Policy Effects of International Taxation on Firm Dynamics and Capital Structure

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Roadmap

1. Introduction
2. Prologue Model: the Static Partial Equilibrium Case
3. Quantitative Model
4. Calibration of Quantitative Model
5. Quantitative Results: Removing the Repatriation Tax
6. Conclusion
Question

- How do tax reforms targeted at multinational firms affect domestic productivity, economic activity and welfare?
Motivation: Recent Policy Episodes

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  - Aimed to reduce tax evasion by multinationals.
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  - Cross-sectional changes aggregate to have an impact on the macroeconomy.
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- Do these frictions interact with the equilibrium effects of the targeted tax reforms?
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(ii) Apply this general framework to the removal of the U.S. repatriation tax.

Study the steady state and transition path. Ask the following:

(a) Does heterogeneity matter quantitatively?
(b) Do dynamics matter quantitatively?
(c) Do financial frictions matter quantitatively?

Answers: yes, yes and yes.
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- Overall impact is a quantitative question.
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- Has a quantitatively significant effect on macroeconomy.
  - \( \uparrow \) productivity (1.2\%), GDP (0.4\%), wage (0.2\%), welfare (0.2\%)
  - Approximate U.S. revenue neutrality.

- Dynamics matter.
  - Remove repatriation tax and study transition between steady states.
    - \( \uparrow \) welfare smaller (0.1\%) when accounting for transition.

- Financial frictions matter.
  - Reform looks better in the presence of financial frictions.
    - Steady state welfare decreases when frictions are shut-down.
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$$\tau_C, R = \tau_C - \tau_C^*$$ is the U.S. repatriation tax rate pre-reform where $\tau_C$ is U.S. domestic corporate tax rate (35%), $\tau_C^*$ is foreign domestic corporate tax rate. $\tau_C, R = 0$ post-reform.
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In the context of removing the repatriation tax.
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- Production function $y = \theta$ for output $y$. 
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- Fixed capital expenditure of $x^D$ if non-exiting.
- Exporter and multinational incur additional fixed costs $x^X$ and $x^M$ respectively.
- Tradeoff: $x^M > x^X$, exporters incur proportional iceberg variable cost of $i \in [0, 1]$. 
Prologue Model Equilibrium

\[ V(\theta) = \max[V^E(\theta), V^D(\theta), V^X(\theta), V^M(\theta)] \]

\[ V^E(\theta) = 0 \]
\[ V^D(\theta) = -x^D + (1 - \tau^C)\theta \]
\[ V^X(\theta) = -x^D - x^X + (1 - \tau^C)\theta + (1 - \tau^C)(1 - i) P^{H*} \theta \]
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Pre-reform: \((1 - \tau^C)\)
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\[ V^X(\theta) = -x^D - x^X + (1 - \tau^C)\theta + (1 - \tau^C)(1 - i)P^{H*} \theta \]

\[ V^M(\theta) = -x^D - x^M + (1 - \tau^C)\theta + (1 - \tau^{C,U} - \tau^{C*})P^{H*} \theta \]  

Post-reform: \( (1 - \tau^{C*}) \)
**Prologue Model: the Static Partial Equilibrium Case**

**Spencer (Nottingham, UK)**

---

**Prologue Model Equilibrium**

\[
V(\theta) = \max[V^E(\theta), V^D(\theta), V^X(\theta), V^M(\theta)]
\]

\[
V^E(\theta) = 0
\]

\[
V^D(\theta) = -x^D + (1 - \tau^C)\theta
\]

\[
V^X(\theta) = -x^D - x^X + (1 - \tau^C)\theta + (1 - \tau^C)(1 - i)P^H\theta
\]

\[
V^M(\theta) = -x^D - x^M + (1 - \tau^C)\theta + (1 - \tau^C)(1 - iP^H)(1 - \tau^C^*)\theta
\]

*Post-reform: (1 - \tau^C^*)*
Prologue Model: **Pre-Reform**

\[ \frac{x^X}{(1 - \tau_C)(1 - i)} P_{H^*}^{\tau_C, U = \tau_C - \tau_C^*} \]

\[ \frac{x^D}{(1 - \tau_C)} \]

\[ \{ (1 - \tau_C^*) i \} P_{H^*}^{\tau_C, U = \tau_C - \tau_C^*} \]
Prologue Model: Post-Reform

\[ \bar{\theta} \]
\[ \begin{array}{ccccccc}
\theta & E & D & X & M & \bar{\theta} \\
\hline
& \frac{x^D}{(1-\tau_C)} & \frac{x^X}{(1-\tau_C)(1-i)P^H_{\tau C, U=\tau C-\tau C^*}} & \frac{x^M-x^X}{(1-\tau_C)P^H_{\tau C, U=\tau C-\tau C^*}} & \{((1-\tau C^*)-(1-\tau C)(1-i))P^H_{\tau C, U=0}\} \\
\end{array} \]
Prologue Model Summary

- Cross-sectional effects on the export-FDI decision come through:
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1. Direct effect: tax savings.
Prologue Model Summary

Cross-sectional effects on the export-FDI decision come through:

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How does the reform affect the exit-domestic decision?
Prologue Model Summary

- Cross-sectional effects on the export-FDI decision come through:
  
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- How does the reform affect the exit-domestic decision?

- How do financial frictions impact the equilibrium effects?
Prologue Model Summary

- Cross-sectional effects on the export-FDI decision come through:
  
  1. Direct effect: tax savings.
  2. Terms of trade effect: lower goods price abroad.

- How does the reform affect the exit-domestic decision?

- How do financial frictions impact the equilibrium effects?

- Need a quantitative model.
Roadmap

1. Introduction
2. Prologue Model: the Static Partial Equilibrium Case
3. Quantitative Model
4. Calibration of Quantitative Model
5. Quantitative Results: Removing the Repatriation Tax
6. Conclusion
Quantitative Model Environment

- Fully dynamic in discrete time.
Quantitative Model Environment

- Fully dynamic in discrete time.
- Six agents: households, firms and government in H and F.
**Quantitative Model Environment**

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- Six agents: households, firms and government in H and F.
- Focus is on heterogeneous H firms; all others are representative.
Quantitative Model Environment

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- Six agents: households, firms and government in H and F.
- Focus is on heterogeneous H firms; all others are representative.
- H firms make one variety, F firms make another.
Quantitative Model Environment

- Fully dynamic in discrete time.

- Six agents: households, firms and government in H and F.

- Focus is on heterogeneous H firms; all others are representative.

- H firms make one variety, F firms make another.

- Households want to consume both varieties.
Quantitative Model Environment

- **Home**
  - Home goods: $P^H_t$ (exogenous)
  - Foreign goods: $P^F_t$ (exogenous)
  - Home wage: $W_t$ (endogenous)

- **Foreign**
  - Home goods: $P^*H_t$ (endogenous)
  - Foreign goods: $P^*F_t$ (exogenous)
  - Foreign wage: $W^*_t$ (exogenous)

- **Home Country is a “small open economy”**.
Quantitative Model Environment

Home
- Home goods: $P_t^H$ (exogenous)
- Foreign goods: $P_t^F$ (exogenous)
- Home wage: $W_t$ (endogenous)

Foreign
- Home goods: $P_t^H$ (endogenous)
- Foreign goods: $P_t^F$ (exogenous)
- Foreign wage: $W_t^*$ (exogenous)

- Home Country is a “small open economy”.
- Exogenous demand curve for Home goods in Foreign.
H firms draw idiosyncratic productivity shocks from persistent distribution

\[
\log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + \epsilon_{t,\theta}, \quad \epsilon_{t,\theta} \sim N(0, \sigma^2_{\theta})
\]
Quantitative Model Environment

- H firms draw idiosyncratic productivity shocks from persistent distribution

\[ \log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + \epsilon_{t,\theta}, \quad \epsilon_{t,\theta} \sim N(0, \sigma_{\theta}^2) \]

- Produce using capital \((k_t^H \text{ in } H \text{ and } k_t^{H*} \text{ in } F)\) and labour in each country.
Quantitative Model Environment

- H firms draw idiosyncratic productivity shocks from persistent distribution

\[
\log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + \epsilon_{t,\theta}, \quad \epsilon_{t,\theta} \sim N(0, \sigma_{\theta}^2)
\]

- Produce using capital \((k^H_t \text{ in H and } k^{H\ast}_t \text{ in F})\) and labour in each country.

- Capital adjustment costs.

\[
\Phi(i^c_t, k^c_t) = \frac{\phi_c}{2} \frac{(i^c_t)^2}{k^c_t} \quad \text{for } c \in \{H, F\}
\]
Quantitative Model Environment

- H firms draw idiosyncratic productivity shocks from persistent distribution
  \[ \log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + \epsilon_{t,\theta}, \quad \epsilon_{t,\theta} \sim N(0, \sigma_\theta^2) \]

- Produce using capital (\(k_t^H\) in H and \(k_t^H^*\) in F) and labour in each country.

- Capital adjustment costs.
  \[ \Phi(i_t^c, k_t^c) = \phi_c \frac{(i_t^c)^2}{2k_t^c} \quad \text{for} \quad c \in \{H, F\} \]

- Same selection setup as prologue model: exit the industry (E), be a domestic firm (D), exporter (X) or multinational (M).
Quantitative Model Environment

- H firms draw idiosyncratic productivity shocks from persistent distribution

\[ \log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + \epsilon_{t,\theta}, \quad \epsilon_{t,\theta} \sim N(0, \sigma_{\theta}^2) \]

- Produce using capital \((k_t^H \text{ in } H \text{ and } k_t^{H*} \text{ in } F)\) and labour in each country.

- Capital adjustment costs.

\[ \Phi(i_t^c, k_t^c) = \frac{\phi_c}{2} \frac{(i_t^c)^2}{k_t^c} \quad \text{for } c \in \{H, F\} \]

- Same selection setup as prologue model: exit the industry (E), be a domestic firm (D), exporter (X) or multinational (M).

- Fixed capital and operating expenses of each status: \((x^l, x^{l,O})\) for \(l \in \{D, X, M\}\).
H firms can raise external financing at Home: equity and debt.
Quantitative Model Environment

- H firms can raise external financing at Home: equity and debt.
- New equity \((e)\) is raised at a premium \(\zeta(e)\)
  \[
  \zeta(e) = \eta_0 + \eta_1|e| + \eta_2 e^2
  \]
H firms can raise external financing at Home: equity and debt.

New equity \( (e) \) is raised at a premium \( \zeta(e) \)

\[
\zeta(e) = \eta_0 + \eta_1|e| + \eta_2e^2
\]

Can borrow \( b_t \) with debt tax shields (interest tax deductions) up to liquidation value of capital stocks.

\[
b_{t+1} \leq \xi^H k_{t+1}^H + \xi^{H*} k_{t+1}^{H*}
\]
Quantitative Model Environment

- Model incorporates occasional repatriation tax holidays pre-reform:

Model incorporates occasional repatriation tax holidays pre-reform:

- **Stochastic** repatriation tax rate pre-reform $\tau_{t}^{C,U}$. 
Quantitative Model Environment


- Model incorporates occasional repatriation tax holidays pre-reform:
  - **Stochastic** repatriation tax rate pre-reform $\tau^{C,U}_t$.
  - Some probability of statutory rate $\tau^C - \tau^{C*}$ with complementary probability of temporary zero rate.
Quantitative Model Environment

- **Apple Sells $12 Billion of Bonds to Keep Cash Overseas** (Bloomberg, 2014).
Quantitative Model Environment


- Model allows multinationals to defer repatriation and wait for a tax holiday pre-reform.
Quantitative Model Environment

- Apple Sells $12 Billion of Bonds to Keep Cash Overseas (Bloomberg, 2014).

- Model allows multinationals to defer repatriation and wait for a tax holiday pre-reform.

- Can borrow against their overseas earnings while they wait:

\[ b_{t+1} \leq \xi^H k_{t+1}^H + \xi^{H*} k_{t+1}^{H*} \]
Denote an incumbent’s state vector $\vec{\varphi}_t = (k_t^H, k_t^{H^*}, b_t, \theta_t, \tau_t^{C,U})$. 
Quantitative Model Equilibrium: Incumbents

- Denote an incumbent’s state vector \( \vec{\phi}_t = (k_t^H, k_t^{H*}, b_t, \theta_t, \tau_{tC,U}) \).

- Seek to maximise present value to equityholders.
Quantitative Model Equilibrium: Incumbents

- Denote an incumbent’s state vector \( \vec{\phi}_t = (k_t^H, k_t^{H*}, b_t, \theta_t, \tau_t^C, U) \).

- Seek to maximise present value to equityholders.

- Make discrete choice conditional on state vector

\[
V_t(\vec{\phi}_t) = \max_{s \in \{E,D,X,M\}} V_t^s(\vec{\phi}_t)
\]

- Denote \( s_{t-1}(\vec{\phi}_{t-1}) \in \{D,X,M\} \) the state of the firm last period.
Quantitative Model Equilibrium: Incumbent Exiting

\[ V_t^E(\bar{\phi}_t) = \xi^H k_t^H + \xi^{H*} k_t^{H*} - b_t \quad \text{for } \xi^H, \xi^{H*} \in [0, 1] \]

Liquidation value of capital stocks  
Debt obligation
Quantitative Model Equilibrium: Incumbent Domestic

\[ V_t^D(\varphi_t) = \max_{\{k_{t+1}, b_{t+1}\}} d_t^D(\varphi_t) + \beta E_t[V_{t+1}(\varphi_{t+1})] \]

Dividends to shareholders net of issuance costs  
Continuation value

\[ d_t^D(\varphi_t) = \begin{cases} e_t^D(\varphi_t) & \text{Dividends to shareholders pre-issuance} \\ -1 & \text{if } e_t^D(\varphi_t) < 0 \end{cases} \]

Equity issuance costs

\[ e_t^D(\varphi_t) = (1 - \tau^C) \left( \theta_t(k_t^H)^{\alpha}(n_t^H)^{\gamma} - W_t n_t^H - x^{D,O} \right) - i_t^H - \Phi^H(i_t^H, k_t^H) \]

H earnings  
H capital adjustment cost

\[ \xi^H \xi^H k_t^H \]

Liquidation of F capital

\[ \frac{b_{t+1}}{1 + r} \]

New debt issuance

\[ b_t \]

Old debt repayment

\[ b_t \left( 1 - \frac{1}{1 + r} \right) \tau^C \]

Debt tax shields

\[ i_t^H = k_{t+1}^H - (1 - \delta) k_t^H \]

\[ b_{t+1} \leq \xi^H k_{t+1}^H \]
Quantitative Model Equilibrium: Incumbent Exporter

\[ V_t^X(\bar{\varphi}_t) = \max_{\{k^H_{t+1}, b_{t+1}\}} d_t^X(\bar{\varphi}_t) + \beta \mathbb{E}_t[V_{t+1}(\bar{\varphi}_{t+1})] \]

\[ d_t^X(\bar{\varphi}_t) = e_t^X(\bar{\varphi}_t) - \mathbb{1}_{e_t^X(\bar{\varphi}_t) < 0} \zeta(e_t^X(\bar{\varphi}_t)) \]

\[ e^X(\bar{\varphi}_t) = (1 - \tau^C) \left( \theta_t(k^H_t)^\alpha (n^H_t)^\gamma - W_t n^H_t - x^{D,0} \right) - i^H_t - \Phi^H(i^H_t, k^H_t) \]

\[ + (1 - \tau^C) \left( \{1 - i\} P^H_{t+1} \theta_t(k^H_t)^\alpha (n^X_t)^\gamma - W_t n^X_t - x^{X,0} \right) \]

Earnings from export sales

\[-(1 - \mathbb{1}_{s_{t-1}=X}) X^X + \xi^H k^H_{t+1} + \frac{b_{t+1}}{1 + r} - b_t + b_t \left(1 - \frac{1}{1 + r}\right) \tau^C \]

Initial X fixed capex

\[ i^H_t = k^H_{t+1} - (1 - 2\delta) k^H_t \]

\[ b_{t+1} \leq \xi^H k^H_{t+1}. \]
Quantitative Model Equilibrium: Incumbent Multinational

\[
V_t^M(\vec{\varphi}_t) = \max_{\{k_{t+1}^H, k_{t+1}^{H*}, b_{t+1}\}} d_t^M(\vec{\varphi}_t) + \beta \mathbb{E}_t[V_{t+1}(\vec{\varphi}_{t+1})]
\]

\[
d_t^M(\vec{\varphi}_t) = e_t^M(\vec{\varphi}_t) - \mathbb{1}_{e_t^M(\vec{\varphi}_t)<0} \zeta(e_t^M(\vec{\varphi}_t))
\]

\[
e_t^M(\vec{\varphi}_t) = (1 - \tau^C) \left( \theta_t(k_t^H)^\alpha (n_t^H)^\gamma - W_t n_t^H - x^{D,O} \right) - i_t^H - \Phi^H(i_t^H, k_t^H)
\]

\[
\quad + \left\{ \mathbb{1}_{u_t(\vec{\varphi}_t) \geq 0} \left( \frac{1 - \tau_t^{C,U} - \tau_t^{C*}}{1 - \tau_t^{C*}} \right) + \mathbb{1}_{u_t(\vec{\varphi}_t) < 0} \right\}
\]

\[
- (1 - \mathbb{1}_{s_{t-1}(\vec{\varphi}_{t-1}) = M}) x_t^M + \frac{b_{t+1}}{1 + r} - b_t + b_t \left( 1 - \frac{1}{1 + r} \right) \tau^C
\]

\[
u_t(\vec{\varphi}_t) = (1 - \tau_t^{C*}) \left( P_t^{H*} \theta_t(k_t^{H*})^\alpha (n_t^{H*})^\gamma - W_t^{H*} n_t^{H*} - x^{M*,O} \right) - i_t^{H*} - \Phi^{H*}(i_t^{H*}, k_t^{H*})
\]

\[
i_t^H = k_{t+1}^H - (1 - \delta) k_t^H
\]

\[
i_t^{H*} = k_{t+1}^{H*} - (1 - \delta) k_t^{H*}
\]

\[
b_{t+1} \leq \xi^H k_{t+1}^H + \xi^{H*} k_{t+1}^{H*}.
\]
New entrants always start as domestic firms.

\[ V_t^N = \max_{\{k_{t+1}^H, b_{t+1}\}} -i_t^H - x_D + \frac{b_{t+1}}{1 + r} + \beta \mathbb{E}_t^N [V_{t+1}(\bar{\varphi}_{t+1})] \]

\[ i_t^H = k_{t+1}^H \]

\[ b_{t+1} \leq \xi^H k_{t+1}^H. \]
Roadmap

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Strategy

- **Discipline the model** with data to answer the quantitative questions:
Strategy

- Discipline the model with data to answer the quantitative questions:
  
  (i) Does heterogeneity matter?
Strategy

- **Discipline the model** with data to answer the quantitative questions:
  
  (i) Does heterogeneity matter?

  (ii) Do dynamics matter?
Strategy

- **Discipline the model** with data to answer the quantitative questions:
  1. Does heterogeneity matter?
  2. Do dynamics matter?
  3. Do financial frictions matter?
# Parameters Calibrated Inside the Model

<table>
<thead>
<tr>
<th>Name</th>
<th>Variable</th>
<th>Value</th>
<th>Moment Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x^D$</td>
<td>Fixed CAPEX for entry</td>
<td>0.48</td>
<td>Exit/entry rate</td>
</tr>
<tr>
<td>$x^X$</td>
<td>Fixed CAPEX for exporter</td>
<td>0.70</td>
<td>Transition probability (D,X)</td>
</tr>
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</tr>
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<tr>
<td>$\phi$</td>
<td>Adjustment cost scaling</td>
<td>0.05</td>
<td>Mean investment to book ratio</td>
</tr>
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<td>Fraction of firms issuing equity</td>
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</tr>
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Transition Probabilities

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<th></th>
<th>Domestic</th>
<th>Exporter</th>
<th>Multinational</th>
<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>84.62</td>
<td>5.41</td>
<td>0.03</td>
<td>9.93</td>
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<tr>
<td>Exporter</td>
<td>13.14</td>
<td>80.69</td>
<td>0.84</td>
<td>5.32</td>
</tr>
<tr>
<td>Multinational</td>
<td>0.27</td>
<td>1.86</td>
<td>91.75</td>
<td>6.13</td>
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<tr>
<td>Entrant</td>
<td>85.95</td>
<td>12.89</td>
<td>1.18</td>
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Data Transition Probabilities

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<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>76.90*</td>
<td>6.05*</td>
<td>0.07*</td>
<td>17.33</td>
</tr>
<tr>
<td>Exporter</td>
<td>10.69</td>
<td>85.21*</td>
<td>4.10</td>
<td>0.00</td>
</tr>
<tr>
<td>Multinational</td>
<td>14.70</td>
<td>0.00</td>
<td>85.30*</td>
<td>0.00</td>
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<tr>
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</table>

Model Transition Probabilities (* targeted moments)

Data source: U.S. census from Boehm, Flaaen, Nayar (2016)
Other Moments

<table>
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<tr>
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<th>Data (%)</th>
<th>Model (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of firms issuing equity</td>
<td>33.14</td>
<td>30.14</td>
</tr>
<tr>
<td>Mean equity issuance to book ratio</td>
<td>5.60</td>
<td>4.52</td>
</tr>
<tr>
<td>S.D. of equity issuance to book ratio</td>
<td>21.41</td>
<td>20.92</td>
</tr>
<tr>
<td>Mean investment to book ratio</td>
<td>5.80</td>
<td>8.32</td>
</tr>
<tr>
<td>Exit rate</td>
<td>9.55</td>
<td>8.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Untargeted Moment</th>
<th>Data (%)</th>
<th>Model (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate repatriations to F earnings</td>
<td>7.33</td>
<td>9.31</td>
</tr>
<tr>
<td>Productivity advantage (X over D)</td>
<td>38.80</td>
<td>37.45</td>
</tr>
<tr>
<td>Productivity advantage (M over D)</td>
<td>53.70</td>
<td>48.21</td>
</tr>
<tr>
<td>Mean debt to book ratio</td>
<td>18.77</td>
<td>23.22</td>
</tr>
<tr>
<td>S.D. of debt to book ratio</td>
<td>41.01</td>
<td>37.89</td>
</tr>
<tr>
<td>Fraction of exporting (X) firms</td>
<td>15.64</td>
<td>23.02</td>
</tr>
<tr>
<td>Fraction of multinational (M) firms</td>
<td>5.60</td>
<td>7.12</td>
</tr>
</tbody>
</table>

Data sources: Compustat, BEA, Helpman, Melitz, & Yeaple (2004)
**Roadmap**

1. Introduction

2. Prologue Model: the Static Partial Equilibrium Case

3. Quantitative Model

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Counterfactual Design

- Start in pre-reform steady state with $\tau_t^{C,U} \geq 0$. 
Counterfactual Design

- Start in pre-reform steady state with $\tau_{t}^{C,U} \geq 0$.
- Three sets of quantitative results:
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- Three sets of quantitative results:
  - (I) Set $\tau_{t,C,U} = 0$ and study effect on steady state ('long-run').
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- Start in pre-reform steady state with $\tau_t^{C,U} \geq 0$.

- Three sets of quantitative results:
  
  (I) Set $\tau_t^{C,U} = 0$ and study effect on steady state ('long-run').

  (II) Set $\tau_t^{C,U} = 0$ and study effect on transition ('short-run').
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- Three sets of quantitative results:

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  2. Set $\tau^{C, U}_t = 0$ and study effect on transition ('short-run').

  3. Set $\zeta_0 = \zeta_1 = \zeta_2$ and re-run exercise (I) above (financial frictions).
(I) Long-Run

(I) Long-run results: does heterogeneity matter?
(I) Long-Run

<table>
<thead>
<tr>
<th>Variable</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. goods price in Foreign ($P^H_*$)</td>
<td>-0.44</td>
</tr>
</tbody>
</table>
(I) Long-Run

<table>
<thead>
<tr>
<th>Variable</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. goods price in Foreign ( (P^{H*}) )</td>
<td>-0.44</td>
</tr>
<tr>
<td>Measure of U.S. firms</td>
<td>1.39</td>
</tr>
</tbody>
</table>
(I) Long-Run

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<td>1.39</td>
</tr>
<tr>
<td>U.S. wage ($W$)</td>
<td>0.23</td>
</tr>
</tbody>
</table>
(I) Long-Run

<table>
<thead>
<tr>
<th>Moment</th>
<th>Pre-reform</th>
<th>Post-reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry/exit rate</td>
<td>8.75</td>
<td>8.78</td>
</tr>
<tr>
<td>Fraction of exporting (X) firms</td>
<td>23.02</td>
<td>22.90</td>
</tr>
<tr>
<td>Fraction of multinational (M) firms</td>
<td>7.12</td>
<td>7.24</td>
</tr>
</tbody>
</table>
## (I) Long-Run

<table>
<thead>
<tr>
<th>Firm Status</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multinational</td>
<td>-0.17</td>
</tr>
<tr>
<td>Exporter</td>
<td>0.01</td>
</tr>
<tr>
<td>Domestic</td>
<td>0.03</td>
</tr>
<tr>
<td>Exiter</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Percentage changes in average productivity
(I) Long-Run

<table>
<thead>
<tr>
<th>Variable</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic output</td>
<td>0.40</td>
</tr>
<tr>
<td>Exports</td>
<td>-0.30</td>
</tr>
<tr>
<td>Productivity</td>
<td>1.18</td>
</tr>
<tr>
<td>Dividends</td>
<td>0.68</td>
</tr>
<tr>
<td>U.S. Government taxes</td>
<td>-0.05</td>
</tr>
<tr>
<td>U.S. Welfare</td>
<td>0.18</td>
</tr>
</tbody>
</table>
(II) Short-Run

(II) Short-run results: do dynamics and transitions matter?
(II) Short-Run

- Start in pre-reform steady state at $t = -1$. 
(II) Short-Run

- Start in pre-reform steady state at $t = -1$.
- U.S. Government announces the reform at the end of period $t = 0$ to be effective from $t = 1$ onwards.
(II) Short-Run

- Start in pre-reform steady state at $t = -1$.
- U.S. Government announces the reform at the end of period $t = 0$ to be effective from $t = 1$ onwards.
- Map convergence to new steady state.
(II) Short-Run

The graph shows the percentage deviation from the pre-reform steady state over time. The red line represents the measure of entrants, indicating a gradual increase and then stabilization after the initial shock. The blue line represents the measure of exits, showing a sharp decline over time, reflecting the reduction in exits due to the removal of the repatriation tax.
(II) Short-Run

U.S. Wage

Percentage deviation from pre-reform steady state

Time period (t)
(II) Short-Run

![Graph showing the percentage deviation from pre-reform steady state over time for Aggregate Consumption. The graph plots time period (t) on the x-axis and percentage deviation on the y-axis. The graph shows an initial drop followed by a steady increase and leveling off.]
(III) Financial Frictions

(III) Do financial frictions matter?
(III) Financial Frictions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Change (%) (Without frictions)</th>
<th>Change (%) (With frictions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. goods price in Foreign ($P^*$)</td>
<td>-0.62</td>
<td>-0.44</td>
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</table>

In the counterfactual without financial frictions:
(III) Financial Frictions

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- In the counterfactual without financial frictions:
  - Terms of trade effect is stronger.
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- In the counterfactual without financial frictions:
  - Terms of trade effect is **stronger**.
  - **Marginal cost** of foreign investment is lower for newly-established multinationals.
### (III) Financial Frictions

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- In the counterfactual without financial frictions:
  - Terms of trade effect is **stronger**.
  - **Marginal cost** of foreign investment is lower for newly-established multinationals.
    - $\Rightarrow$ Larger increase in supply of goods to the foreign market.
### (III) Financial Frictions

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⇒ Bigger drop in value of exporting.
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<td>Measure of U.S. firms</td>
<td>0.36</td>
<td>1.39</td>
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⇒ Bigger drop in value of exporting.

⇒ Pushes-back against the pro-competitive effect: weaker entry.
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⇒ Bigger drop in value of exporting.

⇒ Pushes-back against the pro-competitive effect: weaker entry.

⇒ Decrease in the U.S. wage.
### (III) Financial Frictions

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<th>Variable</th>
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<th>Change (%) (With frictions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic output</td>
<td>0.18</td>
<td>0.40</td>
</tr>
<tr>
<td>Exports</td>
<td>-0.42</td>
<td>-0.30</td>
</tr>
<tr>
<td>Productivity</td>
<td>0.31</td>
<td>1.18</td>
</tr>
<tr>
<td>Dividends</td>
<td>0.10</td>
<td>0.68</td>
</tr>
<tr>
<td>U.S. Government taxes</td>
<td>-0.08</td>
<td>-0.05</td>
</tr>
<tr>
<td>U.S. Welfare</td>
<td>-0.12</td>
<td>0.18</td>
</tr>
</tbody>
</table>
Roadmap

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- **U.S. application:** 0.1% ↑ in welfare and approximate revenue neutrality.
Appendix Contents

- Related literature.
- Equilibrium of static model with financial frictions
- Transition probabilities
- Aggregate repatriations data
- Capital structure of U.S. multinationals
- Response of incumbent multinationals to reform.
  - Data
  - Model
# Transition Probabilities

## Data Transition Probabilities

<table>
<thead>
<tr>
<th>t/t+1</th>
<th>Domestic</th>
<th>Exporter</th>
<th>Multinational</th>
<th>Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>84.62</td>
<td>5.41</td>
<td>0.03</td>
<td>9.93</td>
</tr>
<tr>
<td>Exporter</td>
<td>13.14</td>
<td>80.69</td>
<td>0.84</td>
<td>5.32</td>
</tr>
<tr>
<td>Multinational</td>
<td>0.27</td>
<td>1.86</td>
<td>91.75</td>
<td>6.13</td>
</tr>
<tr>
<td>Entrant</td>
<td>85.95</td>
<td>12.89</td>
<td>1.18</td>
<td></td>
</tr>
</tbody>
</table>

Data source: U.S. census from Boehm, Flaaen, Nayar (2016)
Aggregate Repatriations Data

Source: Bureau of Economic Analysis (BEA)
## Capital Structure of Multinationals

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash/Assets</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Debt/Assets</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Dividends/Assets</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Equity issuance/Assets</td>
<td>0.1</td>
<td>0.3</td>
<td>3.5</td>
</tr>
</tbody>
</table>

*Source: Compustat*
Response of Incumbent Multinationals (Data)

- Homeland Investment Act 2004: “repatriation tax holiday”.
  - Temporary reduction to 5.25%.
  - “A $1 increase in repatriations was associated with an increase of almost $1 in payouts to shareholders” (Dharmapala et al. (2011)).
Response of Incumbent Multinationals (Data)

Figure 1. Quarterly repatriation and reinvestment of the earnings of foreign affiliates of US MNEs, 2014-2018

Note: Quarterly repatriated earnings and reinvested earnings sum to the total quarterly earnings of foreign affiliates of US MNEs. Figures are rounded.

Source: US Bureau of Economic Analysis.
Response of Incumbent Multinationals (Model)

- Keep status for a **given state** the same post-reform as it was pre-reform.
- Keep all prices and the mass of firms **constant**.

<table>
<thead>
<tr>
<th>Variable</th>
<th>(%) of Aggregate Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. output</td>
<td>0.50</td>
</tr>
<tr>
<td>Foreign output</td>
<td>-1.20</td>
</tr>
<tr>
<td>Dividends</td>
<td>62.30</td>
</tr>
<tr>
<td>Debt</td>
<td>-30.20</td>
</tr>
</tbody>
</table>
# Static Model with Financial Frictions: Equilibrium

<table>
<thead>
<tr>
<th>$\bar{\theta}$</th>
<th>$\theta$</th>
<th>$E$</th>
<th>$D$</th>
<th>$X$</th>
<th>$M$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x^X$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\frac{(1-\tau_C)(1-i)P_{\tau C, U = \tau C - \tau C^<em>}}{\tau C, U = \tau C - \tau C^</em>}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\bar{\theta}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>$E$</th>
<th>$D$</th>
<th>$X$</th>
<th>$M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{x^D}{(1-\tau_C)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{x^M - x^X}{{(1-\tau_C)i}P_{\tau C, U = \tau C - \tau C^*}}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>$E$</th>
<th>$D$</th>
<th>$X$</th>
<th>$M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{x^X}{(1-\tau_C)(1-i)P_{\tau C, U = \tau C - \tau C^*}}\sqrt{1+\omega(2\zeta_1+\zeta_1^2)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{x^D}{(1-\tau_C)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{x^M - x^X}{{(1-\tau_C)i}P_{\tau C, U = \tau C - \tau C^*}}\sqrt{1+\omega(2\zeta_1+\zeta_1^2)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

<table>
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<th>$D$</th>
<th>$X$</th>
<th>$M$</th>
</tr>
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<tbody>
<tr>
<td>$\frac{x^X(1+\zeta_1)}{(1-\tau_C)(1-i)P_{\tau C, U = \tau C - \tau C^*}}\sqrt{1+\omega(2\zeta_1+\zeta_1^2)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{x^D(1+\zeta_1)}{(1-\tau_C)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{(x^M - x^X)(1+\zeta_1)}{{(1-\tau_C)i}P_{\tau C, U = \tau C - \tau C^*}}\sqrt{1+\omega(2\zeta_1+\zeta_1^2)}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- $\zeta_1 = 0$

- $\zeta_1 > 0$
  - Unconstrained firms

- $\zeta_1 > 0$
  - Constrained firms
### Static Model with Financial Frictions: Counterfactual

#### Unconstrained firms

\[ \zeta_1 > 0 \]

#### Constrained firms

\[ \zeta_1 > 0 \]
Theory of Second Best

- Why do we get welfare decreasing in the absence of financial frictions?
- Other taxes are in place.
- If there were no other taxes, then domestic wage would be higher.
- More incentive for FDI.
- Fewer pure domestics/exporters: less potential for offshoring.
- Welfare gains: tax savings by MNEs distributed to shareholders.
Related Literature

1. Heterogeneity, selection effects and international policy reforms.
   

2. Dynamics in trade models.
   
Related Literature

(3) Tax reforms and productivity.


(4) Structural corporate finance.

Strebulaev & Whited (2012), Riddick & Whited (2009), Nikolov & Whited (2014), Li, Whited, & Wu (2016), Gomes (2001),

(5) Repatriation taxes.


