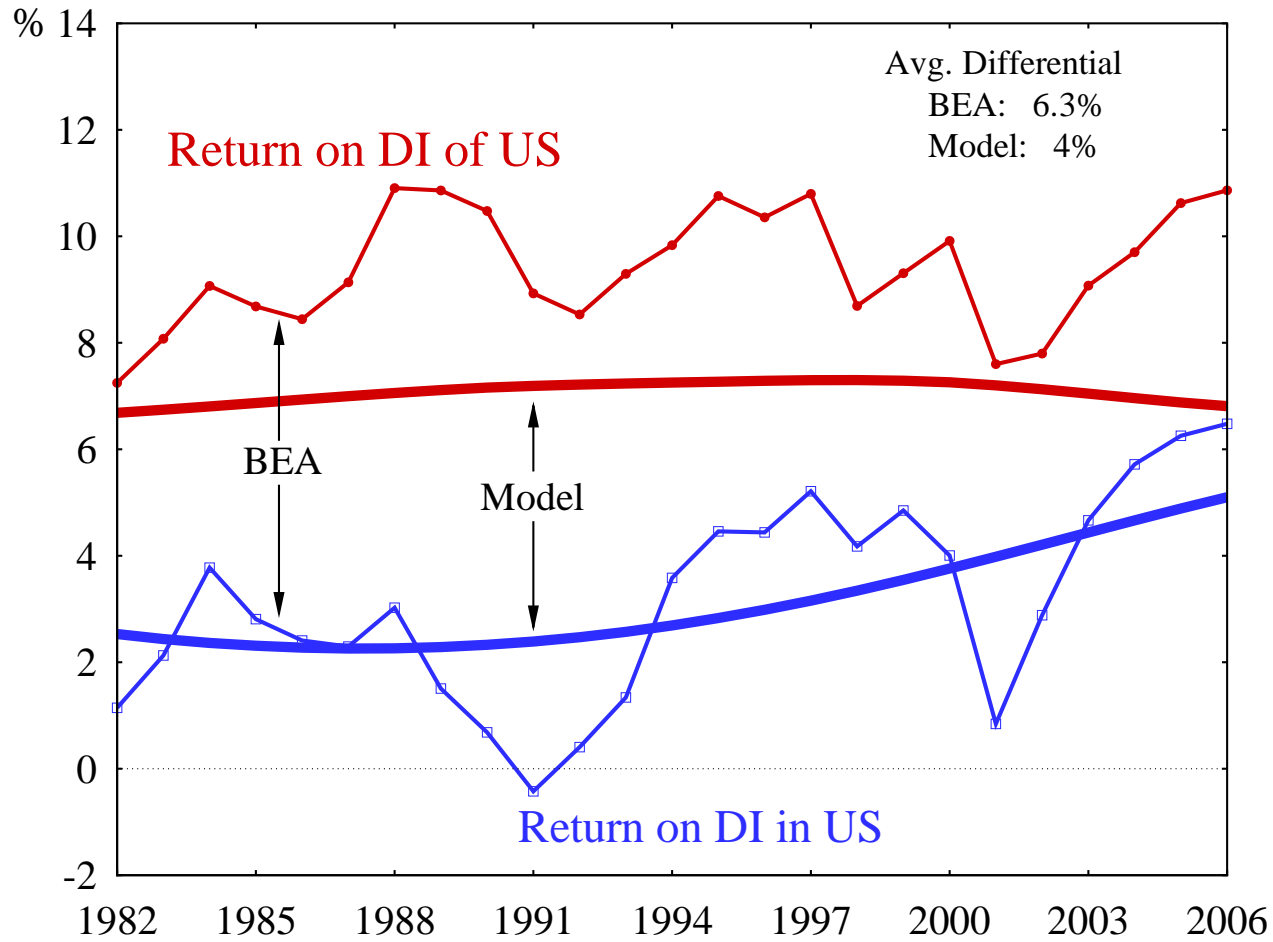


Model

FDI net income rising while net position falling ... as observed



BEA RETURNS—DATA AND MODEL



*Account for over
60% of difference
in return*



WHY MODEL GENERATES DIFFERENT **REPORTED** RETURNS

- Differences primarily due to:
 - Big rents on tech. capital: BEA overstates return
 - Big expensed investments: BEA understates return

with latter especially important for US affiliates



SENSITIVITY

Alternatives:	Averages, 1960-2006				
	1960s $\frac{V_t^u}{GNP_{ut}}$	$\frac{M_t^u}{GNP_{ut}}$	$\frac{\sum_j K_{I,ut}^j}{GNP_{ut}}$	$\frac{K_{I,it}^j}{K_{T,it}^j}$	Return Gap
$\delta_M = 0\%$	1.82	1.39	1.20	0.91	3.91
$\delta_M = 16\%$	1.45	0.37	1.20	0.91	3.97
$\phi = 8\%$	1.49	0.61	1.17	0.90	3.85
$\phi = 6\%$	1.61	0.47	1.34	0.96	4.26
$\delta_I = 6\%$	1.47	0.59	0.60	0.39	2.70
$\alpha_I = 10\%$	1.56	0.52	1.54	1.22	4.51
$\sigma_{it} = \sigma_{i,1960}$	1.47	0.52	1.19	0.90	-.03
Benchmark	1.51	0.53	1.20	0.91	3.96



WHAT MIGHT ACCOUNT FOR REMAINING 2.3%?

- Some think:
 - Transfer pricing to avoid high US taxes
 - Risk premium for projects abroad; discount in US
- Most likely:
 - US more efficient in producing technology capital



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- Some think:
 - Transfer pricing to avoid high US taxes
 - Risk premium for projects abroad; discount in US
- Most likely:
 - US more efficient in producing technology capital
- Challenge: model with added factor must fit US data



US NET ASSET POSITION

- Not a meaningful concept given technology capital
 - What are the domestic assets?
 - What are the foreign assets?



CONCLUSIONS

- BEA reports show:
 - Returns of DI abroad much higher than DI in US
 - US net direct investment position falling
- Want some resolution to avoid unnecessary bad policy
- We resolve large part using model with
 - Technology capital
 - Plant-specific intangible capital