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

October 2008

www.minneapolislisd.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?

Averages, 1982–2006
USDIA: 9.4%
FDIUS: 3.2%
Why is Return Differential Large?
Why is Return Differential Large?

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
WHY IS RETURN DIFFERENTIAL LARGE?

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

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Why is Return Differential Large?

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   \[ \Rightarrow \text{BEA returns not equal economic} \]

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WHY IS RETURN DIFFERENTIAL LARGE?

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   ◦ DI stocks don’t include intangible capital

⇒ BEA returns not equal economic

2. FDI in US is negligible until late 1970s

⇒ Timing of investments different in US & ROW
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 \((r_{BEA})\)

- With no intangible capitals,
  \[
r_{BEA} = \frac{\text{after-tax profits}}{\text{tangible capital}}
  \]

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- With no intangible capitals,
  
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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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• 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
Production of Multinationals from $j$ in Country $i$ at $t$

\[ Y_{it}^j = A_{it} \sigma_{it} (N_{it} M_{jt})^{\phi} (Z_{it}^j)^{1-\phi} \]

$Y_{it}^j$ : output of multinationals from $j$ operating in country $i$

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

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$Z_{it}^j$ : composite of factors in $i$ used by $j$’s multinationals
Aggregate Output in Country $i$ at $t$

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

- Key result provided $\sigma_i > 0$:

Each $i$ has constant returns, but summing over $i$ results in a bigger aggregate production set.
Aggregate Output in Country $i$ at $t$

\[ Y_{it} = A_{it} N_{it}^{\phi} (M_{it}^{i} + \sigma_{it}^{\phi} \sum_{j \neq i} M_{it}^{j})^{\phi} Z_{it}^{1-\phi} \]

- 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 $\sigma_i = 0$,

- If $\phi > 0$ and $\sigma_i > 0$, 
Implications of Adding Technology Capital

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  - No need for FDI

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  - No foreign subsidiaries
  - More locations implies higher $Y/N$ and $Y/L$

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• If $\phi > 0$ and $\sigma_i = 0$,
  
  ○ No foreign subsidiaries
  ○ 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,

\[
D_t^j + \sum_i K_{T,i,t+1}^j - K_{T,it}^j
\]

\textit{Reported} reinvested earnings

\[
= \sum_i \{(1 - \tau_{p,it}) (Y_{it}^j - W_{it}L_{it}^j - \delta_T K_{T,it}^j - X_{I,it}^j - \chi_{ji}^j X_{M,t}^j)\}
\]

\textit{Reported} profits less expensed investments and taxes

where \( \chi_{i}^i = 1 \) and \( \chi_{i}^j = 0 \), \( j \neq i \)
Multinationals Incorporated in Country $j$ Solve

Maximize

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

given definition of dividends,

$$D^j_t + \sum_i K^j_{T,i,t+1} - K^j_{T,it} = \text{Reported reinvested earnings}$$

$$= \sum_i \{(1 - \tau_{p,it})(Y^j_{it} - W_{it}L^j_{it} - \delta_T K^j_{T,it} - X^j_{I,it} - X^j_{i}X^j_{M,t})\} = \text{Reported profits less expensed investments and taxes}$$

$\Rightarrow$ expensing done at home
Multinationals Incorporated in Country $j$ Solve

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

given definition of dividends,

$$D_t^j + \sum_i K_{T,i,t+1}^j - K_{T, it}^j$$

Reported reinvested earnings

$$= \sum_i \{(1 - \tau_{p, it}) (Y_{it}^j - W_{it}L_{it}^j - \delta_T K_{T, it}^j - X_{I, it}^j - \chi_{i}^j X_{M, t}^j)$$

Reported profits less expensed investments and taxes

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

$$\sum_t p_t \left[ (1 + \tau_{c,it}) C_{it} + \sum_j V^j_t (S^j_{i,t+1} - S^j_{it}) + B_{i,t+1} - B_{it} \right]$$

$$\leq \sum_t p_t \left[ (1 - \tau_{l,it}) W_{it} L_{it} + (1 - \tau_{d,t}) \sum_j S^j_{it} D^j_t + r_{b,t} B_{it} + \kappa_{it} \right]$$

$S^j_{i} =$ equity shares of companies from $j$

$B_i =$ foreign debt
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

\[
\sum_t p_t \left[ (1 + \tau_{c, it})C_{it} + \sum_j V_j^t (S_{i, t+1}^j - S_{it}^j) + B_{i, t+1} - B_{it} \right] \\
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\]

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}

- GD\bar{D}_{it} = Y_{it} - X_{M, t}^i - \sum_j X_{I, it}^j

- Net factor receipts:

\[\text{NFR}_{it} = \sum_{l \neq i} \{D_{lt}^i + K_{T, l,t+1}^i - K_{T, lt}^i\} + \sum_{l \neq i} S_{lt}^i D_{t}^l + \max(-r_{bt} B_{it}, 0)\]

- Net factor payments:

\[\text{NFP}_{it} = \sum_{l \neq i} \{D_{lt}^i + K_{T, i,t+1}^l - K_{T, it}^l\} + \sum_{l \neq i} S_{lt}^i D_{t}^i + \max(r_{bt} B_{it}, 0)\]

- Current account:

\[\text{CA}_{it} = NX_{it} + \text{NFR}_{it} - \text{NFP}_{it}\]
Think of $d=$ Dell, $f=$ France

$$r_{\text{FDI},t} = (1 - \tau_{p,ft}) \left( Y_{ft}^d - W_{ft} L_{ft}^d - \delta T K_{T,ft}^d - X_{I,ft}^d \right) / K_{T,ft}^d$$

$$= r_t + (1 - \tau_{p,ft}) \left[ \phi + (1 - \phi) \alpha_I \right] \frac{Y_{ft}^d}{K_{T,ft}^d} - (1 - \tau_{p,ft}) \frac{X_{I,ft}^d}{K_{T,ft}^d}$$

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
    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 $\approx 1.5$ in 1960s
Initial Business Capital Stocks

- Consistent with
  - US GDP, 1960 = 1
  - ROW GDP, 1960 = 2.2
  - No initial jumps in investment \( \frac{\dot{X}_{j,i_1}}{X_{j,i_1}} = \frac{\dot{X}_{j,i_2}}{X_{j,i_2}} \)

\[ K_{T,u,1960} = 1.30, \quad K_{I,u,1960} = 1.17, \quad M^u_{1960} = 0.52 \]
Time-Varying Inputs

• Tax rates on capital

• Portfolio composition

• Paths of openness and relative size
TIME-VARYING INPUTS

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

\[ \text{Size} = N_i A_i^{1−(1−\phi)(\alpha_T+\alpha_I)} \]
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
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

• Next, consider the inputs we use
OPENNESS AND RELATIVE SIZE

ROW Openness to FDI

US Openness to FDI

Relative Size, US to ROW
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

![Graphs showing predicted FDI incomes and trade balance](image-url)
EXTERNAL CONFORMITY
Are Other Trends Consistent?

- **US Consumption Share of GDP**
  - 1960: 72%
  - 1970: 74%
  - 1980: 76%
  - 1990: 78%
  - 2000: 80%

- **US Share of World GDP**
  - 1960: 36%
  - 1970: 34%
  - 1980: 32%
  - 1990: 30%
  - 2000: 28%
Are Other Trends Consistent? **Yes**

**US Consumption Share of GDP**

**US Share of World GDP**

- **Model**
- **Data**
Using the Theory to Predict FDI Stocks and Returns
FDI净收入上升而净职位下降
FDI net income rising while net position falling ... as observed
**BEA Returns—Data and Model**

Return on DI of US

Return on DI in US

Avg. Differential
BEA: 6.3%
Model: 4%

Account for over 60% of difference in return
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

**Averages, 1960-2006**

<table>
<thead>
<tr>
<th></th>
<th>1960s</th>
<th></th>
<th></th>
<th></th>
<th>Return Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$V^u_t$</td>
<td>$M^u_t$</td>
<td>$\sum_{j} K^j_{I,ut}$</td>
<td>$K^j_{I,It}$</td>
<td></td>
</tr>
<tr>
<td><strong>GNP_{ut}</strong></td>
<td>$\frac{V^u_t}{GNP_{ut}}$</td>
<td>$\frac{M^u_t}{GNP_{ut}}$</td>
<td>$\frac{\sum_{j} K^j_{I,ut}}{GNP_{ut}}$</td>
<td>$\frac{K^j_{I,It}}{K^j_{T,It}}$</td>
<td></td>
</tr>
<tr>
<td><strong>Benchmark:</strong></td>
<td>1.51</td>
<td>0.53</td>
<td>1.20</td>
<td>0.91</td>
<td>3.96</td>
</tr>
<tr>
<td><strong>Alternative:</strong></td>
<td>1.47</td>
<td>0.52</td>
<td>1.19</td>
<td>0.90</td>
<td>−.03</td>
</tr>
</tbody>
</table>

$\Rightarrow$ 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

<table>
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<tr>
<td></td>
<td>$V_t^u / \text{GNP}_{ut}$</td>
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<td>$\sum_j K_{I,ut}^j / \text{GNP}_{ut}$</td>
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<td><strong>Benchmark:</strong></td>
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<tr>
<td>$\delta_M = 8%$</td>
<td>1.51</td>
<td>0.53</td>
<td>1.20</td>
</tr>
<tr>
<td><strong>Alternatives:</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$\delta_M = 0%$</td>
<td>1.82</td>
<td>1.39</td>
<td>1.20</td>
</tr>
<tr>
<td>$\delta_M = 16%$</td>
<td>1.45</td>
<td>0.37</td>
<td>1.20</td>
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</table>

$\Rightarrow \delta_M$ has big effect on $V$ and $M$ but small on return gap.
Sensitivity: Technology Capital Share

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<td>Benchmark:</td>
<td>$\frac{V_t^u}{\text{GNP}_{ut}}$</td>
<td>$\frac{M_t^u}{\text{GNP}_{ut}}$</td>
</tr>
<tr>
<td>$\phi = 7%$</td>
<td>1.51</td>
<td>0.53</td>
</tr>
<tr>
<td>Alternatives:</td>
<td>$\frac{V_t^u}{\text{GNP}_{ut}}$</td>
<td>$\frac{M_t^u}{\text{GNP}_{ut}}$</td>
</tr>
<tr>
<td>$\phi = 8%$</td>
<td>1.49</td>
<td>0.61</td>
</tr>
<tr>
<td>$\phi = 6%$</td>
<td>1.61</td>
<td>0.47</td>
</tr>
</tbody>
</table>

$\Rightarrow \phi$ larger implies smaller gap because $K_I$ less important
**Sensitivity: Intangible Capital Depreciation and Share Averages, 1960-2006**

<table>
<thead>
<tr>
<th></th>
<th>1960s</th>
<th>Averages, 1960-2006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\frac{V^u_t}{\text{GNP}_{ut}}$</td>
<td>$\frac{M^u_t}{\text{GNP}_{ut}}$</td>
<td>$\sum_j \frac{K^j_{I,ut}}{\text{GNP}_{ut}}$</td>
</tr>
<tr>
<td><strong>Benchmark:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\delta_I = 0%$, $\alpha_I = 7%$</td>
<td>1.51</td>
<td>0.53</td>
<td>1.20</td>
</tr>
<tr>
<td><strong>Alternatives:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\delta_I = 6%$, $\alpha_I = 7%$</td>
<td>1.47</td>
<td>0.59</td>
<td>0.60</td>
</tr>
<tr>
<td>$\delta_I = 0%$, $\alpha_I = 10%$</td>
<td>1.56</td>
<td>0.52</td>
<td>1.54</td>
</tr>
</tbody>
</table>

$\Rightarrow$ $\delta_I$, $\alpha_I$ 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
What Might Account for Remaining 2.3%?

- Some think:
  - Transfer pricing to avoid high US taxes
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- 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