



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

— ALBERT EINSTEIN



# TECHNOLOGY CAPITAL AND THE US CURRENT ACCOUNT

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

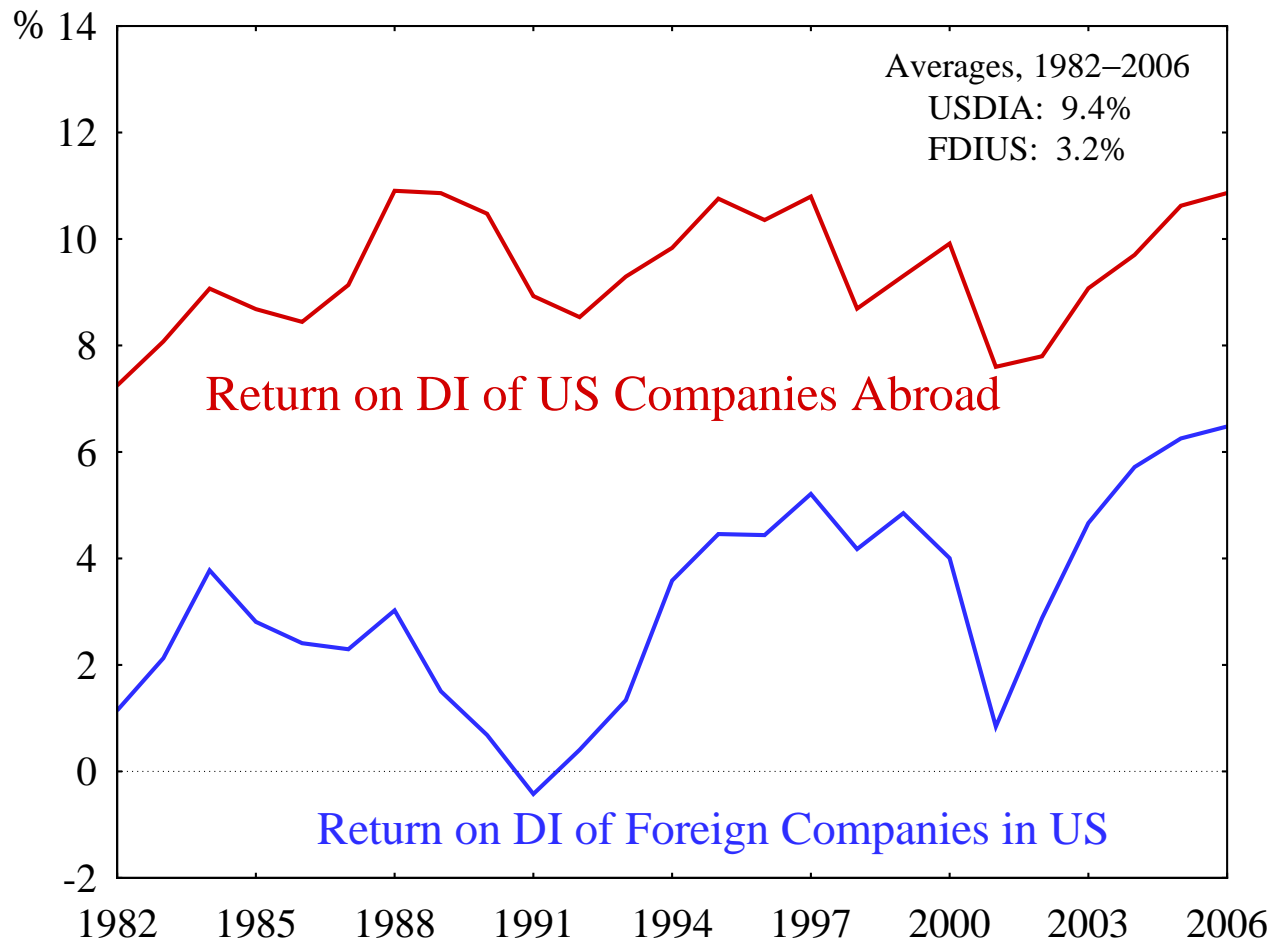


## A DIRECT INVESTMENT (DI) PUZZLE

- 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?*



WHY IS RETURN DIFFERENTIAL LARGE?



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1. BEA returns are accounting measures
2. Timing of FDI different in US & ROW



## WHY IS RETURN DIFFERENTIAL LARGE?

1. Multinationals have large intangible capital stocks

2. FDI in US is negligible until late 1970s



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## 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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Intangible rents key for US, investments for ROW



## WHAT WE DO

- Develop model with time-varying *openness* to FDI
  - Infer *paths* of degrees of openness & relative size from
    - FDI income flows
    - Net exports
    - Relative populations
  - Assume all investments earn same economic return
- Compute BEA statistics for the model economy



## WHAT WE FIND

- Use model where each investment earns 4.6% on average
- We find average *BEA* returns on DI, 1982–2006:
  - of US = 7.1%
  - in US = 3.1%





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- ⇒ Mismeasurement accounts for over 60% of return gap



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⇒ Mismeasurement accounts for over 60% of return gap
- Also show: “net asset position” not a meaningful concept



# THEORY



## PRODUCTION OF MULTINATIONALS FROM $j$ IN COUNTRY $i$ AT $t$

$$Y_{it}^j = A_{it}\sigma_{it}(N_{it}M_t^j)^\phi(Z_{it}^j)^{1-\phi}$$

$Y_i^j$  : output of multinationals from  $j$  in country  $i$

$A_i$  : country  $i$ 's TFP

$\sigma_i$  : country  $i$ 's degree of openness to FDI

$N_i$  : country  $i$ 's measure of production locations

$M^j$  : technology capital of multinationals from  $j$

$Z_i^j$  : composite of factors in  $i$  used by  $j$ 's multinationals



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## AGGREGATE OUTPUT IN COUNTRY $i$ AT $t$

$$Y_{it} = A_{it} N_{it}^{\phi} (M_t^i + \sigma_{it}^{\frac{1}{\phi}} \sum_{j \neq i} M_t^j)^{\phi} Z_{it}^{1-\phi}$$

- Key result provided  $\sigma_i > 0$ :

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



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- Key result provided  $\sigma_i > 0$ :

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



## IMPLICATIONS OF ADDING TECHNOLOGY CAPITAL

- If  $\phi = 0$  in  $Y_i = A_i(N_i[M^i + \sigma_i^{\frac{1}{\phi}} \sum_j M^j])^\phi (Z_i)^{1-\phi}$
- If  $\phi > 0$  and  $\sigma_i = 0$ ,
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- If  $\phi = 0$  in  $Y_i = A_i(N_i[M^i + \sigma_i^{\frac{1}{\phi}} \sum_j M^j])^\phi (Z_i)^{1-\phi}$ 
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  - No need for FDI
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- If  $\phi > 0$  and  $\sigma_i = 0$ ,
  - No foreign subsidiaries
  - More locations implies higher  $Y/N$  and  $Y/L$
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- If  $\phi > 0$  and  $\sigma_i = 0$ ,
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  - More locations implies higher  $Y/N$  and  $Y/L$
- If  $\phi > 0$  and  $\sigma_i > 0$ ,
  - Foreign subsidiaries if  $\sigma_i$  not too small
  - More done by big (high  $A, N$ ), closed (low  $\sigma$ ) countries



## COMPOSITE INPUT OF MULTINATIONALS FROM $j$ IN $i$

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

$K_{T,i}^j =$  *tangible* capital

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

$L_i^j =$  labor input

- With capital accumulation,

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

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

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



## 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  $N$



# ALIGNING MODEL AND BEA ACCOUNTS



## BEA MEASURES

- $GDP_{it} = C_{it} + \sum_j X_{T,it}^j + NX_{it}$

- $GDI_{it} = Y_{it} - X_{M,t}^i - \sum_j X_{I,it}^j$

- Net factor receipts:

$$NFR_{it} = \sum_{l \neq i} \{D_{lt}^i + K_{T,l,t+1}^i - K_{T,lt}^i\} + \sum_{l \neq i} S_{it}^l D_t^l + \max(r_{bt} B_{it}, 0)$$

- Net factor payments:

$$NFP_{it} = \sum_{l \neq i} \{D_{it}^l + K_{T,i,t+1}^l - K_{T,it}^l\} + \sum_{l \neq i} S_{lt}^i D_t^i + \max(-r_{bt} B_{it}, 0)$$

- Current account:

$$CA_{it} = NX_{it} + NFR_{it} - NFP_{it}$$



## BEA RETURN ON FDI

- Think of  $d$ =Dell,  $f$ =France

$$\begin{aligned} r_{\text{FDI},t} &= (1 - \tau_{p,ft}) (Y_{ft}^d - W_{ft}L_{ft}^d - \delta_T K_{T,ft}^d - X_{I,ft}^d) / K_{T,ft}^d \\ &= r_t + \underbrace{(1 - \tau_{p,ft}) [\phi + (1 - \phi)\alpha_I]}_{\text{intangible rents}} \frac{Y_{ft}^d}{K_{T,ft}^d} - \underbrace{(1 - \tau_{p,ft})}_{\text{expenses}} \frac{X_{I,ft}^d}{K_{T,ft}^d} \end{aligned}$$

where  $r_t$  is actual return on all types of capital



## USING THE THEORY

- Simulate time series from the model
- Construct statistics using same methodology as BEA
- Compare these accounting statistics to BEA's



## 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
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    - 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  $\approx 1.5$  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



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- Tax rates on capital: smoothed US rates
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- 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



## TIME-VARYING INPUTS

- Tax rates on capital: smoothed US rates
- Portfolio composition indeterminate
  - 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

- 4 reasons why this is reasonable:

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

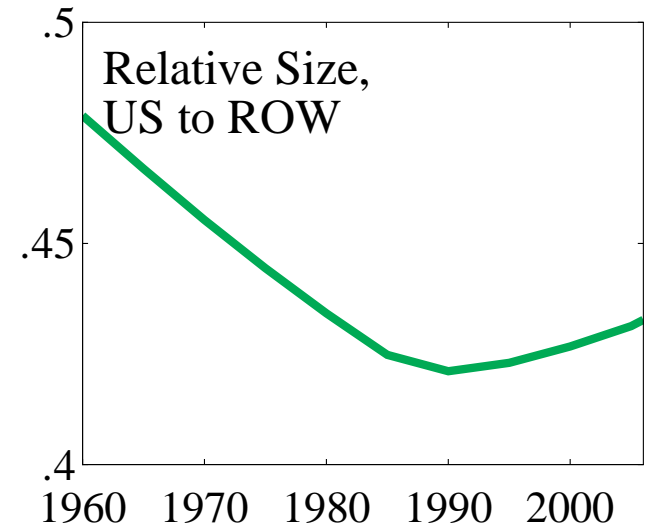
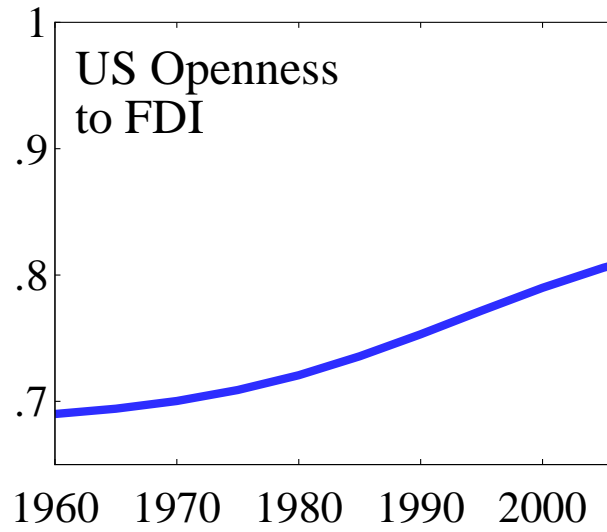
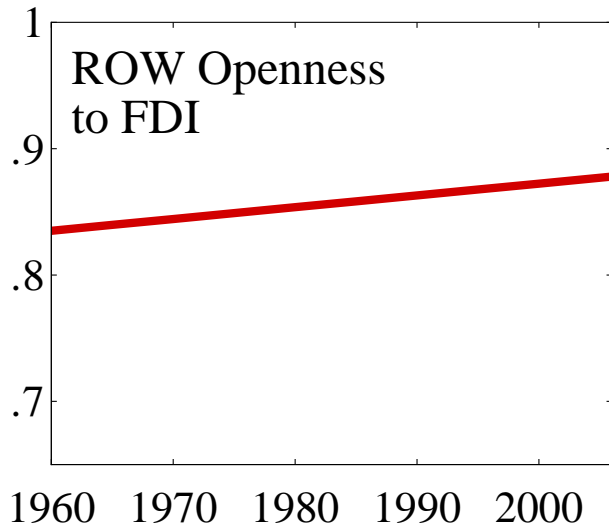


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  4. National security concerns used to block FDI
- Next, consider the inputs we use

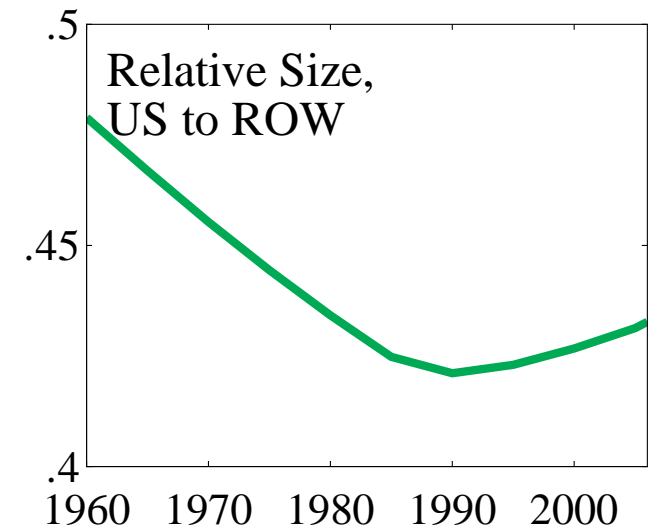
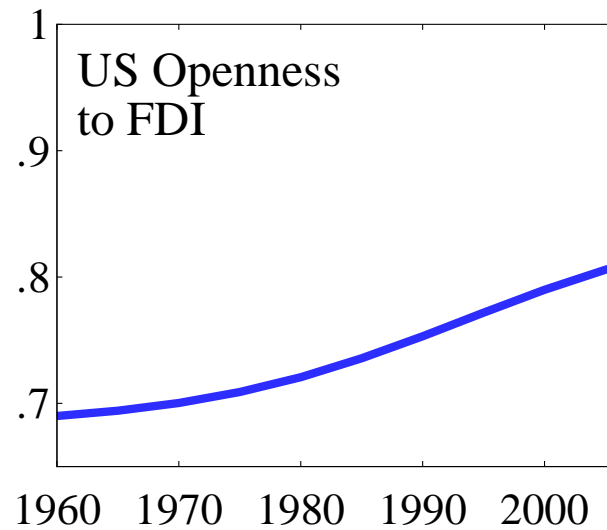
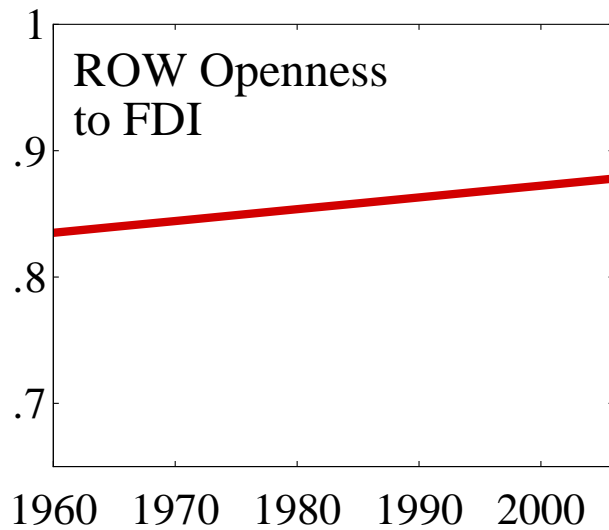


# OPENNESS AND RELATIVE SIZE





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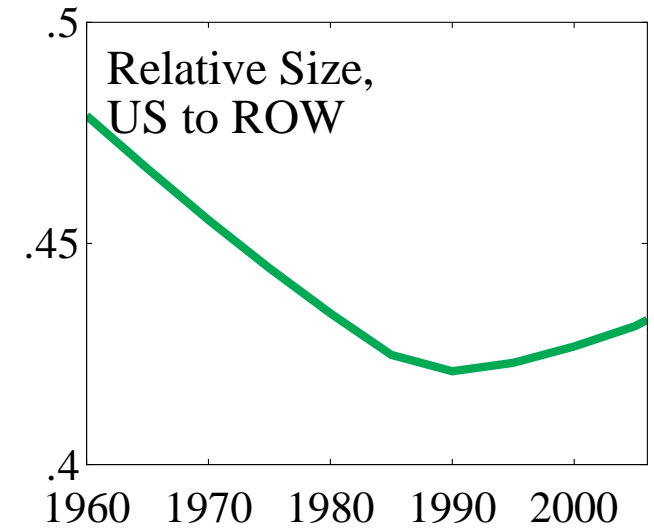
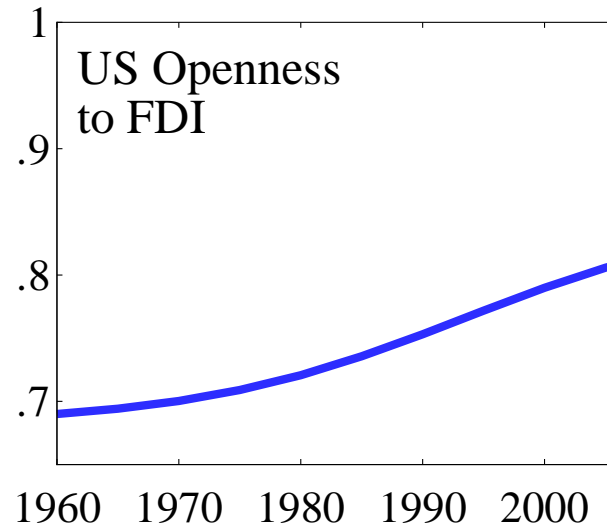
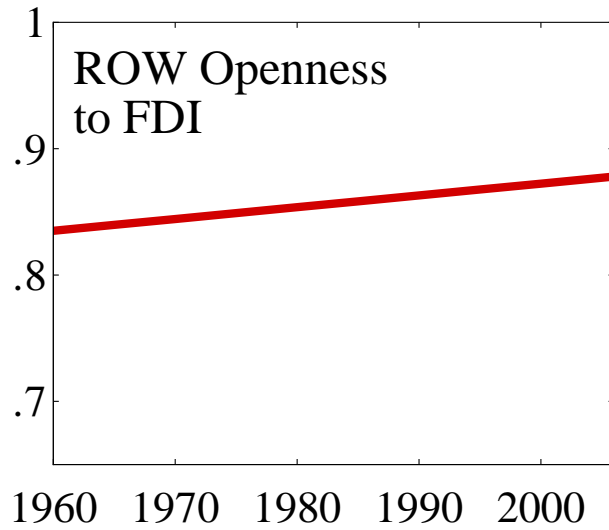


Note that ROW is more open than US....





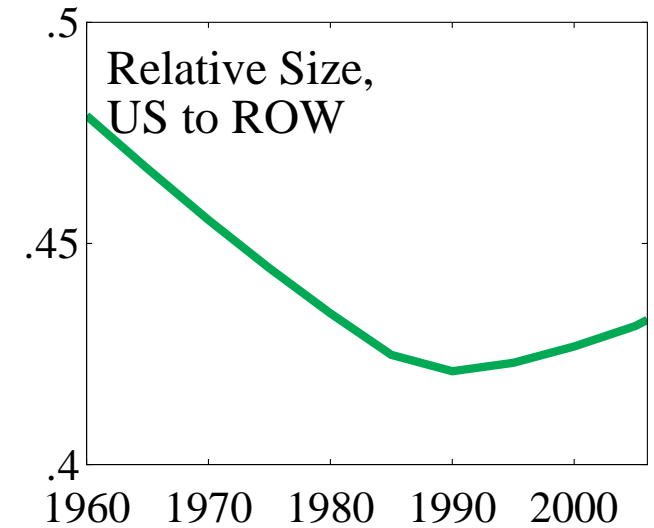
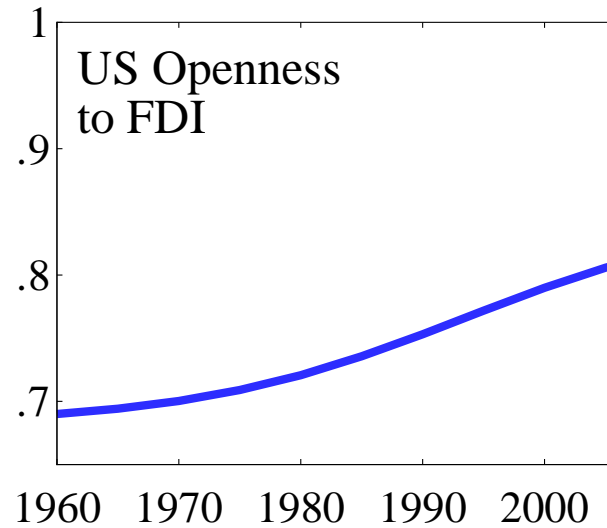
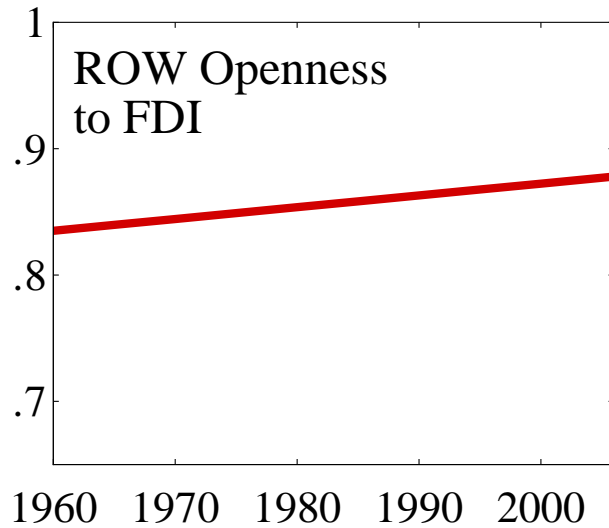
## OPENNESS AND RELATIVE SIZE



Also note fall in size ....



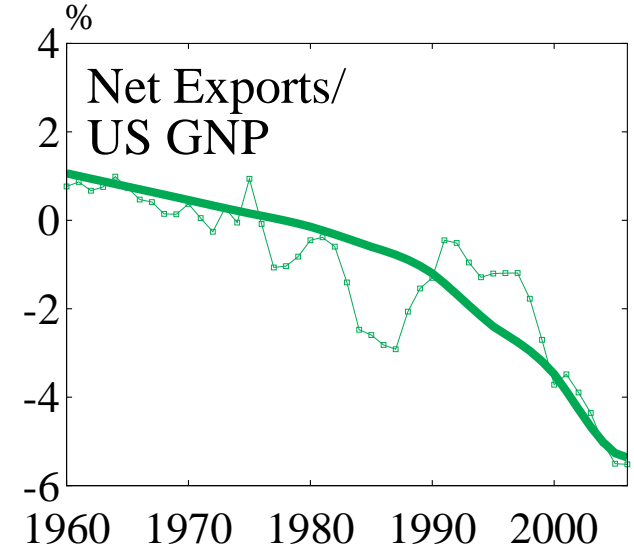
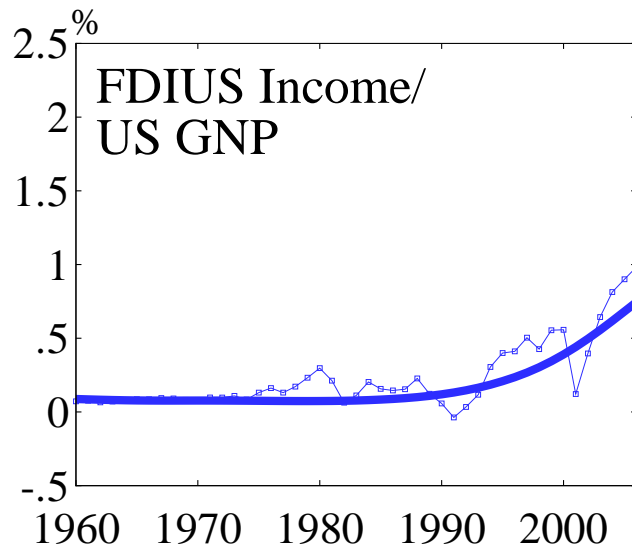
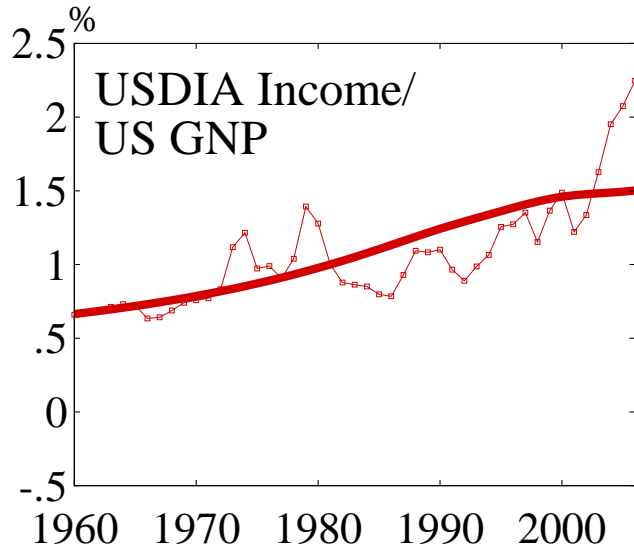
## OPENNESS AND RELATIVE SIZE



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



# PREDICTED FDI INCOMES AND TRADE BALANCE



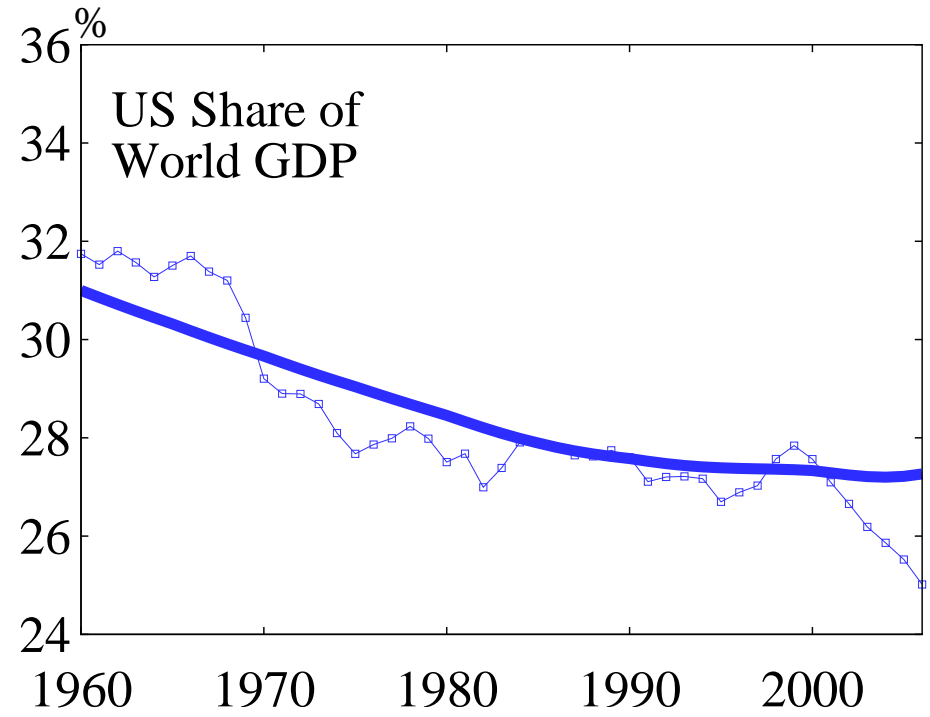
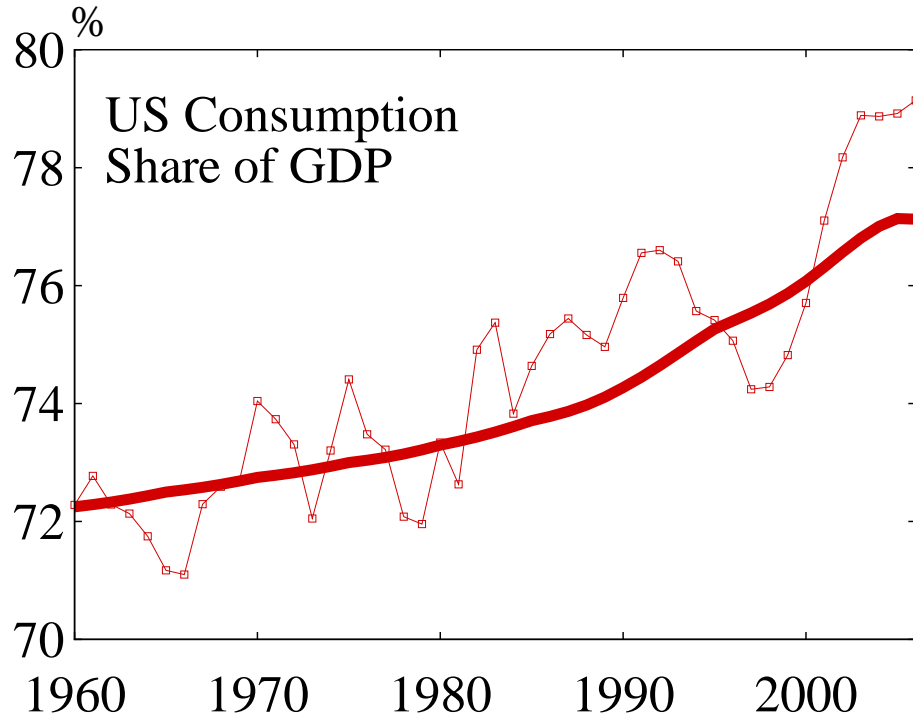
— Model  
—□— Data



# EXTERNAL CONFORMITY



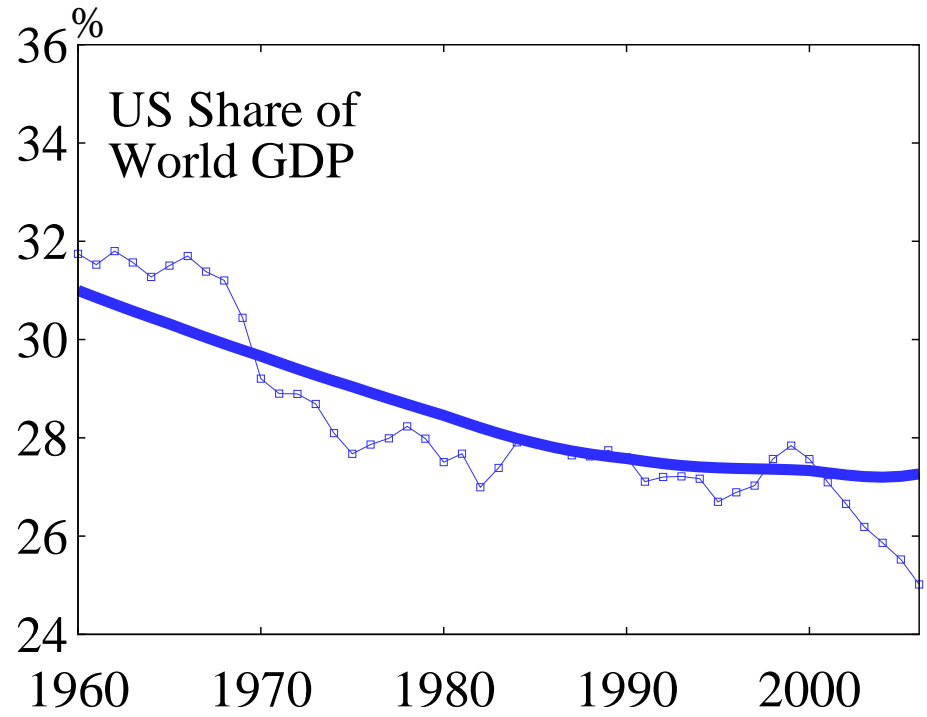
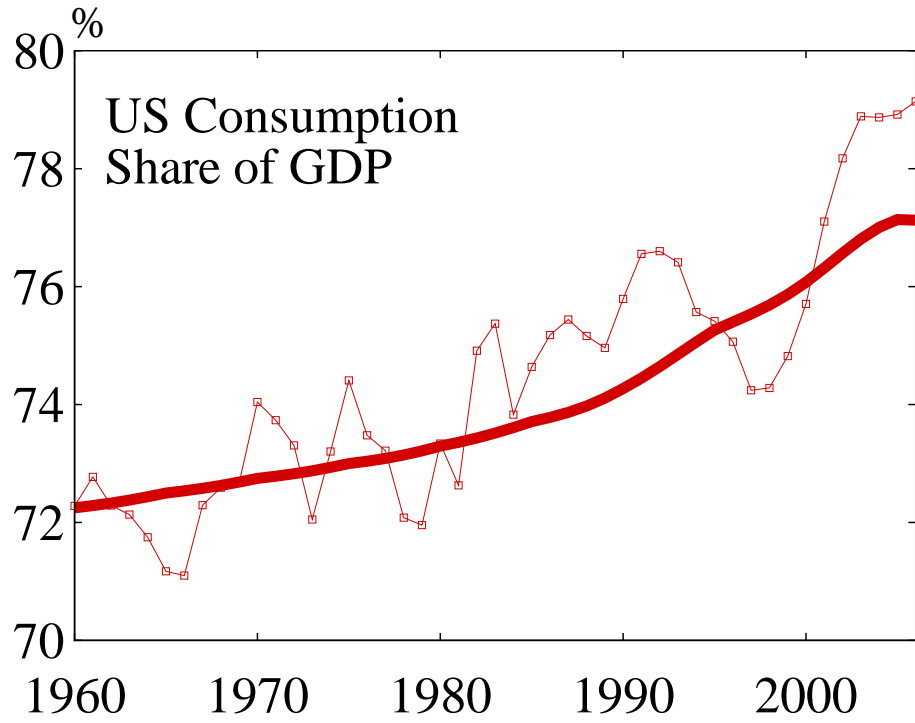
# ARE OTHER TRENDS CONSISTENT?



— Model  
—□— Data



# ARE OTHER TRENDS CONSISTENT? **YES**



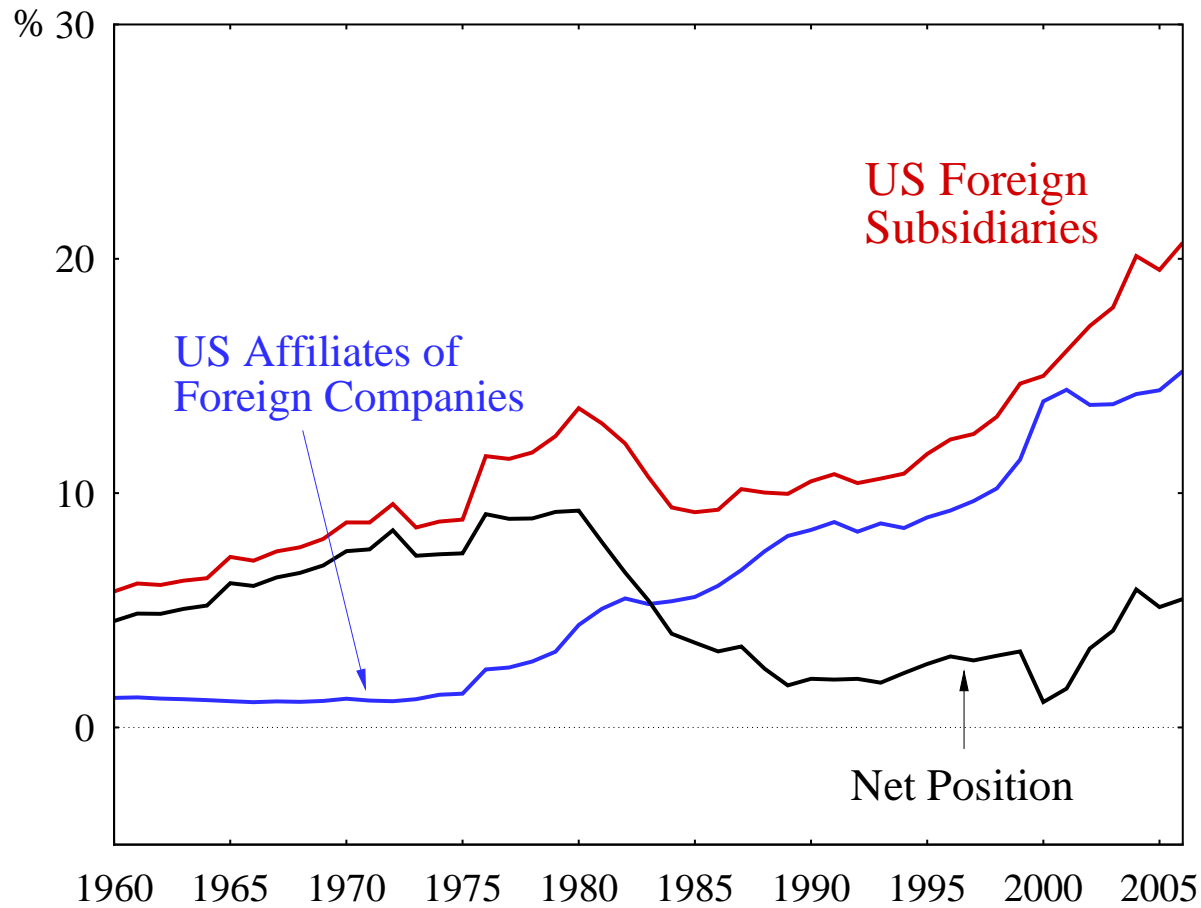
— Model  
—□— Data



# USING THE THEORY TO PREDICT FDI STOCKS AND RETURNS



# FDI STOCKS AT CURRENT COST/US GNP: DATA

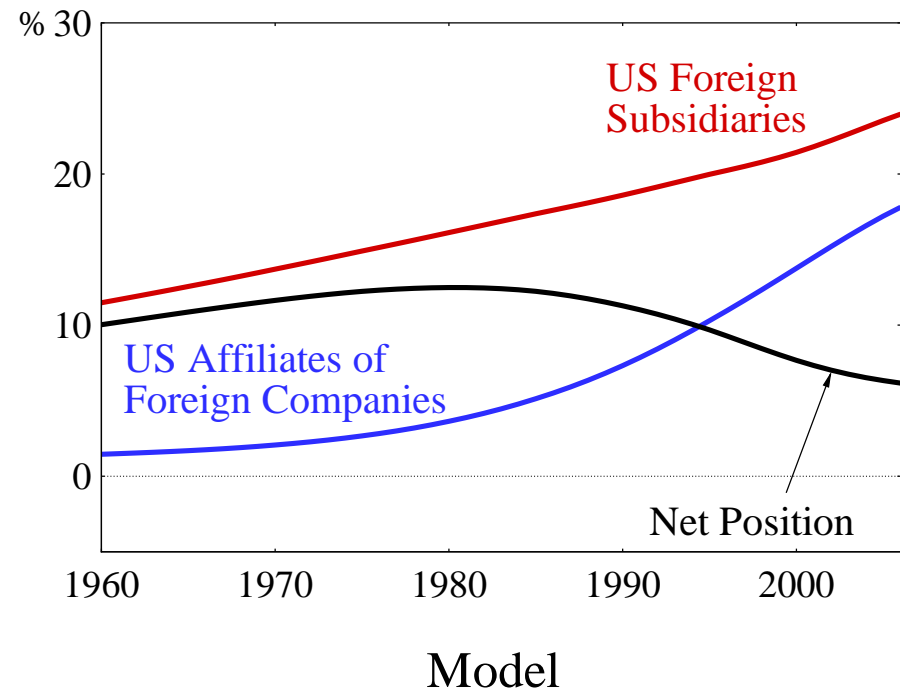
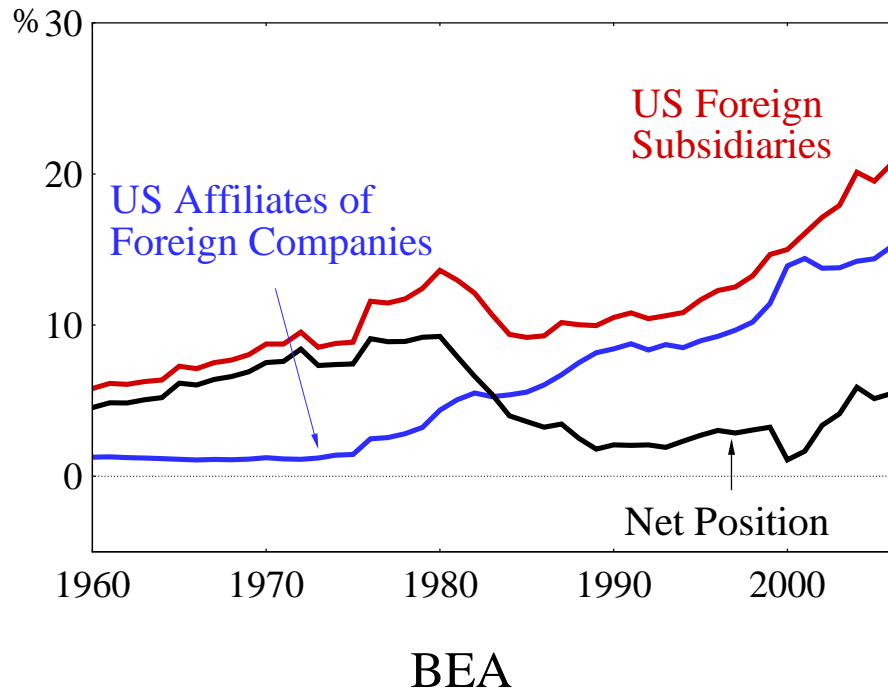


FDI net income rising while net position falling





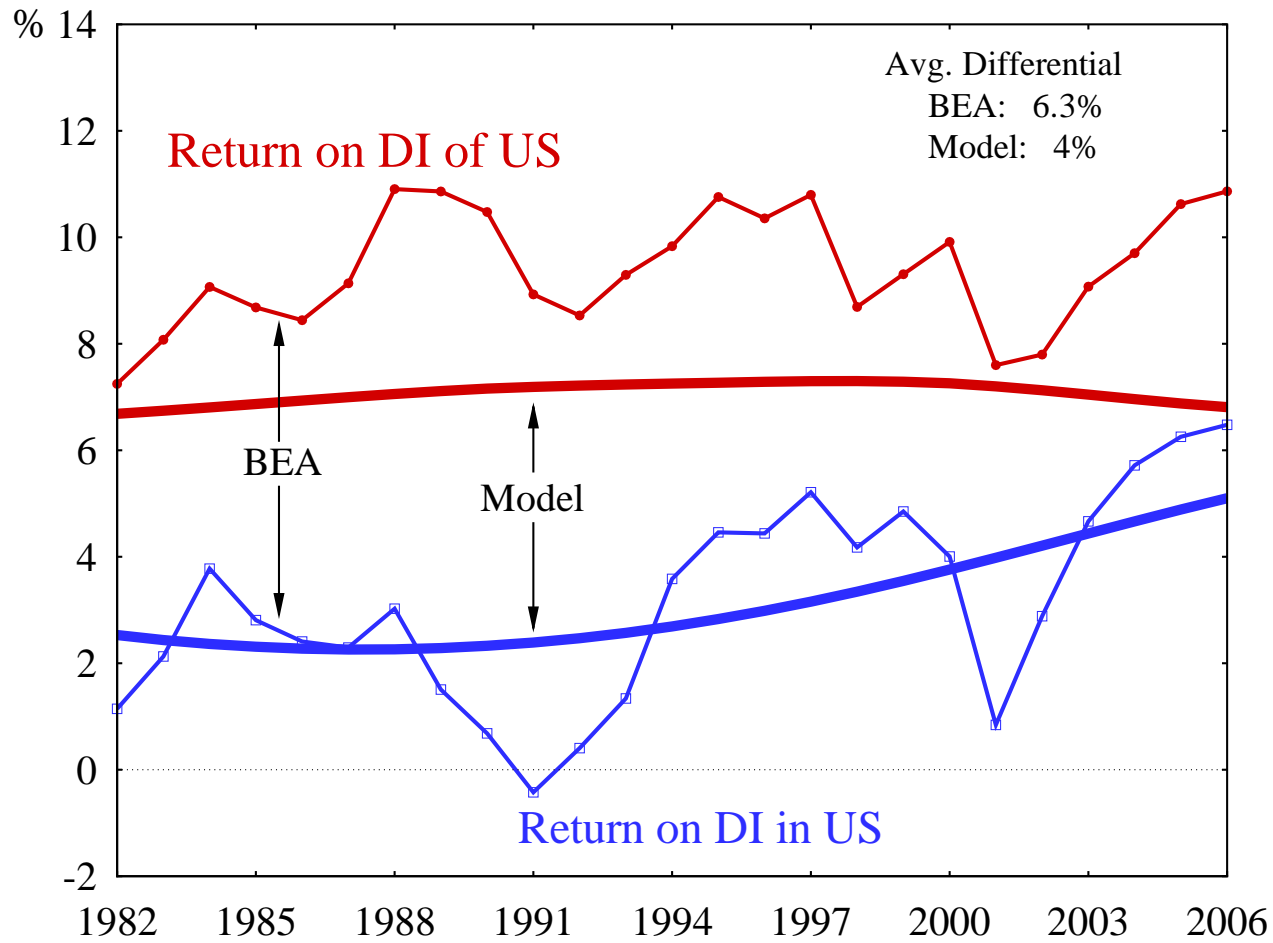
# BEA STOCKS/US GNP—DATA AND MODEL



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



## IMPORTANCE OF OPENNESS PATHS

|                                 | 1960s                    | Averages, 1960-2006      |                                      |                                 |            |
|---------------------------------|--------------------------|--------------------------|--------------------------------------|---------------------------------|------------|
|                                 | $\frac{V_t^u}{GNP_{ut}}$ | $\frac{M_t^u}{GNP_{ut}}$ | $\frac{\sum_j K_{I,ut}^j}{GNP_{ut}}$ | $\frac{K_{I,it}^j}{K_{T,it}^j}$ | Return Gap |
| Benchmark:                      | 1.51                     | 0.53                     | 1.20                                 | 0.91                            | 3.96       |
| Alternative:                    |                          |                          |                                      |                                 |            |
| $\sigma_{it} = \sigma_{i,1960}$ | 1.47                     | 0.52                     | 1.19                                 | 0.90                            | -.03       |

⇒ if countries stayed at 1960s openness level,  
predicted gap is roughly zero



## SENSITIVITY

- How sensitive is result to key parameters for intangibles?
- When answering, assume
  1. Openness & size set so current account matches US
  2. Stock market and technology capital values don't match



# SENSITIVITY: TECHNOLOGY CAPITAL DEPRECIATION

|                   | 1960s                    | Averages, 1960-2006      |                                      |                                 |            |
|-------------------|--------------------------|--------------------------|--------------------------------------|---------------------------------|------------|
|                   | $\frac{V_t^u}{GNP_{ut}}$ | $\frac{M_t^u}{GNP_{ut}}$ | $\frac{\sum_j K_{I,ut}^j}{GNP_{ut}}$ | $\frac{K_{I,it}^j}{K_{T,it}^j}$ | Return Gap |
| Benchmark:        |                          |                          |                                      |                                 |            |
| $\delta_M = 8\%$  | 1.51                     | 0.53                     | 1.20                                 | 0.91                            | 3.96       |
| Alternatives:     |                          |                          |                                      |                                 |            |
| $\delta_M = 0\%$  | 1.82                     | 1.39                     | 1.20                                 | 0.91                            | 3.91       |
| $\delta_M = 16\%$ | 1.45                     | 0.37                     | 1.20                                 | 0.91                            | 3.97       |

$\Rightarrow \delta_M$  has big effect on  $V$  and  $M$  but small on return gap



# SENSITIVITY: TECHNOLOGY CAPITAL SHARE

|               | 1960s                    | Averages, 1960-2006      |                                      |                                 |            |
|---------------|--------------------------|--------------------------|--------------------------------------|---------------------------------|------------|
|               | $\frac{V_t^u}{GNP_{ut}}$ | $\frac{M_t^u}{GNP_{ut}}$ | $\frac{\sum_j K_{I,ut}^j}{GNP_{ut}}$ | $\frac{K_{I,it}^j}{K_{T,it}^j}$ | Return Gap |
| Benchmark:    |                          |                          |                                      |                                 |            |
| $\phi = 7\%$  | 1.51                     | 0.53                     | 1.20                                 | 0.91                            | 3.96       |
| Alternatives: |                          |                          |                                      |                                 |            |
| $\phi = 8\%$  | 1.49                     | 0.61                     | 1.17                                 | 0.90                            | 3.85       |
| $\phi = 6\%$  | 1.61                     | 0.47                     | 1.34                                 | 0.96                            | 4.26       |

$\Rightarrow \phi$  larger implies smaller gap because  $K_I$  less important



# SENSITIVITY: INTANGIBLE CAPITAL DEPRECIATION AND SHARE

Averages, 1960-2006

|                                   | 1960s                    | Averages, 1960-2006      |                                      |                                 |            |
|-----------------------------------|--------------------------|--------------------------|--------------------------------------|---------------------------------|------------|
|                                   | $\frac{V_t^u}{GNP_{ut}}$ | $\frac{M_t^u}{GNP_{ut}}$ | $\frac{\sum_j K_{I,ut}^j}{GNP_{ut}}$ | $\frac{K_{I,it}^j}{K_{T,it}^j}$ | Return Gap |
| Benchmark:                        |                          |                          |                                      |                                 |            |
| $\delta_I = 0\%, \alpha_I = 7\%$  | 1.51                     | 0.53                     | 1.20                                 | 0.91                            | 3.96       |
| Alternatives:                     |                          |                          |                                      |                                 |            |
| $\delta_I = 6\%, \alpha_I = 7\%$  | 1.47                     | 0.59                     | 0.60                                 | 0.39                            | 2.70       |
| $\delta_I = 0\%, \alpha_I = 10\%$ | 1.56                     | 0.52                     | 1.54                                 | 1.22                            | 4.51       |

$\Rightarrow \delta_I, \alpha_I$  together determine size of  $K_I$ , which is key for gap

But even if  $K_I$  cut in half, predicted gap still sizable





## 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