Policy Effects of International Taxation on Firm Dynamics and Capital Structure

Adam Hal Spencer

The University of Nottingham (UK)

NBER SI ITM
Thursday July 11^{th}, 2019

Roadmap

Question

- How do tax reforms targeted at multinational firms affect domestic productivity, economic activity and welfare?

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  - Aimed to reduce tax evasion by multinationals.

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  $\Rightarrow$ 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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Answers: yes, yes and yes.

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- Did its removal in the TCJA increase or decrease domestic economic activity?

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- Overall impact is a quantitative question.

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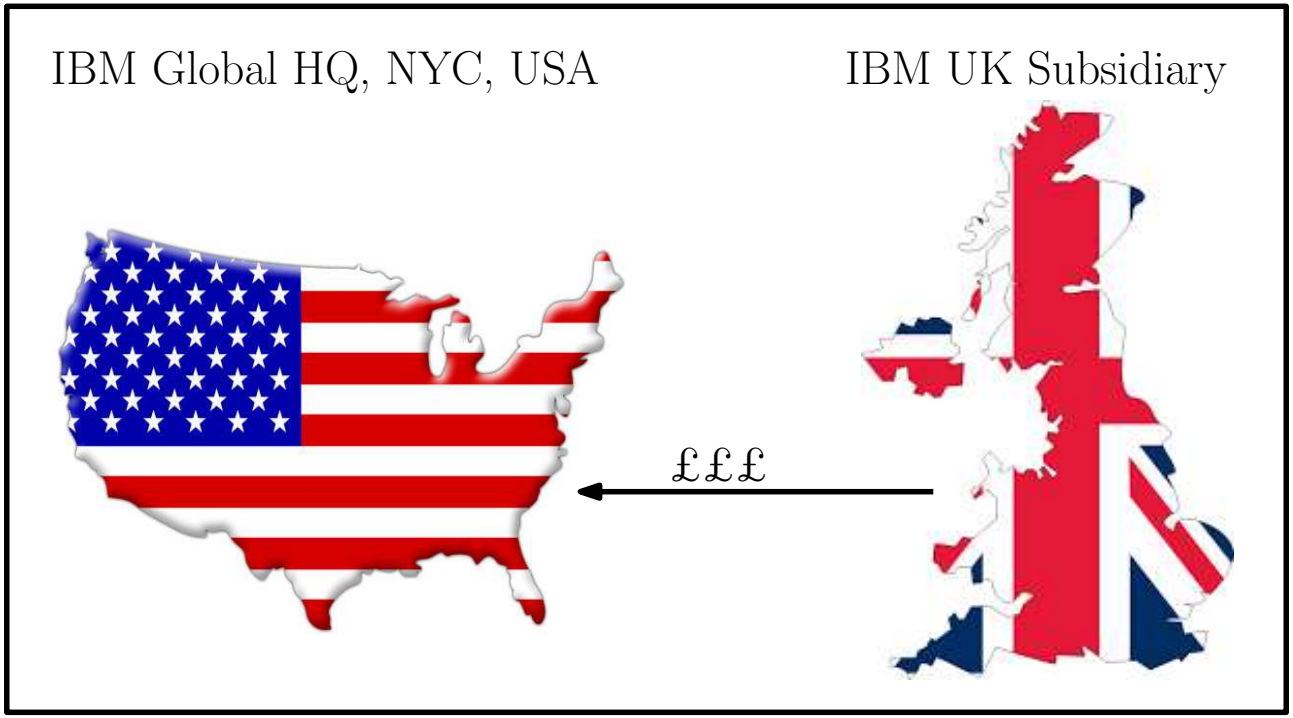

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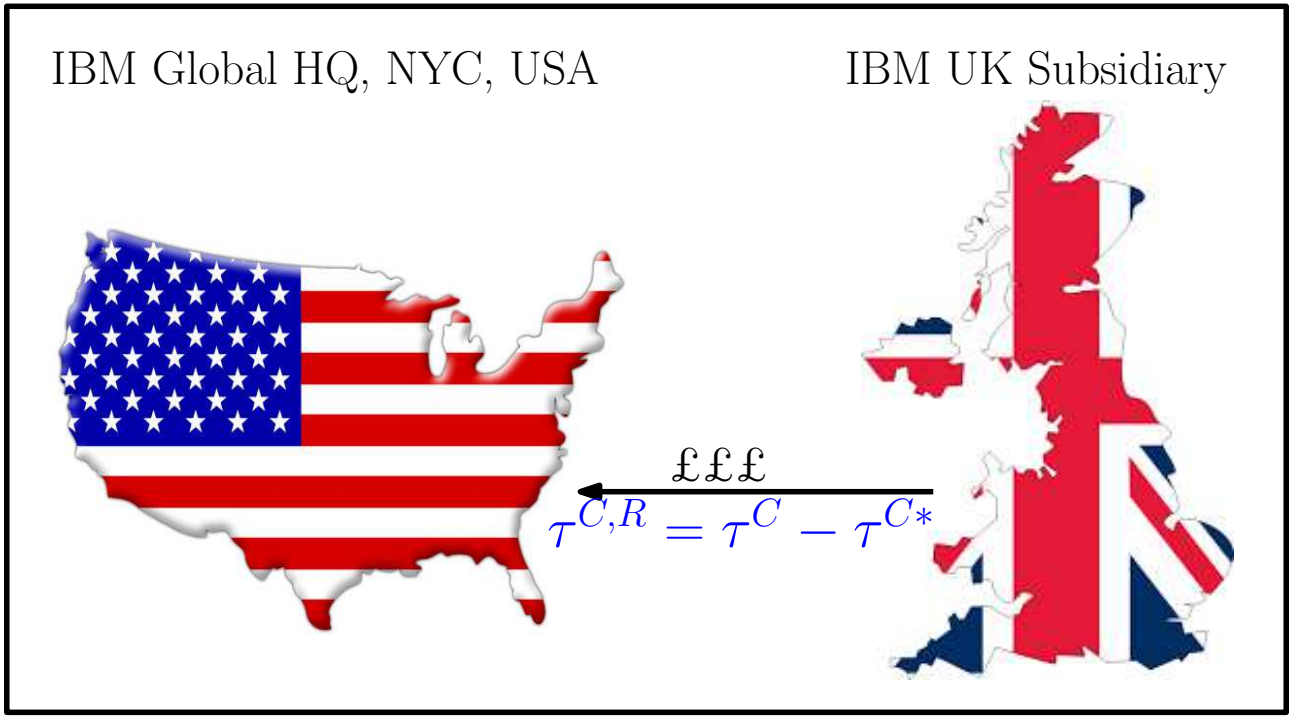

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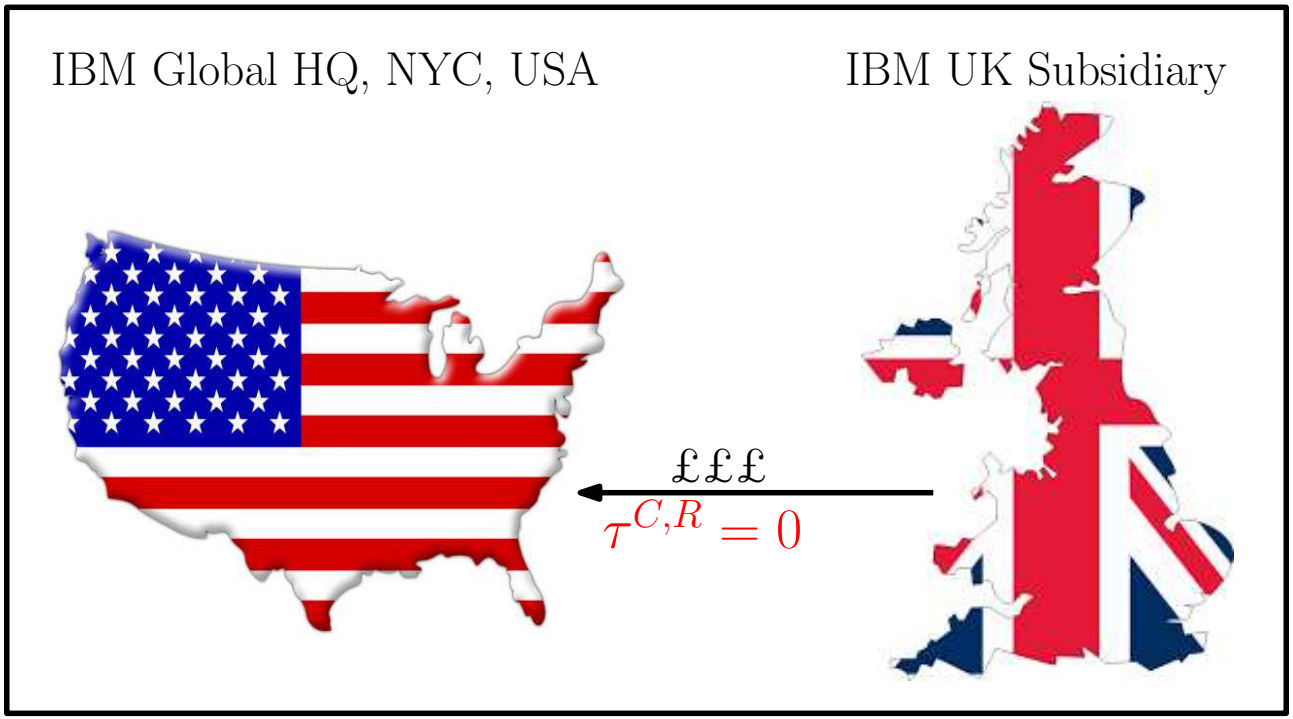

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- Exporter and multinational incur additional fixed costs x^X and x^M respectively.
- Tradeoff: $x^M > x^X$, exporters incur proportional iceberg variable cost of $i \in [0, 1]$.

Prologue Model Equilibrium

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$$V^E(\theta) = 0$$
$$V^D(\theta) = -x^D + (1 - \tau^C)\theta$$
$$V^X(\theta) = -x^D - x^X + (1 - \tau^C)\theta + (1 - \tau^C)(1 - i)\, P^{H*}\, \theta$$
$$V^M(\theta) = -x^D - x^M + (1 - \tau^C)\theta + \underbrace{(1 - \tau^{C,U} - \tau^{C*})}\, P^{H*}\, \theta$$

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$$V^M(\theta) = -x^D - x^M + (1-\tau^C)\theta + \underbrace{(1-\tau^{C,U}-\tau^{C*})}_{\text{Post-reform: } (1-\tau^{C*})}\,P^{H*}\,\theta$$

Prologue Model Equilibrium

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

$$V^E(\theta) = 0$$
$$V^D(\theta) = -x^D + (1-\tau^C)\theta$$
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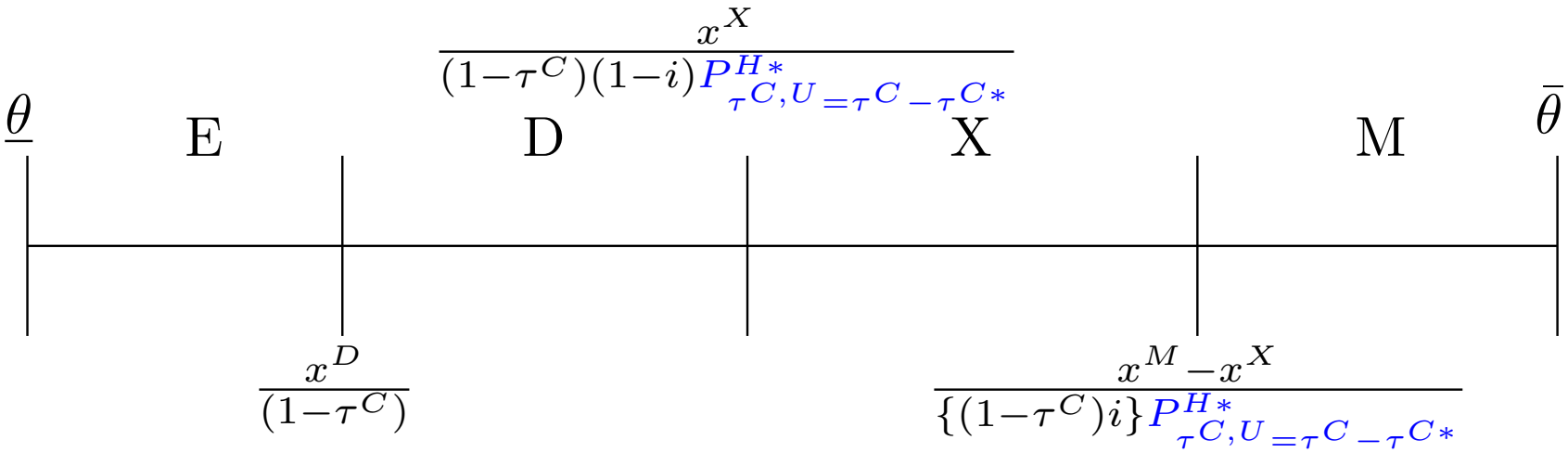
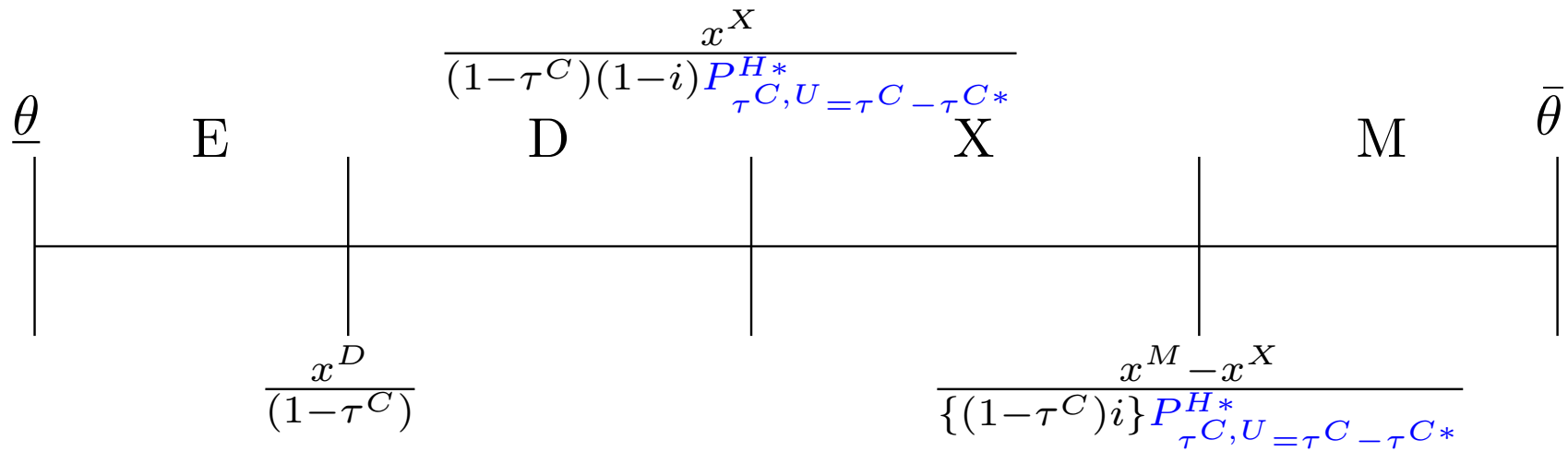
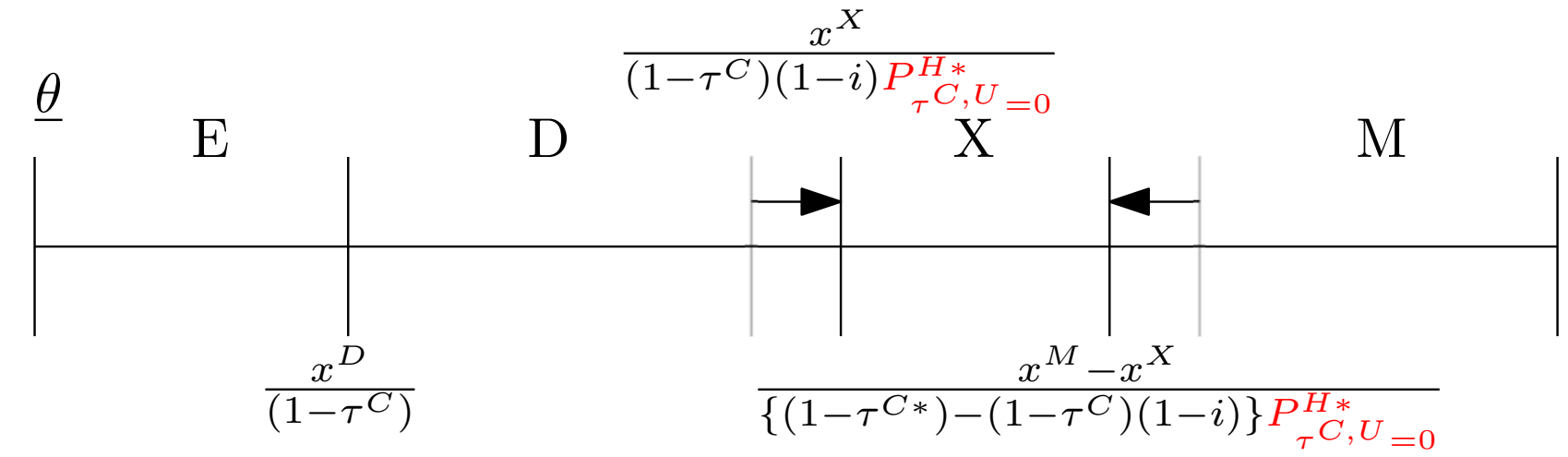
Prologue Model: **Pre-Reform**



Prologue Model: **Post-Reform**





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Roadmap

Quantitative Model Environment

- Fully dynamic in discrete time.

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- Households want to consume both varieties.

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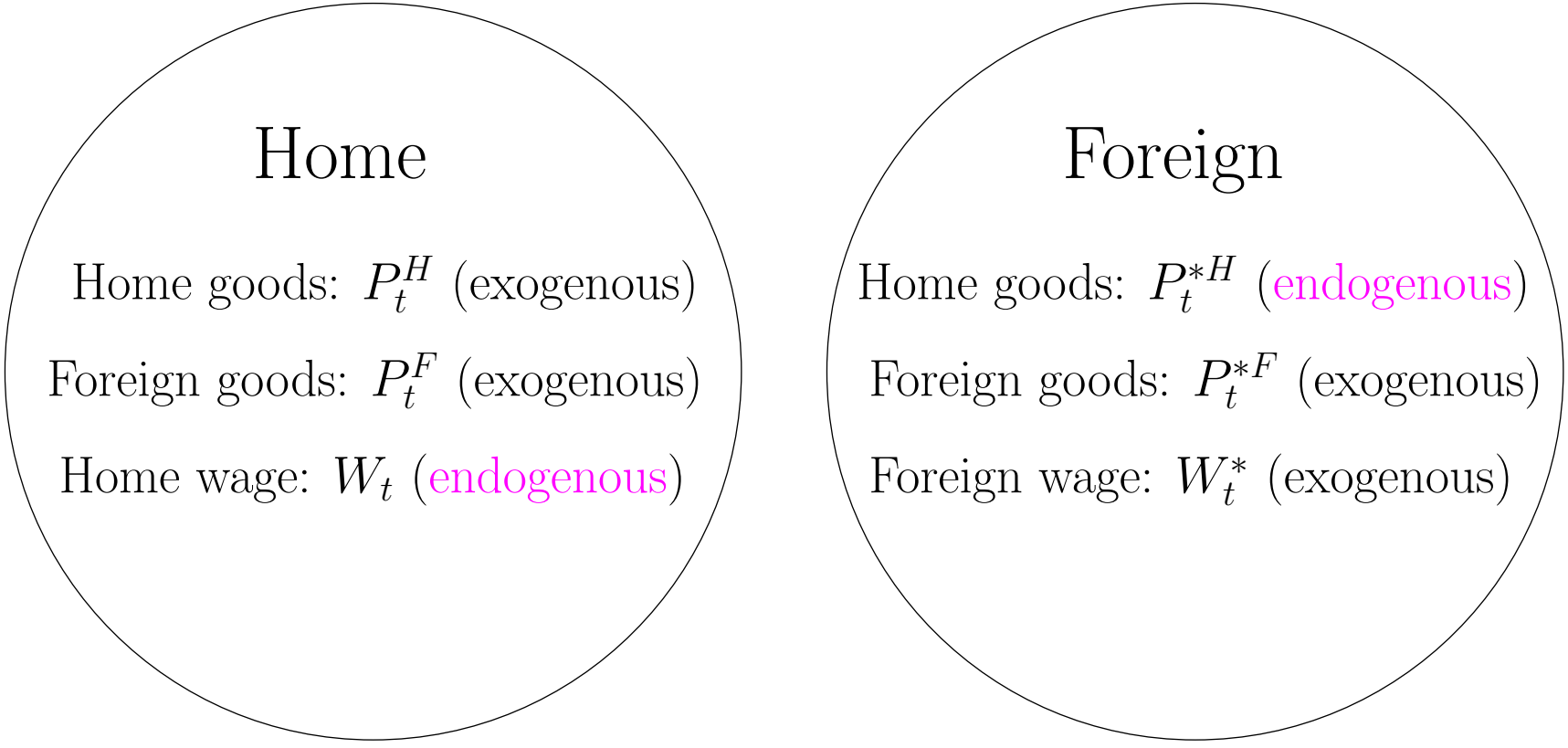

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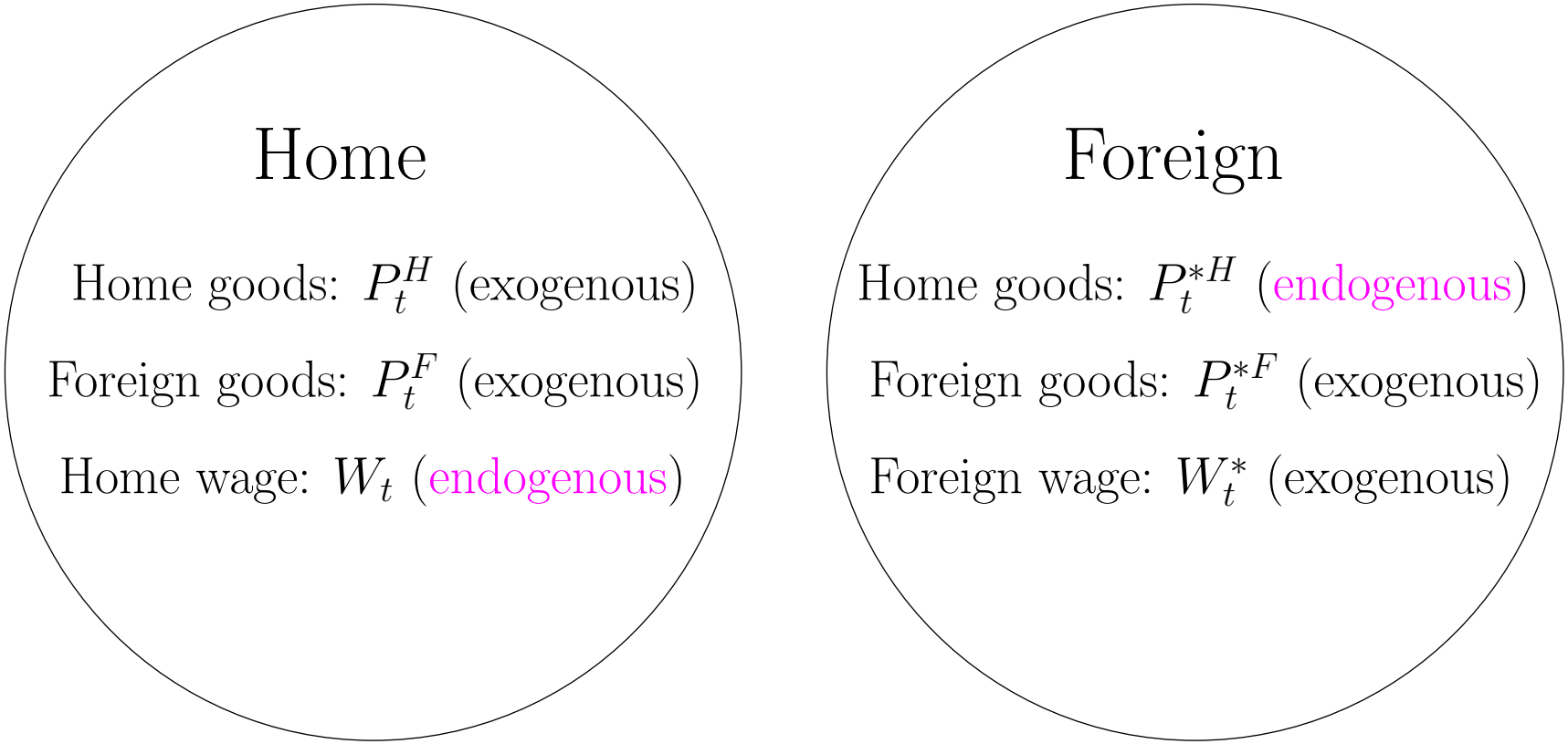

- Home Country is a "small open economy".
- Exogenous demand curve for Home goods in Foreign.

Quantitative Model Environment

- H firms draw idiosyncratic productivity shocks from persistent distribution

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

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- Fixed capital and operating expenses of each status: $(x^I, x^{I,O})$ for $I \in \{D, X, M\}$.

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

$$b_{t+1} \leq \xi^H k^H_{t+1} + \xi^{H*} k^{H*}_{t+1}$$

Quantitative Model Environment

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  - Stochastic repatriation tax rate pre-reform $\tau_t^{C,U}$.
  - Some probability of statutory rate $\tau^C - \tau^{C*}$ with complementary probability of temporary zero rate.

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- Model allows multinationals to defer repatriation and wait for a tax holiday pre-reform.
- Can borrow against their overseas earnings while they wait:

$$b_{t+1} \leq \xi^{H} k_{t+1}^{H} + \xi^{H*} k_{t+1}^{H*}$$

Quantitative Model Equilibrium: Incumbents

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

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- Denote an incumbent's state vector $\vec{\varphi}_t = (k_t^H, k_t^{H*}, b_t, \theta_t, \tau_t^{C,U})$.
- Seek to maximise present value to equityholders.
- Make discrete choice conditional on state vector

$$V_t(\vec{\varphi}_t) = \max_{s \in \{E,D,X,M\}} V_t^s(\vec{\varphi}_t)$$

- Denote $s_{t-1}(\vec{\varphi}_{t-1}) \in \{D, X, M\}$ the state of the firm last period.

Quantitative Model Equilibrium: Incumbent Exiting

$$V_t^E(\vec{\varphi}_t) = \underbrace{\xi^H k_t^H + \xi^{H*} k_t^{H*}}_{\text{Liquidation value of capital stocks}} - \underbrace{b_t}_{\text{Debt obligation}} \quad \text{for } \xi^H, \xi^{H*} \in [0,1]$$

Quantitative Model Equilibrium: Incumbent Domestic

$$V_t^D(\vec{\varphi}_t) = \max_{\{k_{t+1}^H, b_{t+1}\}} \underbrace{d_t^D(\vec{\varphi}_t)}_{\text{Dividends to shareholders net of issuance costs}} + \underbrace{\beta \mathbb{E}_t[V_{t+1}(\vec{\varphi}_{t+1})]}_{\text{Continuation value}}$$

$$d_t^D(\vec{\varphi}_t) = \underbrace{e_t^D(\vec{\varphi}_t)}_{\text{Dividends to shareholders pre-issuance}} - \mathbb{1}_{e_t^D(\vec{\varphi}_t)<0} \underbrace{\zeta(e_t^D(\vec{\varphi}_t))}_{\text{Equity issuance costs}}$$

$$e_t^D(\vec{\varphi}_t) = (1-\tau^C) \underbrace{\left(\theta_t (k_t^H)^\alpha (n_t^H)^\gamma - W_t n_t^H - x^{D,O}\right)}_{\text{H earnings}} - i_t^H - \underbrace{\Phi^H(i_t^H, k_t^H)}_{\text{H capital adjustment cost}}$$

$$+ \underbrace{\xi^{H*} k_t^{H*}}_{\text{Liquidation of F capital}} + \underbrace{\frac{b_{t+1}}{1+r}}_{\text{New debt issuance}} - \underbrace{b_t}_{\text{Old debt repayment}} + \underbrace{b_t \left(1 - \frac{1}{1+r}\right) \tau^C}_{\text{Debt tax shields}}$$

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

$$b_{t+1} \leq \xi^H k_{t+1}^H$$

Quantitative Model Equilibrium: Incumbent Exporter

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

$$d_t^X(\vec{\varphi}_t) = e_t^X(\vec{\varphi}_t) - \mathbb{1}_{e_t^X(\vec{\varphi}_t)<0}\zeta(e_t^X(\vec{\varphi}_t))$$

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

$$+ \underbrace{(1-\tau^C)\left(\{1-i\}P_t^{H*}\theta_t(k_t^H)^\alpha(n_t^X)^\gamma - W_t n_t^X - x^{X,O}\right)}_{\text{Earnings from export sales}}$$

$$- \underbrace{(1-\mathbb{1}_{s_{t-1}=X})x^X}_{\text{Initial X fixed capex}} + \xi^{H*}k_t^{H*} + \frac{b_{t+1}}{1+r} - b_t + b_t\left(1-\frac{1}{1+r}\right)\tau^C$$

$$i_t^H = k_{t+1}^H - (1-2\delta)k_t^H$$

$$b_{t+1} \leq \xi^H k_{t+1}^H.$$

Quantitative Model Equilibrium: Incumbent Multinational

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

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

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$$+ \underbrace{u_t(\vec{\varphi}_t)}_{\text{Repatriations}} \times \left\{\mathbb{1}_{u_t(\vec{\varphi}_t)\geq 0}\left(\frac{1-\tau_t^{C,U}-\tau^{C*}}{1-\tau^{C*}}\right) + \mathbb{1}_{u_t(\vec{\varphi}_t)<0}\right\}$$

$$- \underbrace{(1-\mathbb{1}_{s_{t-1}(\vec{\varphi}_{t-1})=M})x^M}_{\text{Initial M fixed capex}} + \frac{b_{t+1}}{1+r} - b_t + b_t\left(1-\frac{1}{1+r}\right)\tau^C$$

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

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

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

$$b_{t+1} \leq \xi^H k_{t+1}^H + \xi^{H*} k_{t+1}^{H*}.$$

Quantitative Model Equilibrium: New Entrant

- New entrants always start as domestic firms.

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

$$i_t^H = k_{t+1}^H$$

$$b_{t+1} \leq \xi^H k_{t+1}^H.$$

Roadmap

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

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Parameters Calibrated Inside the Model

Name	Variable	Value	Moment Targeted
x^D	Fixed CAPEX for entry	0.48	Exit/entry rate
x^X	Fixed CAPEX for exporter	0.70	Transition probability (D,X)
x^M	Fixed CAPEX for multinational	1.30	Transition probability (D,M)
$x^{D,O}$	Fixed OPEX for domestic	0.30	Transition probability (D,D)
$x^{X,O}$	Fixed OPEX for exporter	0.21	Transition probability (X,X)
$x^{M*,O}$	Fixed OPEX for multinational	1.17	Transition probability (M,M)
ϕ	Adjustment cost scaling	0.05	Mean investment to book ratio
ζ_0	Equity issuance cost	0.05	Fraction of firms issuing equity
ζ_1	Equity issuance cost	0.02	Mean issuance to book ratio
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Transition Probabilities

Data Transition Probabilities

t/t+1	Domestic	Exporter	Multinational	Exit
Domestic	84.62	5.41	0.03	9.93
Exporter	13.14	80.69	0.84	5.32
Multinational	0.27	1.86	91.75	6.13
Entrant	85.95	12.89	1.18	

Model Transition Probabilities (* targeted moments)

t/t+1	Domestic	Exporter	Multinational	Exit
Domestic	76.90*	6.05*	0.07*	17.33
Exporter	10.69	85.21*	4.10	0.00
Multinational	14.70	0.00	85.30*	0.00
Entrant	95.00	0.05	0.00	

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

Other Moments

Targeted Moment	**Data (%)**	**Model (%)**
Fraction of firms issuing equity	33.14	30.14
Mean equity issuance to book ratio	5.60	4.52
S.D. of equity issuance to book ratio	21.41	20.92
Mean investment to book ratio	5.80	8.32
Exit rate	9.55	8.75
Untargeted Moment	**Data (%)**	**Model (%)**
Aggregate repatriations to F earnings	7.33	9.31
Productivity advantage (X over D)	38.80	37.45
Productivity advantage (M over D)	53.70	48.21
Mean debt to book ratio	18.77	23.22
S.D. of debt to book ratio	41.01	37.89
Fraction of exporting (X) firms	15.64	23.02
Fraction of multinational (M) firms	5.60	7.12

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

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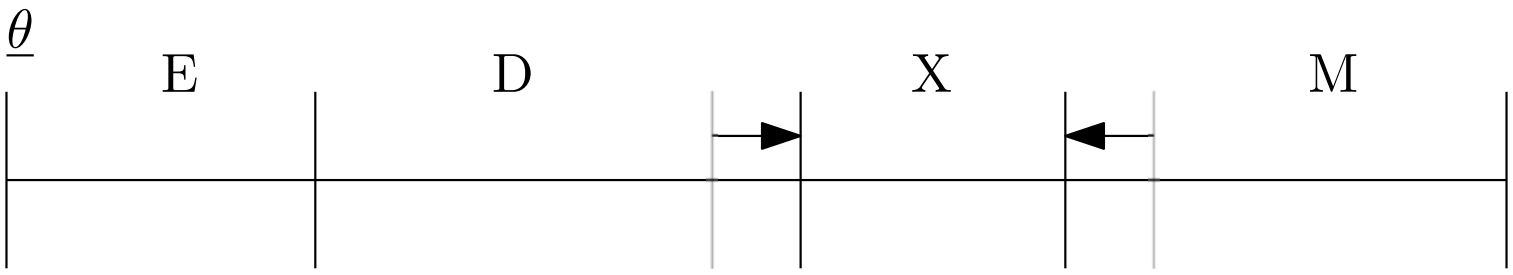
(III) Set $\zeta_0 = \zeta_1 = \zeta_2$ and re-run exercise **(I)** above (financial frictions).

(I) Long-Run

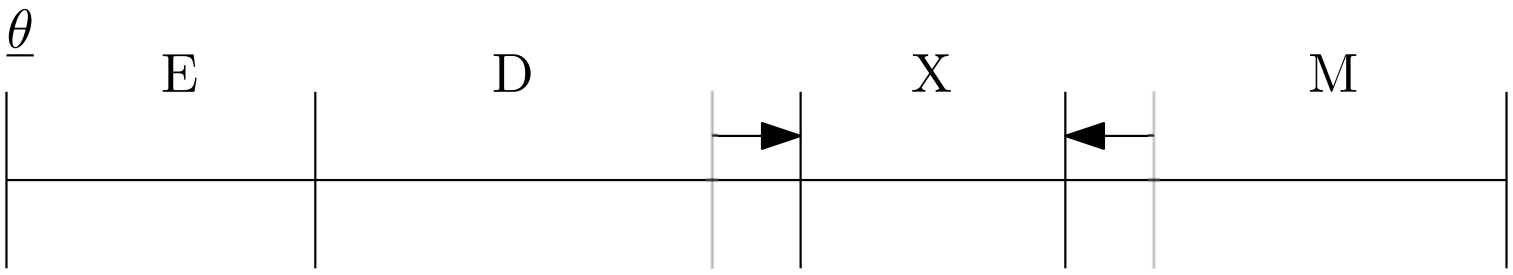
(I) Long-run results: does heterogeneity matter?

(I) Long-Run



Variable	**Change (%)**
U.S. goods price in Foreign (P^{H*})	-0.44

(I) Long-Run



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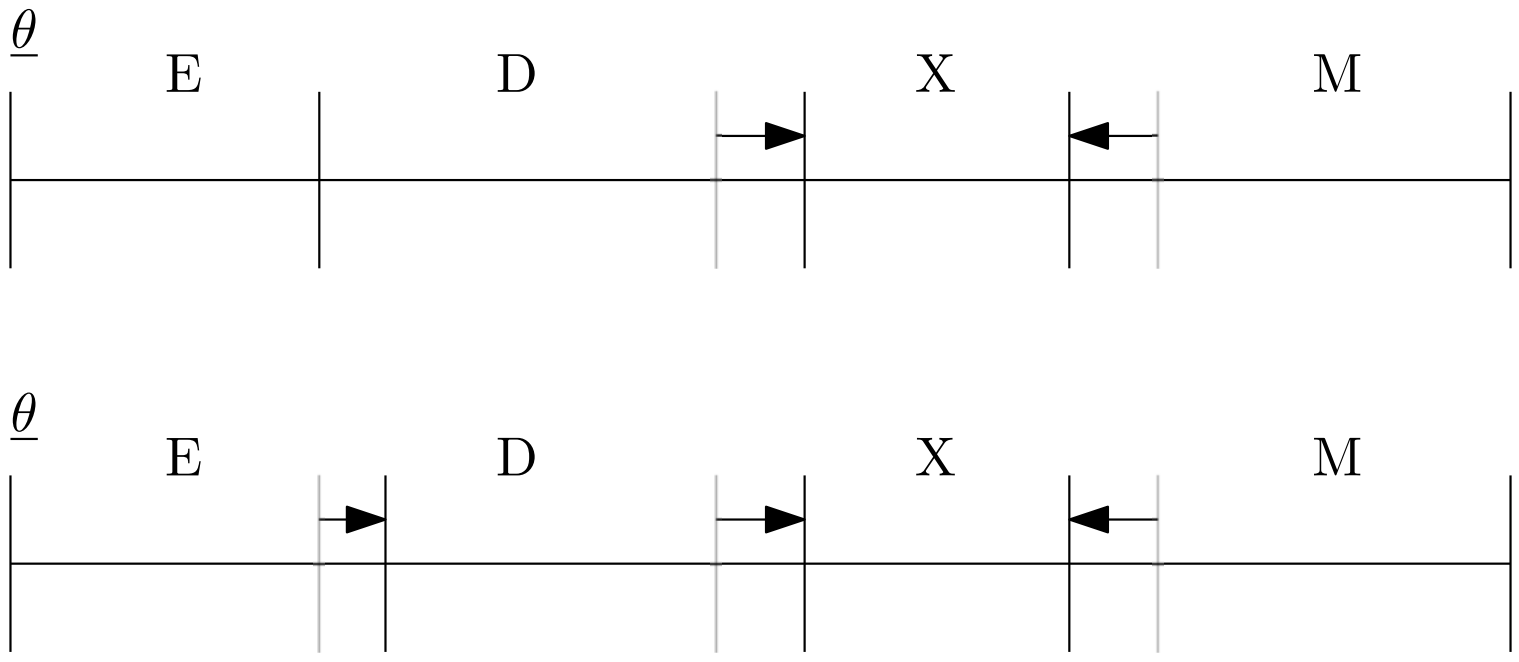

Variable	**Change (%)**
U.S. goods price in Foreign (P^{H*})	-0.44
Measure of U.S. firms	1.39
U.S. wage (W)	0.23

(I) Long-Run

Moment	Pre-reform	Post-reform
Entry/exit rate	8.75	8.78
Fraction of exporting (X) firms	23.02	22.90
Fraction of multinational (M) firms	7.12	7.24

(I) Long-Run

Firm Status	Change (%)
Multinational	-0.17
Exporter	0.01
Domestic	0.03
Exiter	0.09

Percentage changes in average productivity

(I) Long-Run

Variable	Change (%)
Domestic output	0.40
Exports	-0.30
Productivity	1.18
Dividends	0.68
U.S. Government taxes	-0.05
U.S. Welfare	0.18

(II) Short-Run

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

(II) Short-Run

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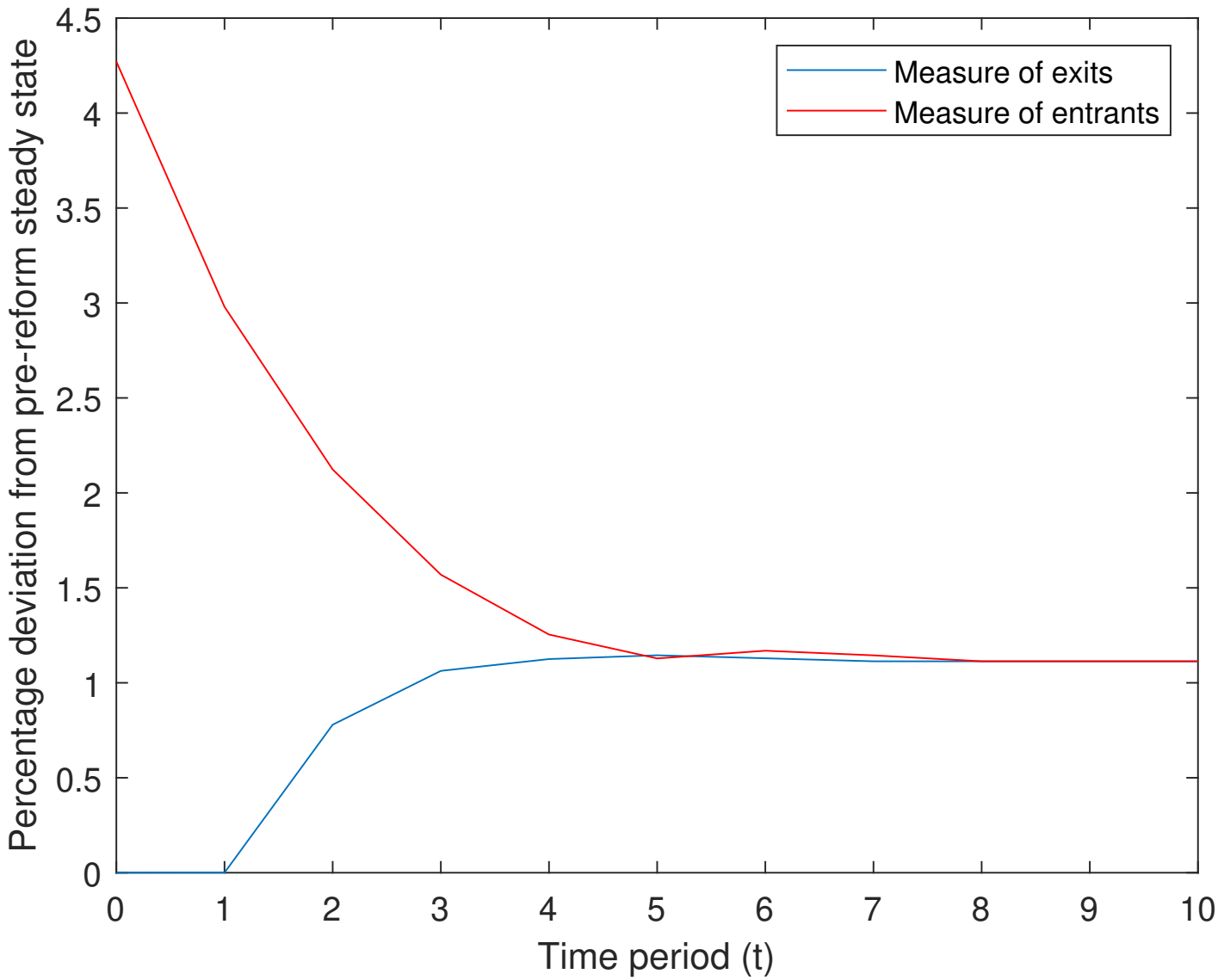
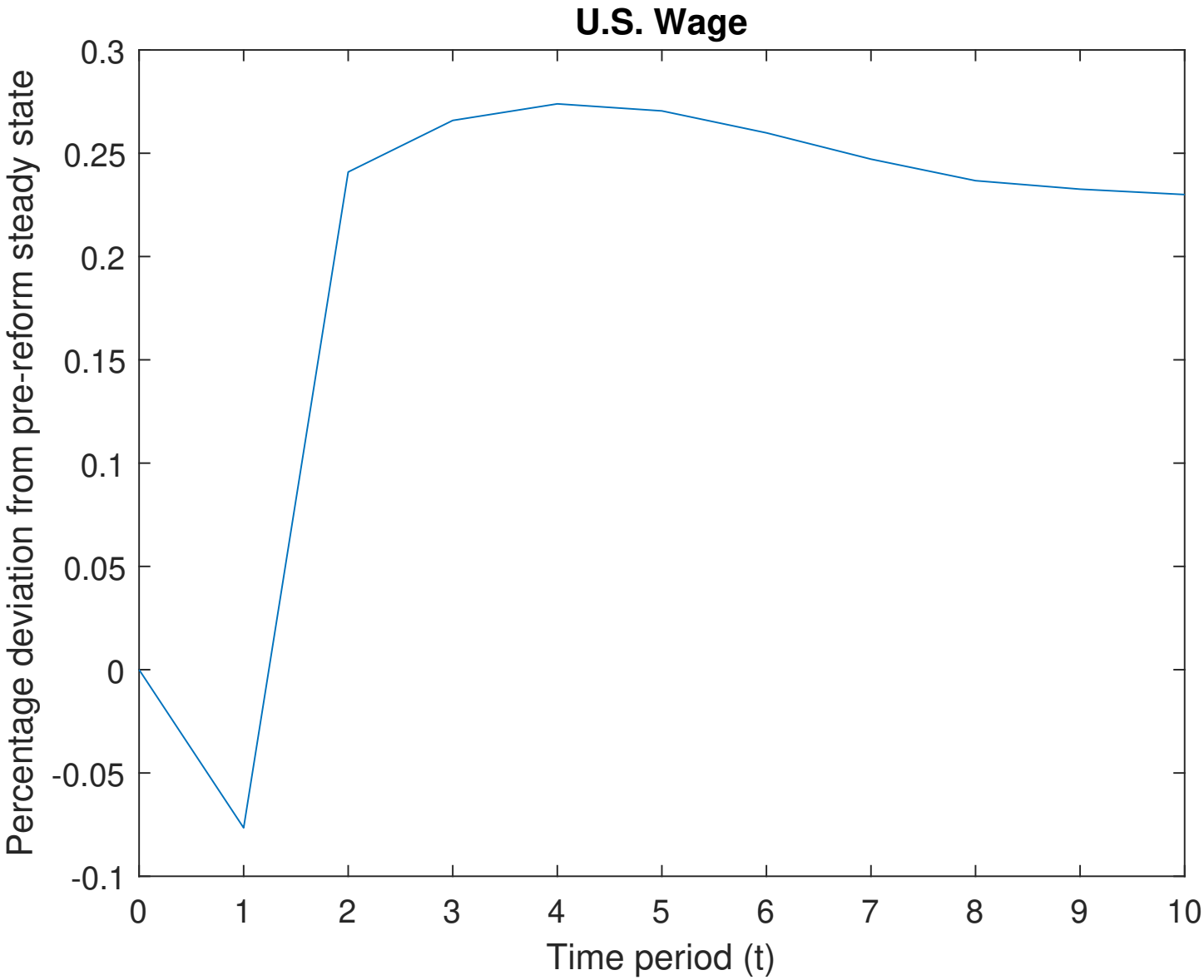
- Map convergence to new steady state.

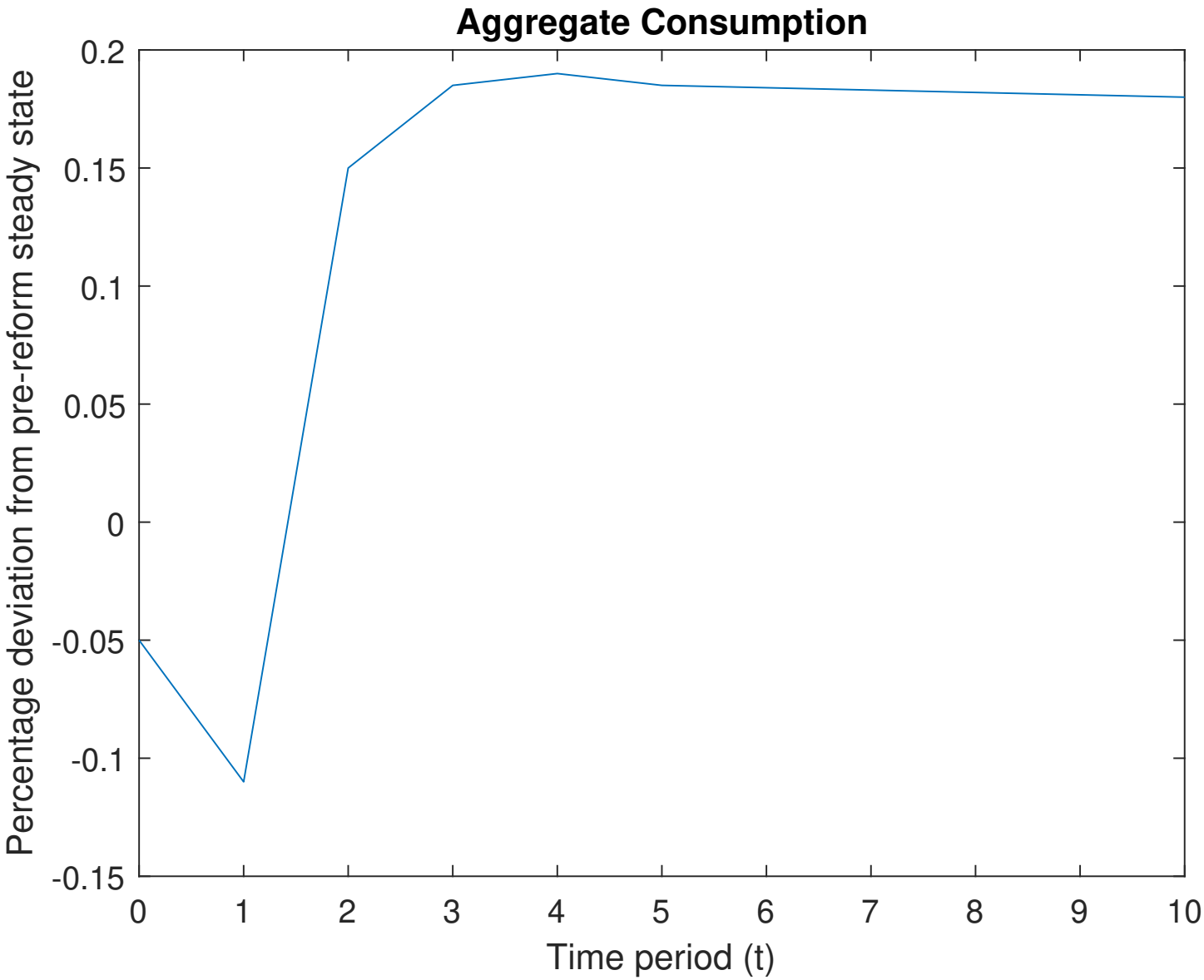
(II) Short-Run


Measure of exits
Measure of entrants
Percentage deviation from pre-reform steady state
Time period (t)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
1
2
3
4
5
6
7
8
9
10

(II) Short-Run


U.S. Wage
Percentage deviation from pre-reform steady state
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
1
2
3
4
5
6
7
8
9
10
Time period (t)

(II) Short-Run


Aggregate Consumption
Percentage deviation from pre-reform steady state
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
1
2
3
4
5
6
7
8
9
10
Time period (t)

(III) Financial Frictions

(III) Do financial frictions matter?

(III) Financial Frictions

Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)

- In the counterfactual without financial frictions:

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Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)
U.S. goods price in Foreign (P^{H*})	-0.62	-0.44

- In the counterfactual without financial frictions:
  - Terms of trade effect is stronger.

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- In the counterfactual without financial frictions:
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    $\Rightarrow$ Larger increase in supply of goods to the foreign market.

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Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)
U.S. goods price in Foreign (P^{H*})	-0.62	-0.44

$\Rightarrow$ Bigger drop in value of exporting.

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Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)
U.S. goods price in Foreign (P^{H*})	-0.62	-0.44
Measure of U.S. firms	0.36	1.39

$\Rightarrow$ Bigger drop in value of exporting.

$\Rightarrow$ Pushes-back against the pro-competitive effect: weaker entry.

(III) Financial Frictions

Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)
U.S. goods price in Foreign (P^{H*})	-0.62	-0.44
Measure of U.S. firms	0.36	1.39
U.S. wage (W)	-0.05	0.23

$\Rightarrow$ Bigger drop in value of exporting.

$\Rightarrow$ Pushes-back against the pro-competitive effect: weaker entry.

$\Rightarrow$ Decrease in the U.S. wage.

(III) Financial Frictions

Variable	**Change (%)** (Without frictions)	**Change (%)** (With frictions)
Domestic output	0.18	0.40
Exports	-0.42	-0.30
Productivity	0.31	1.18
Dividends	0.10	0.68
U.S. Government taxes	-0.08	-0.05
U.S. Welfare	-0.12	0.18

Roadmap

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  - Financial frictions.
- 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
- Welfare losses without financial frictions? Theory of second best.

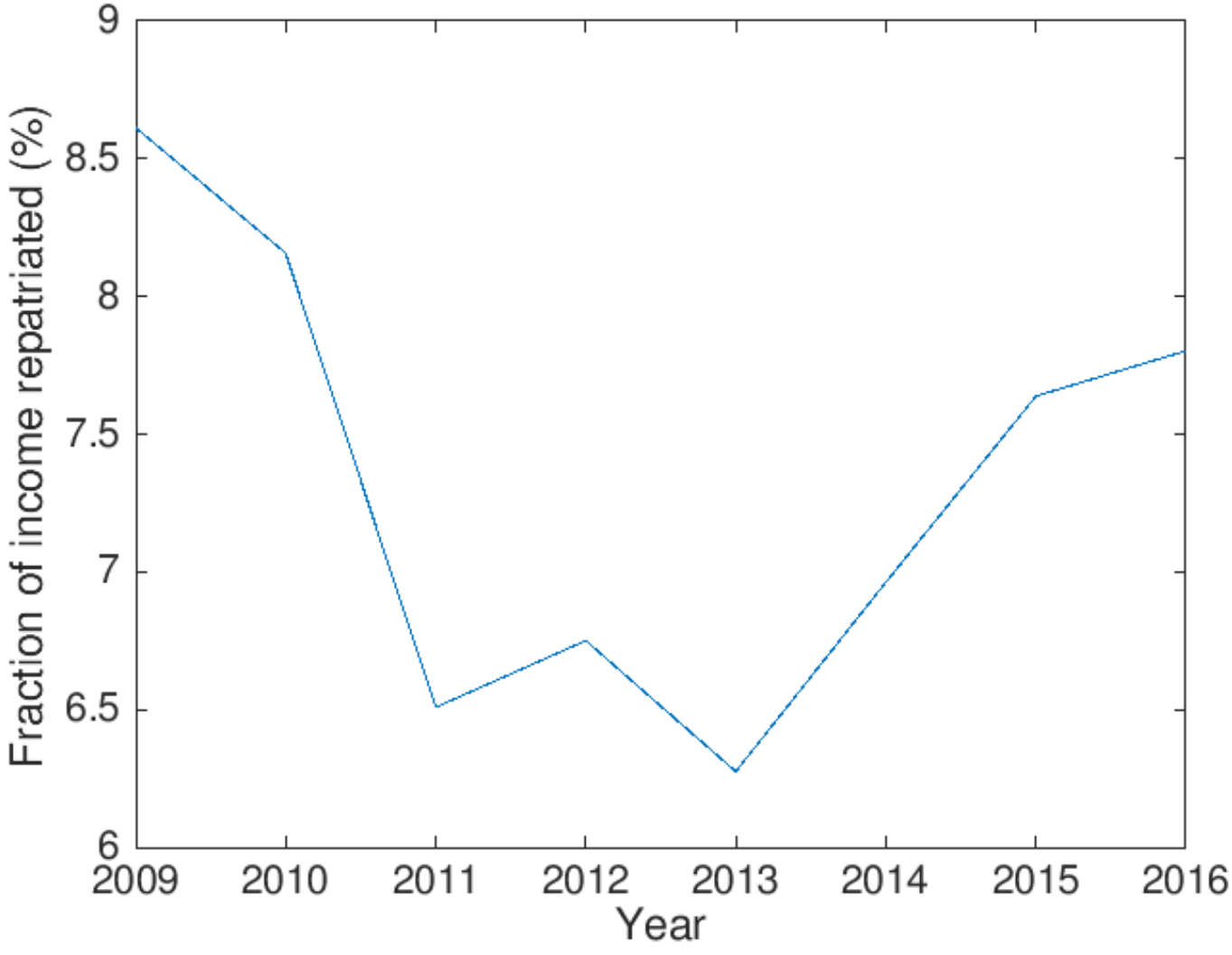
Transition Probabilities

Data Transition Probabilities

t/t+1	Domestic	Exporter	Multinational	Exit
Domestic	84.62	5.41	0.03	9.93
Exporter	13.14	80.69	0.84	5.32
Multinational	0.27	1.86	91.75	6.13
Entrant	85.95	12.89	1.18	

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

Aggregate Repatriations Data



Source: Bureau of Economic Analysis (BEA)

Capital Structure of Multinationals

Multinationals Only			
Variable	**Mean**	**Median**	**Std. dev.**
Cash/Assets	0.1	0.1	0.2
Debt/Assets	0.2	0.1	0.3
Dividends/Assets	0.1	0.0	0.1
Equity issuance/Assets	0.1	0.3	3.5

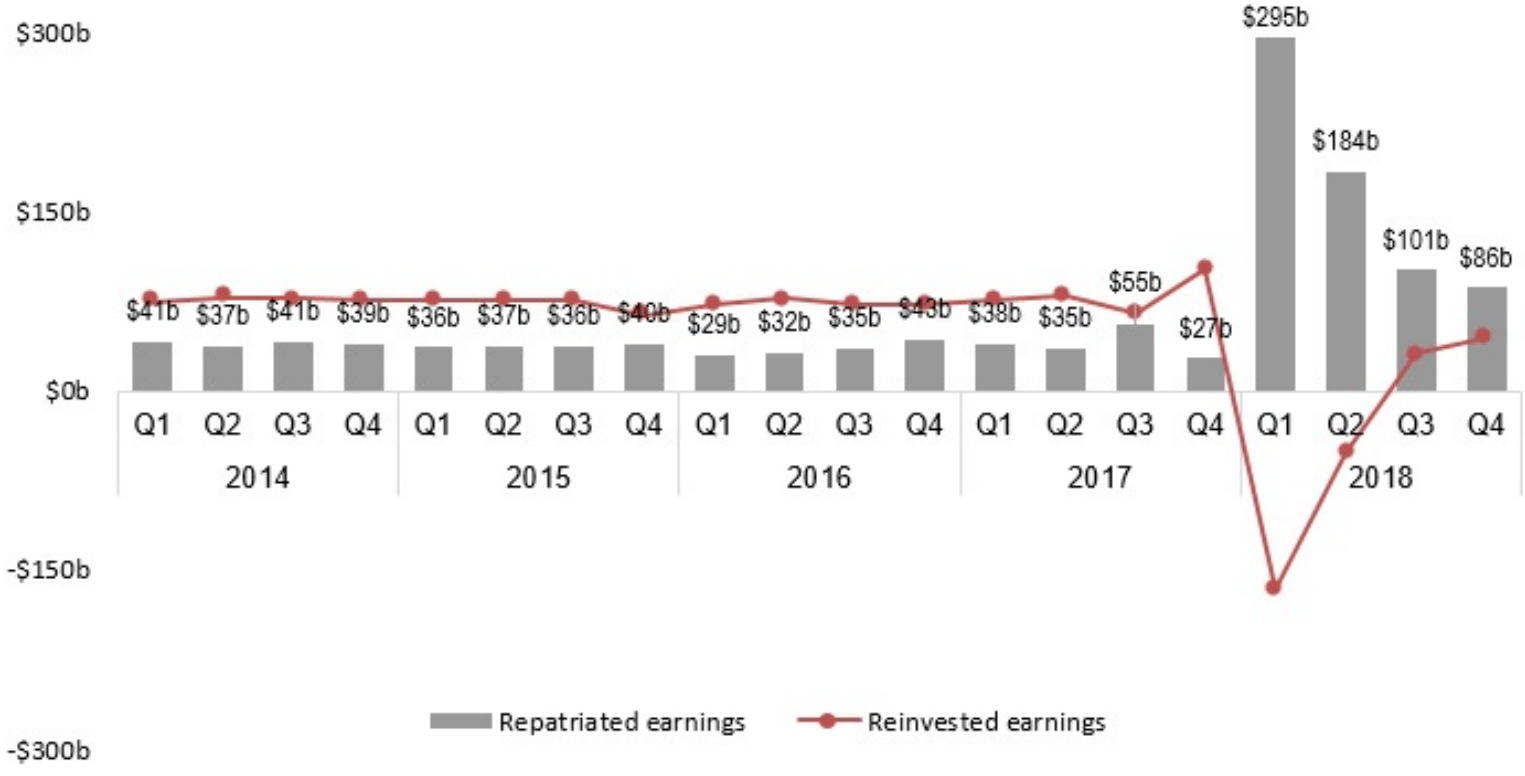
Source: Compustat

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.

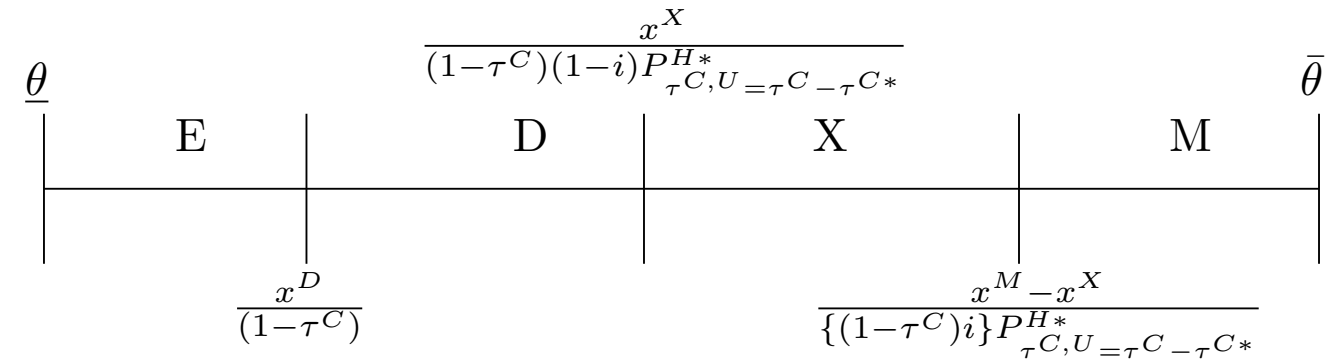
Source: US Bureau of Economic Analysis.

Response of Incumbent Multinationals (Model)

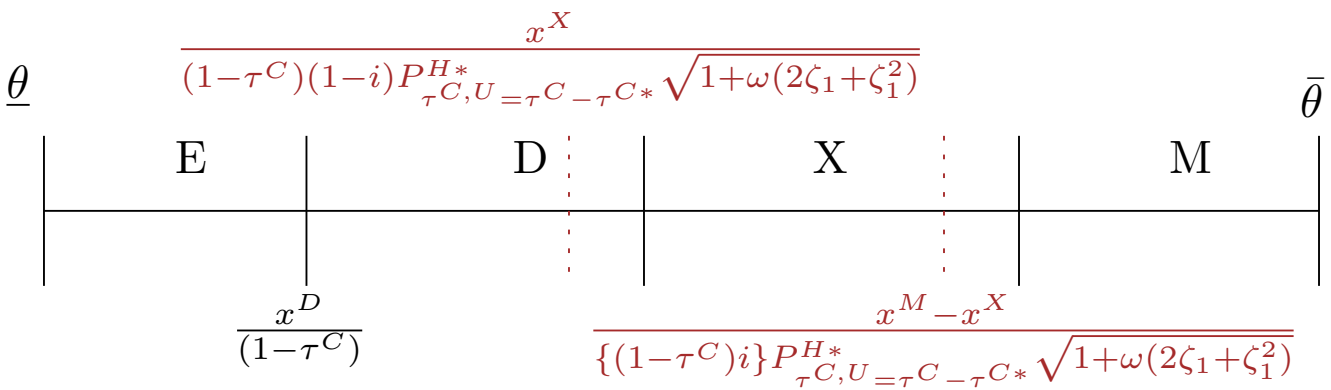
- Keep status for a given state the same post-reform as it was pre-reform.
- Keep all prices and the mass of firms constant.

Variable	**(%) of Aggregate Response**
U.S. output	0.50
Foreign output	-1.20
Dividends	62.30
Debt	-30.20

Static Model with Financial Frictions: Equilibrium

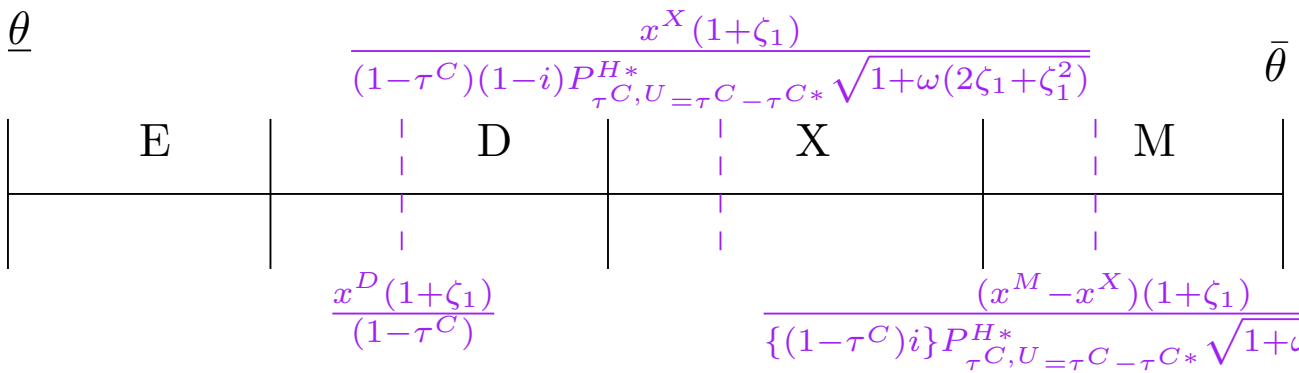


$\zeta_1 = 0$



$\zeta_1 > 0$

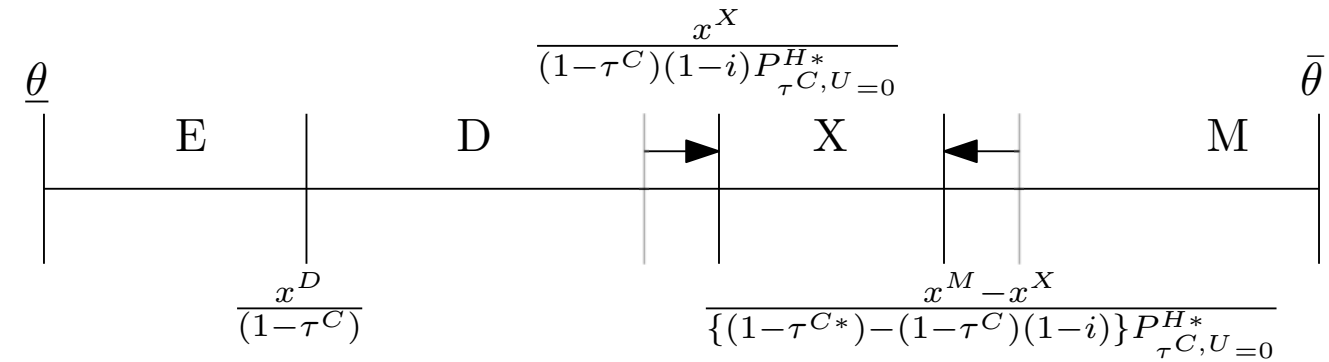
Unconstrained firms



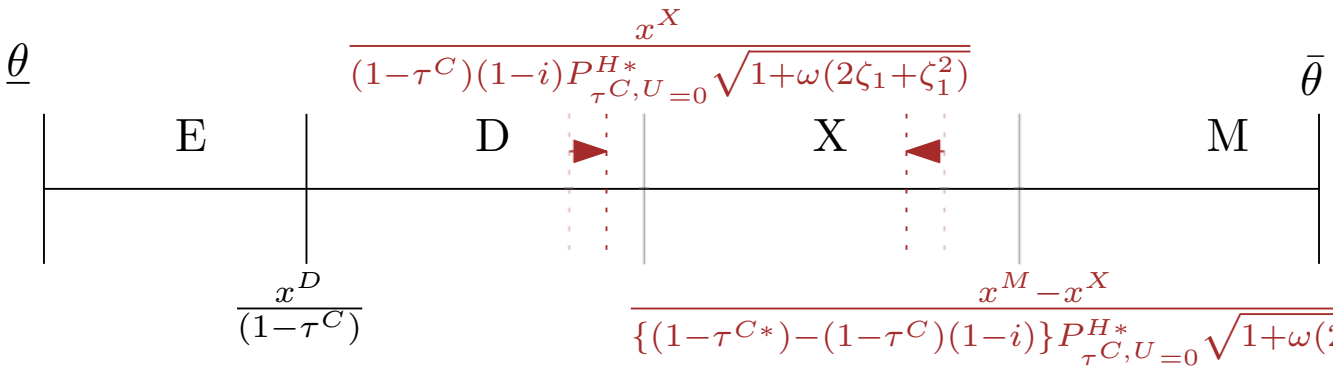
$\zeta_1 > 0$

Constrained firms

Static Model with Financial Frictions: Counterfactual



$\zeta_1 = 0$



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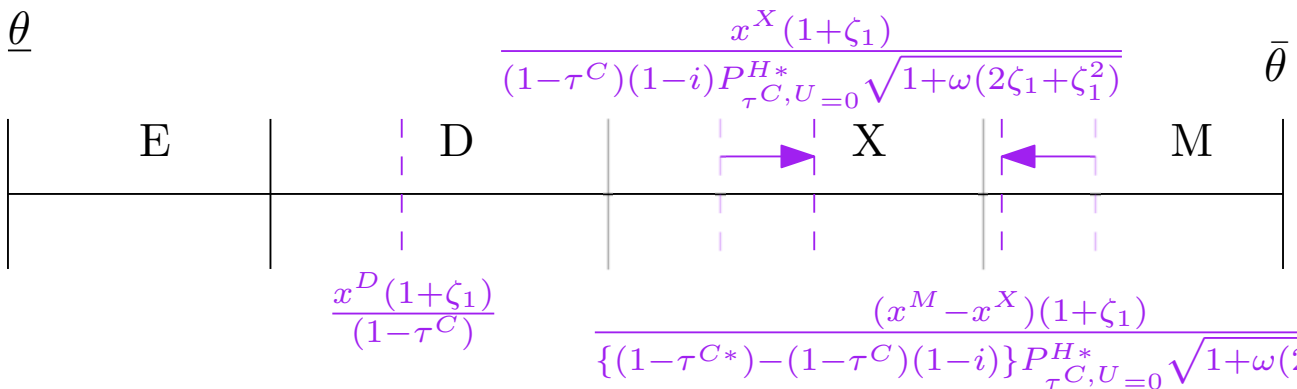
Unconstrained firms



$\zeta_1 > 0$

Constrained firms

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.

Melitz (2003), Helpman, Melitz, & Yeaple (2004), Eaton, Kortum, & Kramarz (2011), Antràs & Yeaple (2014), McGrattan & Prescott (2009), Burstein & Monge-Naranjo (2009), Ramondo (2014), Ramondo & Rodríguez-Clare (2013), McGrattan (2012)

(2) Dynamics in trade models.

Alessandria, Choi, & Ruhl (2014), Ruhl & Willis (2017), Fitzgerald, Haller, & Yedid-Levi (2016), Brooks & Dovis (2019), Ravikumar, Santacreu, & Sposi (2017)

Related Literature

(3) Tax reforms and productivity.

Restuccia & Rogerson (2008), Gourio & Miao (2009), Chen, Qi, & Schlagenhauf (2018), Acemoglu, Akcigit, Alp, Bloom, & Kerr (2018)

(4) Structural corporate finance.

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

(5) Repatriation taxes.

Gu (2017), Curtis, Garın, & Mehkari (2017), Albertus, Glover, & Levine (2018), Arena & Kutner (2015), Foley, Hartzell, Titman, & Twite (2007), Harford, Wang, & Zhang (2017)

Acemoglu, D., Akcigit, U., Alp, H., Bloom, N., & Kerr, W. (2018). Innovation, reallocation, and growth. *American Economic Review*, *108*(11), 3450–91.

Albertus, J. F., Glover, B., & Levine, O. (2018). Foreign investment of us multinationals: The effect of tax policy and agency conflicts.

Alessandria, G., Choi, H., & Ruhl, K. (2014). *Trade adjustment dynamics and the welfare gains from trade* (Tech. Rep.). National Bureau of Economic Research.

Antràs, P., & Yeaple, S. R. (2014). Multinational firms and the structure of international trade. In *Handbook of international economics* (Vol. 4, pp. 55–130). Elsevier.

Arena, M. P., & Kutner, G. W. (2015). Territorial tax system reform and corporate financial policies. *The Review of Financial Studies*, *28*(8), 2250–2280.

Brooks, W., & Dovis, A. (2019). Credit market frictions and trade liberalizations. *Journal of Monetary Economics*.

Burstein, A. T., & Monge-Naranjo, A. (2009). Foreign know-how, firm control, and the income of developing countries. *The Quarterly Journal of Economics*, *124*(1), 149–195.

Chen, D., Qi, S., & Schlagenhauf, D. (2018). Corporate income tax, legal form of organization, and employment. *American Economic Journal: Macroeconomics*, *10*(4), 270–304.

Curtis, C. C., Garın, J., & Mehkari, M. S. (2017). *Repatriation taxes* (Tech. Rep.). Working paper.

Dharmapala, D., Foley, C. F., & Forbes, K. J. (2011). Watch what i do, not what i say: The unintended consequences of the homeland investment act. *The Journal of Finance*, *66*(3), 753–787.

Eaton, J., Kortum, S., & Kramarz, F. (2011). An anatomy of international trade: Evidence from french firms. *Econometrica*, *79*(5), 1453–1498.

Fitzgerald, D., Haller, S., & Yedid-Levi, Y. (2016). *How exporters grow* (Tech. Rep.). National Bureau of Economic Research.

Flaaen, A. (2014). *Multinational firms in context.* Working Paper.

Foley, C. F., Hartzell, J. C., Titman, S., & Twite, G. (2007). Why do firms hold so much cash? a tax-based explanation. *Journal of Financial Economics*, *86*(3), 579–607.

Gomes, J. F. (2001). Financing investment. *American Economic Review*, *91*(5), 1263–1285.

Gourio, F., & Miao, J. (2009). *Transitional dynamics of dividend tax reform* (Tech. Rep.). Boston University-Department of Economics.

Gu, T. (2017). Us multinationals and cash holdings. *Journal of Financial Economics*, *125*(2), 344–368.

Harford, J., Wang, C., & Zhang, K. (2017). Foreign cash: Taxes, internal capital markets, and agency problems. *The Review of Financial Studies*, *30*(5), 1490–1538.

Helpman, E., Melitz, M. J., & Yeaple, S. R. (2004). Export versus fdi with heterogeneous firms. *American economic review*, *94*(1), 300–316.

Hennessy, C. A., & Whited, T. M. (2007). How costly is external financing? evidence from a structural estimation. *The Journal of Finance*, *62*(4), 1705–1745.

Li, S., Whited, T. M., & Wu, Y. (2016). Collateral, taxes, and leverage. *The Review of Financial Studies*, *29*(6), 1453–1500.

McGrattan, E. R. (2012). Transition to fdi openness: Reconciling theory and evidence. *Review of Economic Dynamics*, *15*(4), 437–458.

McGrattan, E. R., & Prescott, E. C. (2009). Openness, technology capital, and development. *Journal of Economic Theory*, *144*(6), 2454–2476.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6), 1695–1725.

Nikolov, B., & Whited, T. M. (2014). Agency conflicts and cash: Estimates from a dynamic model. *The Journal of Finance*, *69*(5), 1883–1921.

Ramondo, N. (2014). A quantitative approach to multinational production. *Journal of International Economics*, *93*(1), 108–122.

Ramondo, N., & Rodríguez-Clare, A. (2013). Trade, multinational production, and the gains from openness. *Journal of Political Economy*, *121*(2), 273–322.

Ravikumar, B., Santacreu, A. M., & Sposi, M. (2017). Capital accumulation and dynamic gains from trade.

Restuccia, D., & Rogerson, R. (2008). Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic dynamics*, *11*(4), 707–720.

Riddick, L. A., & Whited, T. M. (2009). The corporate propensity to save. *The Journal of Finance*, *64*(4), 1729–1766.

Ruhl, K. J., & Willis, J. L. (2017). New exporter dynamics. *International Economic Review*, *58*(3), 703–726.

Strebulaev, I. A., & Whited, T. M. (2012). Dynamic models and structural estimation in corporate finance. *Foundations and Trends® in Finance*, *6*(1–2), 1–163.