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The Interaction and Sequencing of Policy Reforms

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Which reforms? When?

Countries face broad array of potential reforms

IMF Title IV consultation for Brazil (May 2015)

- “relatively closed economy”
- “tax system is uncommonly complex”
- “high risk loans by public banks”

How do reforms interact? Are there gains from sequencing reform?

We build model to study sequencing of reforms

We construct a two-country, general equilibrium model in which growth of economy is driven by continual entry of more productive firms.

Firms in model face three policy barriers:

- Cost of creating new firm
- Trade cost
- Contract enforcement / banking efficiency

Once we have constructed model…

Characterize balanced growth path of economy.

Calibrate the model to symmetric two-country in which the United States trades with the rest of the world.

Simulate 6 different sequences of reforms that are symmetric and multilateral.

Our findings

Best sequence of reforms involves reforming trade costs first.

Worst sequence of reforms involves reforming enforcement of contracts first.

Large welfare differences: 4.9 percent of period 0 consumption to compensate worst sequence

Export reforms induce productive domestic firms to export and less productive potential firms to not enter.

Model

Two countries, home and foreign

Continuum of tradable intermediate good firms

- Monopolistic competitors
- Fixed cost to create firm, fixed cost to export
- Endogenous borrowing constraints

Representative final good producer

- Aggregates intermediate goods

Households

Representative household in country i solves

$$\max \sum_{t=0}^{\infty} \beta^t \log C_{it}$$

$$\text{s.t. } P_{it} C_{it} + q_{it+1} B_{it+1} = w_{it} L_i + D_{it} + B_{it}$$

$$D_{i0}, B_{i0} \text{ given}$$

where D_{it} = dividends from domestic firms

Final good producers

Perfect competition, constant returns to scale

Purchases intermediate goods (y_{it}^d, y_{jt}^e) to solve

$$\min \int_{\omega \in \Omega_{it}^d} p_{it}^d(\omega) y_{it}^d(\omega) d\omega + \int_{\omega \in \Omega_{jt}^e} p_{jt}^e(\omega) y_{jt}^e(\omega) d\omega$$

$$\text{s.t.} \left(\int_{\omega \in \Omega_{it}} y_{it}^d(\omega)^\rho d\omega + \int_{\omega \in \Omega_{jt}^e} y_{jt}^e(\omega)^\rho d\omega \right)^{\frac{1}{\rho}} = Y_{it}$$

Ω_{it}^d: country *i*'s domestic varieties

Ω_{jt}^e: country *j*'s exported varieties to country *i*

Intermediate goods producers

Measure μ_j of potential entrants each period

Potential entrants draw from productivity distribution

$$F_{it}(x) = 1 - \left(\frac{x}{\underline{x}_j g^t} \right)^{-\gamma}$$

where the mean of distribution grows at rate $g - 1$

Production technology of firm ω

$$y_{it}(\omega) = x_{it}(\omega) \ell_{it}(\omega)$$

Fixed costs

Firms face two fixed costs

- κ_i^d in units of labor
- κ_i^e in units of labor, where $\kappa_i^e > \kappa_i^d$

Time-to-build constraint: One period gestation lag after paying fixed cost before operation begins

Prices of existing firm

Existing firm chooses price to maximize profits in *domestic* market

$$\pi_{1t}^{d}(\omega) = \max p_{1t}^{d}(\omega) y_{1t}^{d}(\omega) - w_{1t} \frac{y_{1t}^{d}(\omega)}{x_{1t}(\omega)}$$

Existing firm chooses price to maximize profits in *export* market

$$\pi_{1t}^{e}(\omega) = \max p_{1t}^{e}(\omega) y_{1t}^{e}(\omega) - w_{1t} \frac{y_{1t}^{e}(\omega)}{x_{1t}(\omega)}$$

Prices of existing firms

Constant markup pricing for both domestic and export markets

$$p_{it}^{d}(\omega) = p_{it}^{e}(\omega) = \frac{w_{it}}{\rho x_{it}(\omega)}$$

Pricing decisions can be re-written as a function of productivity $p_{it}^{d}(x) = p_{it}^{e}(x)$

Profitability re-written as $\pi_{it}^{d}(x)$ and $\pi_{it}^{e}(x)$

Existing exporter

Exporter has state variables (b,x) and chooses debt, dividends, and exit decision to solve

$$V_{it}^{e}(b,x) = \max\left[d + q_{it+1}\left(1-\delta\right)V_{it+1}^{e}(b',x),0\right]$$

$$\text{s.t.} \quad d = \pi_{it}^{d}(x) + \pi_{it}^{e}(x) + \left(1-\delta\right)q_{it+1}b' - b \geq 0$$

$$V_{it}^{e}(b,x) \geq \left(1-\theta_{i}\right)V_{it}^{e}(0,x) \quad \text{(EC)}$$

Once a firm exits, there is zero exit value and it cannot re-enter

Firms die with probability δ each period

Limited enforcement of contracts

Degree of enforceability of contracts governed by θ_i

Manager of a firm can abscond with fraction $\left(1-\theta_i\right)$ of the value of the firm in case of default

Enforcement constraint implies that manager's value of honoring debt is greater than that of absconding

$$V_{it}^{e}(b,x) \geq \left(1-\theta_i\right) V_{it}^{e}(0,x)$$

Possible range: $1 \geq \theta_i > 0$

Existing non-exporter

Non-exporter has state variables (b,x) and chooses debt, dividends, and export/exit decision to solve

$$V_{it}^{n}(b,x)=\max\begin{bmatrix} d^{n}+q_{it+1}\left(1-\delta\right)V_{it+1}^{n}(b',x), \\ d^{e}+q_{it+1}\left(1-\delta\right)V_{it+1}^{e}(b',x),0 \end{bmatrix}.$$

$$\begin{aligned} \text{s.t.} \quad & d^{n}=\pi_{it}^{d}(x)+\left(1-\delta\right)q_{it+1}b'-b\geq 0 \\ & d^{e}=\pi_{it}^{d}(x)+\left(1-\delta\right)q_{it+1}b'-b-w_{it}\kappa_{i}^{e}\geq 0 \\ & V_{it}^{n}(b,x)\geq\left(1-\theta_{i}\right)V_{it}^{n}(0,x) \end{aligned}$$

If a firm chooses to become an exporter, it must pay fixed cost $w_{it}\kappa_{i}^{e}$ but it cannot export until next period

Potential entrant's decision to enter domestic market

Potential entrant pays fixed cost $w_{it}\kappa_i^d$ only if:

- Value of firm is greater than zero

$$V_{it+1}^n\left(\frac{w_{it}\kappa_i^d}{(1-\delta)q_{it+1}},x\right)\geq 0.$$

- There exists a debt path such that all enforcement constraints are satisfied

Solution characterized by cutoff productivities

- $\hat{x}_{i0t}^d$: potential entrant productivity needed to enter
- $\hat{x}_{ikt}^d$: minimum productivity of firms, age *k* at time *t*

Potential entrant's decision to enter export market

Potential entrant pays fixed cost $w_{it}\kappa_i^e$ to enter export market and $w_{it}\kappa_i^d$ to enter domestic market only if:

- Value of entering both markets is greater than the value of only entering the domestic market

$$V_{it+1}^e\left(\frac{w_{it}\kappa_i^d + w_{jt}\kappa_i^e}{(1-\delta)q_{it+1}}, x\right) \geq V_{it+1}^n\left(\frac{w_{it}\kappa_i^d}{(1-\delta)q_{it+1}}, x\right) \geq 0$$

- There exists a debt path such that all enforcement constraints are satisfied

Solution characterized by cutoff productivities

Export cutoff productivities

$\hat{x}^{e}_{ik\ell t}$: minimum productivity of firms of age *k* who pay the export cost at age ℓ

$\hat{x}^{e}_{i00t}$: potential entrant's minimum productivity to enter the domestic market and export market at age 0

Measure of exporting firms

Measure of exporting firms η_{it}^{e} evolves according to

$$\eta_{it+1}^{e} = \left(\eta_{it}^{e} + \lambda_{it}^{e}\right)\left(1-\delta\right)$$

Measure of new exporters λ_{it}^{e}

$$\lambda_{it}^{e} = \mu_{i}\left(1 - F_{it}\left(\hat{x}_{i00t}^{e}\right) + \sum_{k=1}^{\hat{n}_{it}} (1-\delta)^{k}\left[F_{it-k}\left(\hat{x}_{ik,k-1,t}^{e}\right) - F_{it-k}\left(\hat{x}_{ikkt}^{e}\right)\right]\right)$$

$\hat{n}_{it}$: oldest age at which a firm born in period *t* pays the export cost

Measure of domestic firms

Measure of domestic firms η_{it}^{d} evolves according to

$$\eta_{it+1}^{d} = \left(\eta_{it}^{d} + \lambda_{it}^{d}\right)\left(1-\delta\right)$$

Measure of new firms λ_{it}^{d}

$$\lambda_{it}^{d} = \mu_{i}\left(1 - F_{it}\left(\hat{x}_{i0t}^{d}\right)\right)$$

Definition of equilibrium

Given initial conditions, an equilibrium is sequences for $i = 1,2$ of

- Prices $\{w_{it}, P_{it}, q_{it+1}\}_{t=0}^{\infty}$
- Aggregate income, consumption, dividends and bonds
- Entry-exit thresholds
- New entry measures
- Prices and allocations for intermediate firms that produce for the domestic and export market

Definition of equilibrium

such that in both countries

- **Household** maximizes lifetime utility
- **Intermediate good firm** maximizes discounted profits and entry-exit thresholds solve entry-exit problem
- **Final good firm** minimizes cost
- **Clearing conditions**: labor market, bond market, dividend payments, balanced trade

Proposition 1. Balanced growth path exists

Economy converges to a balanced growth path in which

- Aggregate income, consumption, dividends, and bonds grow by *g*
- Entry and exit thresholds grow by g
- Measures of entrants and firms remain constant

Balanced growth path (BGP)

We prove the existence of a balanced growth path and characterize key variables

In the characterizations of BGP,

- $\theta_i < 1$ so enforcement is imperfect
- κ_i^d is low enough relative to κ_i^e so that the marginal entrant never exports
- $1/(1-\rho) > 2$ so that profits of a firm decrease over time

Domestic cutoffs for cohort aged 0

The (EC) at age 1 will hold with equality for the cutoff firm operating domestically at age 0

The EC for this firm will not hold with equality after age 1

Reason: It is most advantageous to default at age 1

- debt is highest
- declining profitability through time implies that this is when the value of the firm is highest

Expression for domestic cutoff for cohort aged 0

- Using the condition that EC will hold with equality for the cutoff firm at age 1, we find

$$\hat{x}_{i0t}^{d} = \tilde{\kappa}_{i}^{d}(\kappa_{i}^{d}, \theta_{i})^{\frac{1-\rho}{\rho}} \left(\frac{1}{1-\rho} \frac{w_{it}}{Y_{it}} \right)^{\frac{1-\rho}{\rho}} \frac{1}{\rho} w_{it}$$

- Similar to that in a static model except that the entry cost in that expression is replaced with effective entry cost $\tilde{\kappa}_{i}^{d}$

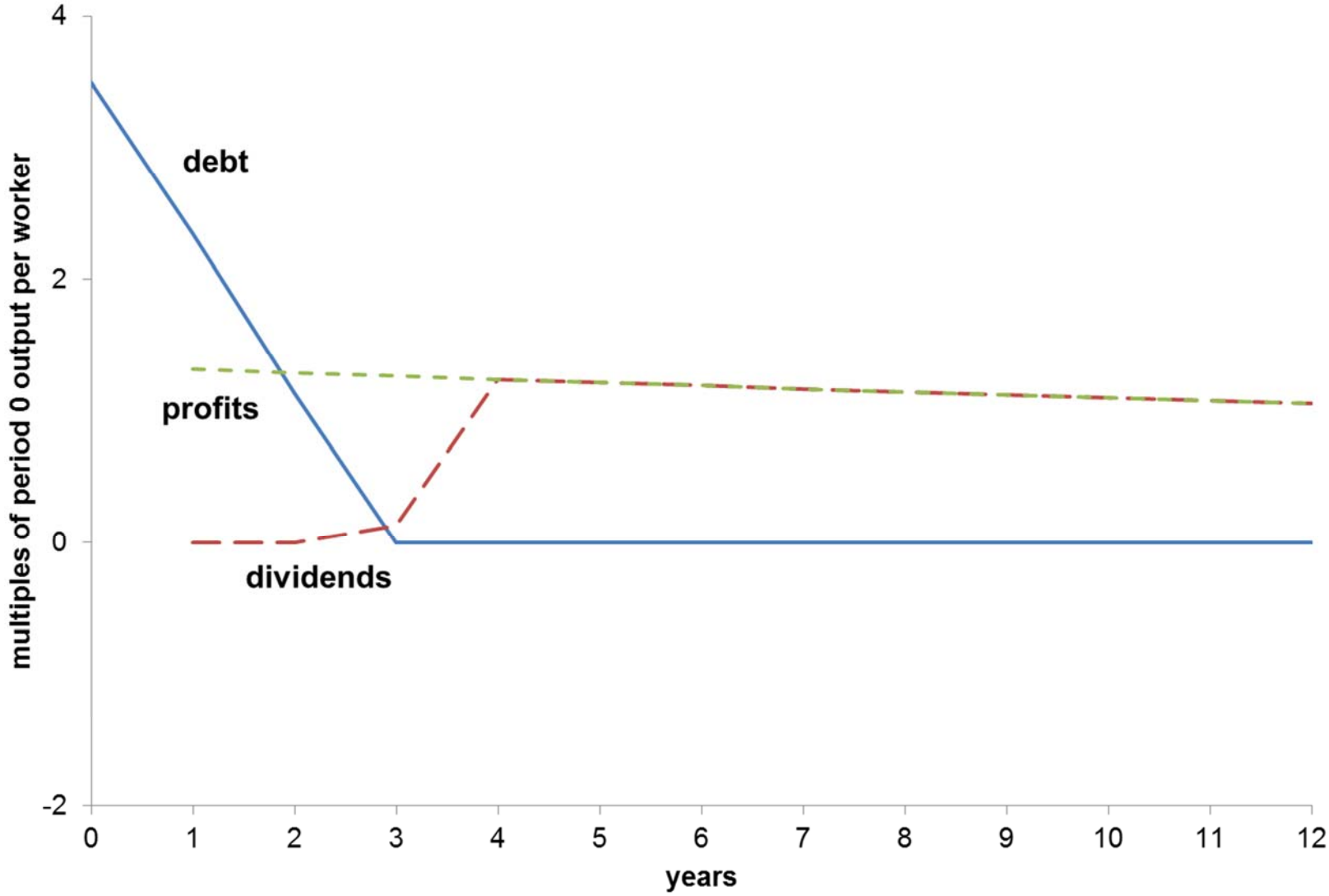
How is $\tilde{\kappa}_i^d$ related to policy variables?

$$\tilde{\kappa}_i^d(\kappa_i^d,\theta) = \frac{\kappa_i^d}{\theta_i \sum_{k=1}^{\infty} \beta^k \left(1-\delta\right)^k g^{k\frac{-\rho}{1-\rho}}}$$

If κ_i^d increases or θ_i declines, $\tilde{\kappa}_i^d$ increases

As θ_i approaches 0, $\tilde{\kappa}_i^d$ approaches infinity since firms can no longer finance the entry cost

Debt, profits, and dividends of a domestic firm



Condition for Export cutoffs

For a firm that pays at age ℓ, the EC at age $\ell+1$ either

- holds with equality for the cutoff exporting firm
- or is slack, in which case, determined by

$$V^{e}_{i,\ell+1,t-k+\ell+1}\left(b^{e}_{i,\ell,t-k+\ell+1}\left(\hat{x}^{e}_{ik\ell t}\right),\hat{x}^{e}_{ik\ell t}\right)=V^{n}_{i,\ell+1,t-k+\ell+1}\left(b^{d}_{i,\ell,t-k+\ell+1}\left(\hat{x}^{e}_{ik\ell t}\right),\hat{x}^{e}_{ik\ell t}\right)$$

where

$b^{e}_{i,\ell,t-k+\ell+1}$: debt chosen at age ℓ after paying the fixed cost

$b^{d}_{i,\ell,t-k+\ell+1}$: debt chosen at age ℓ

Expression for constrained marginal exporter

Using the condition that EC at age $\ell+1$ hold with equality for the cutoff exporting firm, we find

$$\hat{x}^{ec}_{ik\ell t} = \tilde{\kappa}^{ec}_{i\ell}\left(\kappa^{d}_{1},\kappa^{e}_{1},\theta_{1},\kappa^{d}_{2},\kappa^{e}_{2},\theta_{2}\right)^{\frac{1-\rho}{\rho}}\left(\frac{1}{1-\rho}\frac{w_{i,t-k}}{P_{i,t-k}Y_{i,t-k}}\right)^{\frac{1-\rho}{\rho}}\frac{1}{\rho}\frac{w_{i,t-k}}{P_{i,t-k}}$$

Like before, expression is similar to the static case except that the entry cost is replaced with $\tilde{\kappa}^{ec}_{i\ell}$

How is $\tilde{\kappa}_{i\ell}^{ec}$ related to policy variables?

$$\tilde{\kappa}_{i\ell}^{ec}\left(\kappa_1^d,\kappa_1^e,\theta_1,\kappa_2^d,\kappa_2^e,\theta_2\right)=$$

$$\frac{\left(1-\delta\right)^{\ell}\beta^{\ell}\kappa_i^e+\kappa_i^d}{\theta_i\left[1+\Delta_{iY}\Delta_{iP}^{\frac{-1}{1-\rho}}\right]\sum_{m=\ell+1}^{\infty}\left(1-\delta\right)^m\beta^m g^{m\frac{-\rho}{1-\rho}}+\sum_{m=1}^{\ell}\left(1-\delta\right)^m\beta^m g^{m\frac{-\rho}{1-\rho}}}$$

- If either fixed costs (κ_i^d or κ_i^e) increase or θ_i declines then $\tilde{\kappa}_{i\ell}^{ec}$ increases
- As θ_i approaches 0, $\tilde{\kappa}_{i\ell}^{ec}$ does not approach infinity since firms can self-finance export cost

Expression for unconstrained marginal exporter

- Using $V^{e}_{i,\ell+1,t-k+\ell+1}\left(\cdot,\hat{x}^{e}_{ik\ell t}\right)=V^{n}_{i,\ell+1,t-k+\ell+1}\left(\cdot,\hat{x}^{e}_{ik\ell t}\right)$, we find

$$\hat{x}^{eu}_{ik\ell t}=\tilde{\kappa}^{eu}_{i\ell}\left(\kappa^{d}_{1},\kappa^{e}_{1},\theta_{1},\kappa^{d}_{2},\kappa^{e}_{2},\theta_{2}\right)^{\frac{1-\rho}{\rho}}\left(\frac{1}{1-\rho}\frac{w_{i,t-k}}{P_{i,t-k}Y_{i,t-k}}\right)^{\frac{1-\rho}{\rho}}\frac{1}{\rho}\frac{w_{i,t-k}}{P_{i,t-k}}$$

- Like before, expression is similar to the static case except that the entry cost is replaced with $\tilde{\kappa}^{eu}_{i\ell}$

How is $\tilde{\kappa}_{i\ell}^{eu}$ related to policy variables?

$$\tilde{\kappa}_{i\ell}^{eu}\left(\kappa_1^d,\kappa_1^e,\theta_1,\kappa_2^d,\kappa_2^e,\theta_2\right)=\frac{\kappa_i^e}{\Delta_{iY}\Delta_{iP}^{\frac{-1}{1-\rho}}\sum_{m=1}^{\infty}\left(1-\delta\right)^m\beta^m g^{m\frac{-\rho}{1-\rho}}}g^{\ell\frac{\rho}{1-\rho}}$$

- If fixed cost (κ_i^d) increases, then $\tilde{\kappa}_{i\ell}^{eu}$ increases
- Notice expression is increasing in ℓ: the more a firm waits to pay the export cost, the more profitable it needs to be.
- In general, the marginal exporter efficiency is

$$\hat{x}_{ik\ell t}^{e}=\max\left\{\hat{x}_{ik\ell t}^{ec},\hat{x}_{ik\ell t}^{eu}\right\}$$

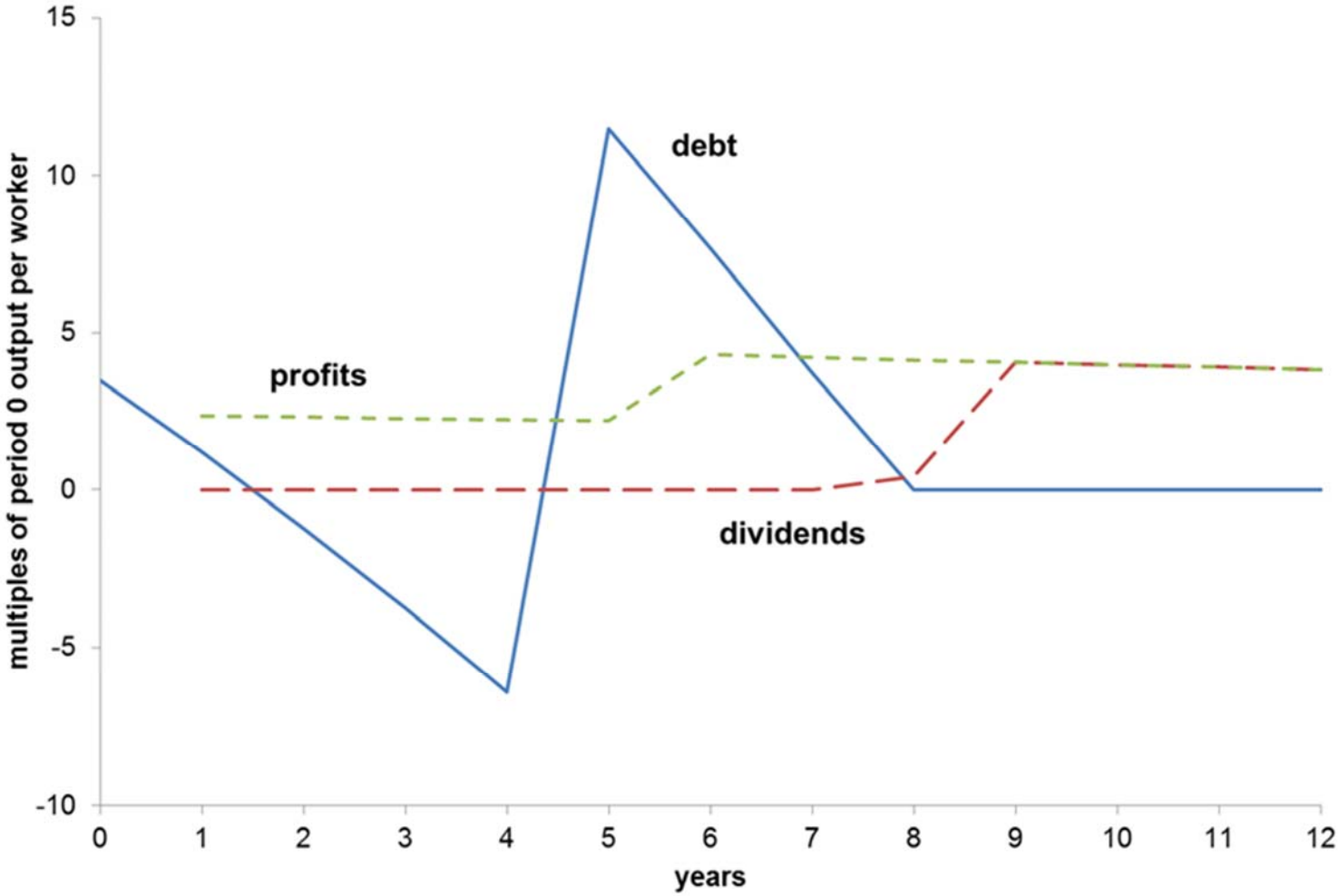
How does enforcement affect export cutoffs?

In the case of perfect enforcement, any firm that will ever export will pay the fixed cost at age 0, cutoff is $\hat{x}^e_{i,0,0,t}$

As enforcement worsens, less efficient firms take longer to export because they must first decrease their debt, cutoffs for cohort aged 0 at time t:

$$\underbrace{\hat{x}^e_{i,0,0,t}}_{\text{Pay } \kappa_i^e \text{ age 0}} > \underbrace{\hat{x}^e_{i,0,1,t}}_{\text{Pay } \kappa_i^e \text{ age 1}} > \ldots > \underbrace{\hat{x}^e_{i,0,\hat{n}_{it},t}}_{\text{Pay } \kappa_i^e \text{ age } \hat{n}_{it}}$$

Debt, profits, and dividends of an eventual exporter



Quantitative exercise

- Calibrate the model to the U.S. economy trading with a symmetric economy, which represents the rest of the world

- Examine welfare implications of symmetric multilateral reforms

Calibration

parameter		Value	target / source
fixed cost domestic	κ^d	8.6	average U.S. establishment size: 16.0
fixed cost export	κ^e	39.8	fraction of exporting firms: 21 percent
enforcement	θ	0.39	debt / revenue of firms of age less than 5: 0.27
tail parameter	γ	4.03	std. dev. of U.S. establishment size: 91.2
death rate	δ	0.10	establishment death rate: 10 percent per year
discount factor	β	0.98	real interest rate: 4 percent per year
entrant productivity growth	g	1.02	BGP growth factor: 1.02 per year
elasticity of substitution	$\frac{1}{1-\rho}$	3	Broda and Weinstein (2006)
Pareto parameters	$\mu,\underline{x}$	1	without loss of generality as long as cutoffs are strictly interior

Quantitative exercise

- Starting from the US, we solve for three separate distorted economies each with income levels that are three percent lower than the US

- These three economies correspond to the following changes in parameters
    - Entry costs increase from 8.5 to 9.9
    - Enforcement decreases from 0.39 to 0.32
    - Trade costs increase from 39.8 to 89.5

Quantitative exercise

- We begin with an economy with all 3 distortions

- We consider the transition path of 6 possible reforms sequences that end in an economy with no distortions

- Each sequence involves 1 unanticipated reforms followed by 2 anticipated reforms 4 years apart

Comparing the balanced growth paths

Compare the balanced growth paths that result from various reform sequences.

Compare the welfare gains from reform sequences with transition dynamics.

Changes in income levels

Reform #1	Real income (percent)
Trade costs	3.77
Entry costs	3.49
Enforcement	3.22

Trade cost reform delivers the highest income level after the first reform.

Interaction of reforms

Reform #1	Reform #2	
Trade costs	Entry costs	**Substitutable**
Trade costs	Enforcement	**Substitutable**
Enforcement	Entry costs	**Complementary**

Substitutable (Complementary): once a country has enacted one type of reform, the percentage increase in GDP from enacting the other reform decreases (increases).

Reforms affect firm composition

	Percent change			
Reform #1	Varieties available to consumer	Domestic non-exporting firms	Domestic exporting firms	Foreign exporting firms
Enforcement	22.8	23.8	-0.5	-0.5
Entry costs	18.2	19.9	-0.8	-0.8
Trade costs	0.8	-39.0	19.9	19.9

Reforms to entry costs and enforcement increase varieties and non-export firms, but “crowd out” exporting firms.

Crowding out of export firms

Two opposing effects:

- Direct: The effective entry cost of exporting declines if θ increases or κ^d declines.
- General equilibrium: The large increase in non-exporting firms raises wages and reduces the profitability of exporting.

General equilibrium effects are stronger.

Welfare effects with transition dynamics

Consider welfare effects of all possible sequences with

- 1 reform
- 2 reforms
- 3 reforms

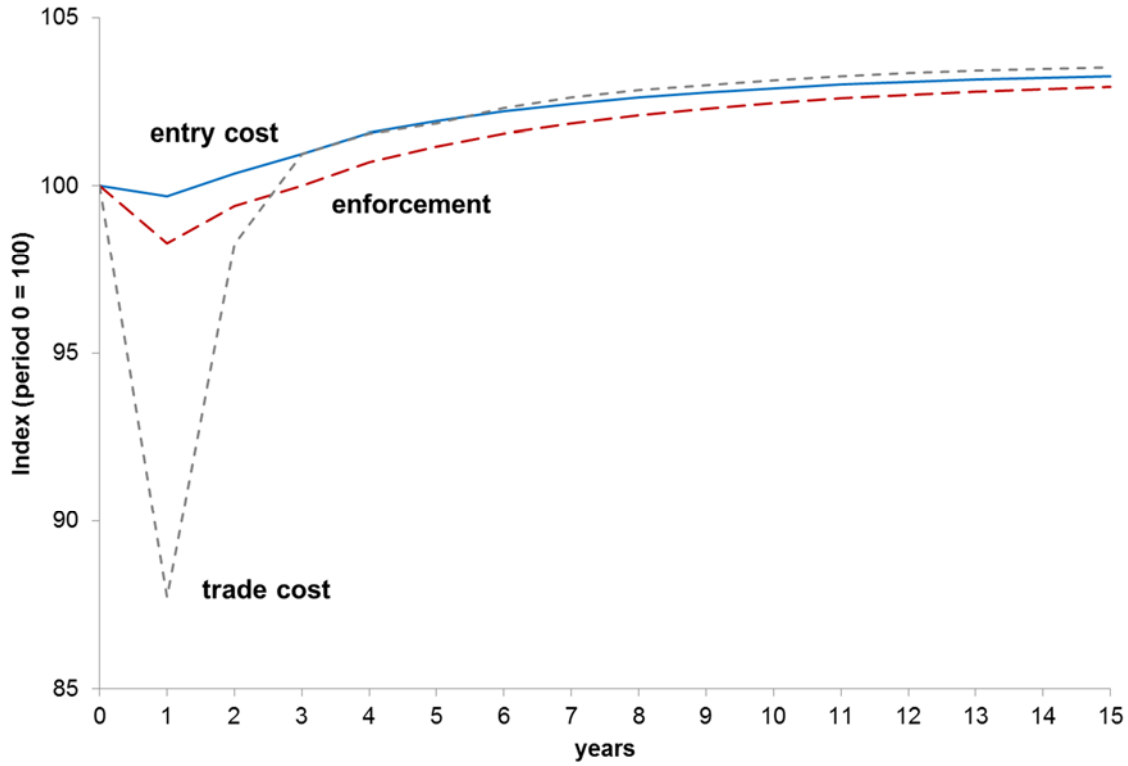
Welfare gains from 1 reform

Reform	Change in real income (percent)
Entry costs	3.14
Trade costs	3.11
Enforcement	2.74

Entry costs reform yields the highest welfare gain.

Trade cost reform results in the highest balanced growth path consumption levels, but less beneficial.

Detrended consumption paths



Consumption path with trade cost reform has large drop.

Entry cost reform preferred even though it has a lower balanced growth path consumption level.

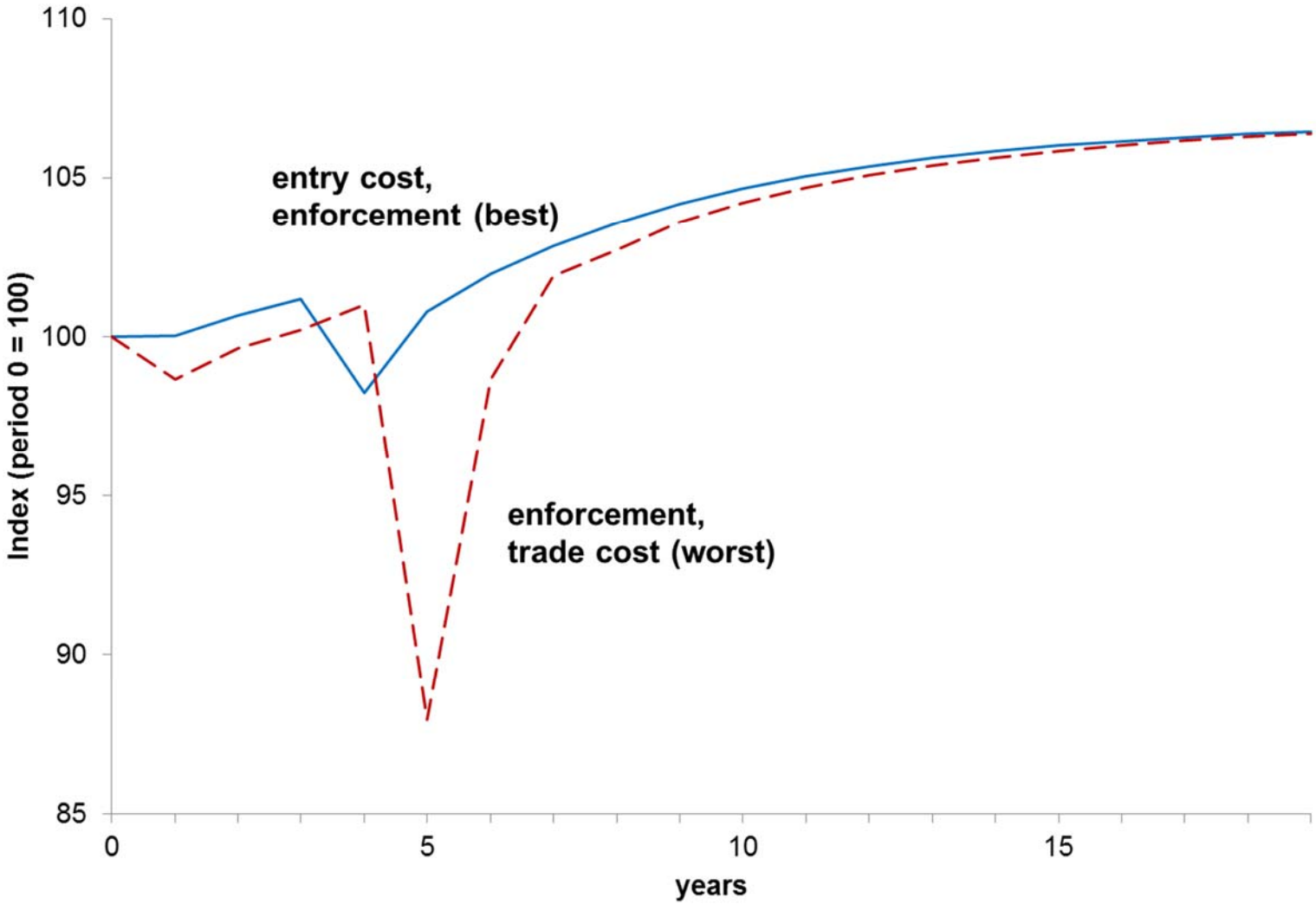
Welfare gains from 2 reforms

Reform #1	Reform #2	Change in real income (percent)
Entry costs	Enforcement	5.79
Enforcement	Entry costs	5.71
Trade costs	Entry costs	5.63
Entry costs	Trade costs	5.60
Trade costs	Enforcement	5.56
Enforcement	Trade costs	5.46

The best reforms involve entry costs and enforcement, reforms which are complementary.

Trade cost reforms are substitutable with other reforms and have large initial drop in consumption.

Detrended consumption paths



Welfare gains from 3 reforms

Reform #1	Reform #2	Reform #3	Change in real income (percent)
Trade costs	Enforcement	Entry costs	8.04
Trade costs	Entry costs	Enforcement	8.03
Entry costs	Enforcement	Trade costs	8.02
Entry costs	Trade costs	Enforcement	8.01
Enforcement	Entry costs	Trade costs	7.94
Enforcement	Trade costs	Entry costs	7.93

Best sequence: trade costs, enforcement, entry costs

The best reform sequences involve reforming export costs followed by enforcement.

Welfare gains from 3 reforms

Reform #1	Reform #2	Reform #3	Change in real income (percent)
Trade costs	Enforcement	Entry costs	8.04
Trade costs	Entry costs	Enforcement	8.03
Entry costs	Enforcement	Trade costs	8.02
Entry costs	Trade costs	Enforcement	8.01
Enforcement	Entry costs	Trade costs	7.94
Enforcement	Trade costs	Entry costs	7.93

Welfare differences are large: 0.10 percent permanent real income, equivalent to 4.9 percent of period 1 consumption to compensate worst sequence.

Compare best and worst reform sequence

We compare the transition path for the most and least beneficial reform sequence

- Best: export cost, entry cost, enforcement
- Worst: enforcement, export cost, entry cost

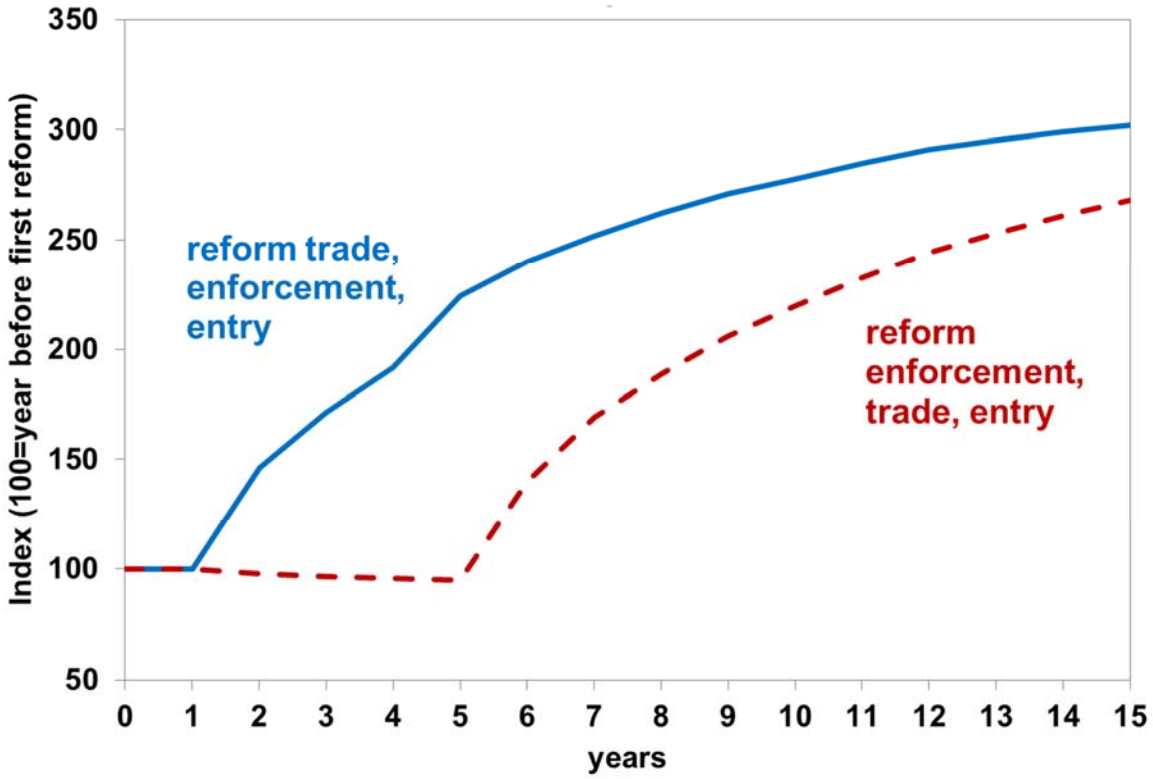
We find reducing export costs increases the mass of exporters and reduces the mass of domestic-only firms.

We find reforms to enforcement increase the mass of domestic-only firms.

Detrended consumption

Initial drop in consumption after export reform, but consistently higher consumption afterwards.

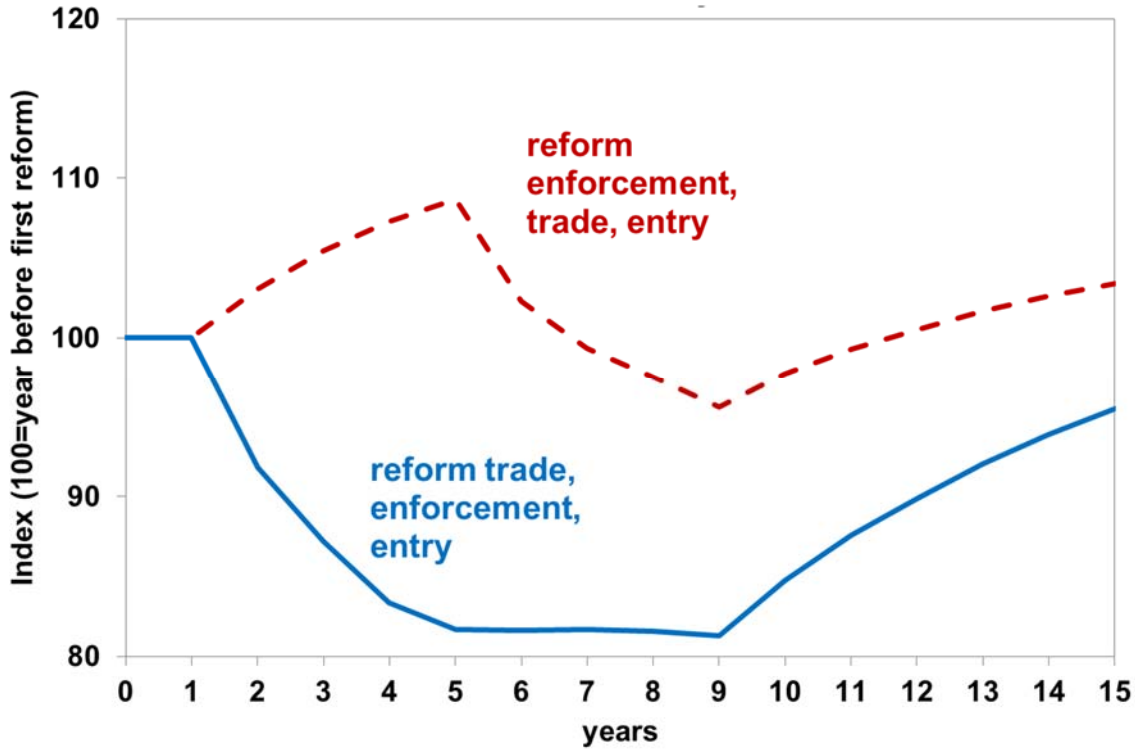
Mass of exporters



Trade cost reform leads to increase in the mass of exporters.

Timing of reform to trade costs leads to large and persistent differences in the mass of exporters.

Mass of domestic-only firms



Trade cost reform decreases the mass of unproductive domestic-only firms, whereas enforcement reform increases the mass of unproductive domestic-only firms.

Conclusion

We construct a model that incorporate three potential reforms that a government can undertake in order to study the optimal sequencing of reforms

We find that sequencing matters and that the best reforms are those that reduce export costs first

The timing of reforms can lead to welfare differences of 0.14 percent, equivalent to 7.2 percent of period 1 consumption