The Interaction and Sequencing of Policy Reforms

Jose Asturias
School of Foreign Service in Qatar, Georgetown University

Sewon Hur
University of Pittsburgh

Timothy J. Kehoe
University of Minnesota, Federal Reserve Bank of Minneapolis,
and National Bureau of Economic Research

Kim J. Ruhl
Stern School of Business, New York University

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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?

Suppose we are forced to do reforms sequentially. Does the order matter?

Mexico's fast growth 1955–1980 was accompanied by protectionism.

China's fast growth 1990–2015 was accompanied by trade liberalization.

Both countries pursued policies that encouraged urbanization, industrialization, and education.

Kehoe and Meza (2011): Mexico would have benefited from opening to trade early in its rapid growth period.

Model of 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).

Easy to characterize balanced growth path.

Numerical experiments

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

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

Economy starts in distorted balanced growth path in year 0. Unexpected reform 1 in year 1. Afterwards, perfectly foreseen reform 2 in year 5 and reform 3 in year 9.

Findings

Best sequence of reforms involves reforming trade cost first.

Worst sequence of reforms involves reforming enforcement of contracts first.

Large welfare differences: 7.3 percent of year 1 consumption to compensate worst sequence.

Trade reform induces productive domestic firms to export and less productive potential firms to not enter.

Model

Two countries, 1 and 2.

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.

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

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

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

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

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

Intermediate goods producers

Measure μ_i of potential entrants each period.

Potential entrants draw from productivity distribution

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

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 of other country, where $\kappa_i^e > \kappa_i^d$.

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

Prices

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

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

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

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

Prices

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 vector (b,x) and chooses debt, dividends, and exit decision to solve

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

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

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

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 vector (b,x) and chooses debt, dividends, and export/exit decision to solve

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

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

$$d^{e}=\pi_{it}^{d}(x)+\left(1-\delta\right)q_{it+1}b'-b-w_{jt}\kappa_{i}^{e}\geq 0$$

$$V_{it}^{n}(b,x)\geq\left(1-\theta_{i}\right)V_{it}^{n}(0,x).$$

If a firm chooses to become an exporter, it pays fixed cost $w_{jt}\kappa_{i}^{e}$ but it does not 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 $w_{jt}\kappa_i^e$ 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}

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

$\hat{n}_{it}$: 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 thresholds
- new entry measures
- prices and allocations for intermediate firms that produce for the domestic and export market

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 and earns zero profits,
- **clearing conditions**: labor market, bond market, dividend payments, balanced trade.

Proposition 1. Balanced growth path exists

Equilibria converge 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

Enforcement constraint at age 1 holds with equality for the cutoff firm operating domestically at age 0.

Enforcement constraints for this firm do not hold with equality after age 1.

It is most advantageous to default at age 1 because

- debt is highest;
- declining profitability through time implies that age 1 is when the value of the firm is highest.

Expression for domestic cutoff for cohort aged 0

Enforcement constraint holds with equality for the cutoff firm at age 1:

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

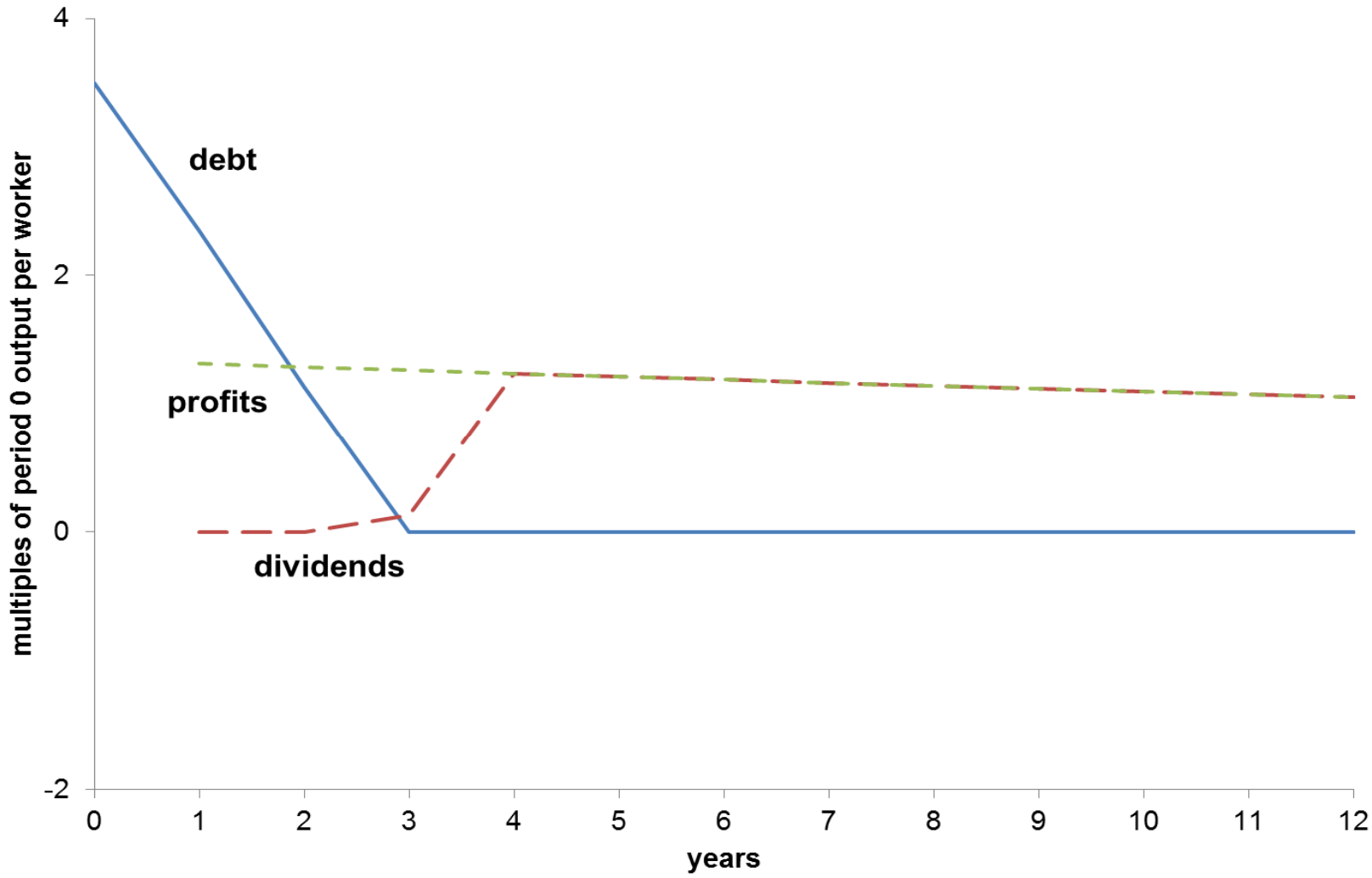
Similar to condition in static model except that the entry cost in that expression is replaced with effective entry cost $\tilde{\kappa}_{i}^{d}$.

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

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

- 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 $w_{jt}\kappa_i^e$ at age ℓ, 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

Condition that enforcement constraint at age $\ell+1$ holds with equality for the cutoff exporting firm:

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

As 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?

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

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

- 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.

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

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

As 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?

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

- If κ_i^d increases, then $\tilde{\kappa}_{i\ell}^{eu}$ increases
- $\tilde{\kappa}_{i\ell}^{eu}$ 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

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

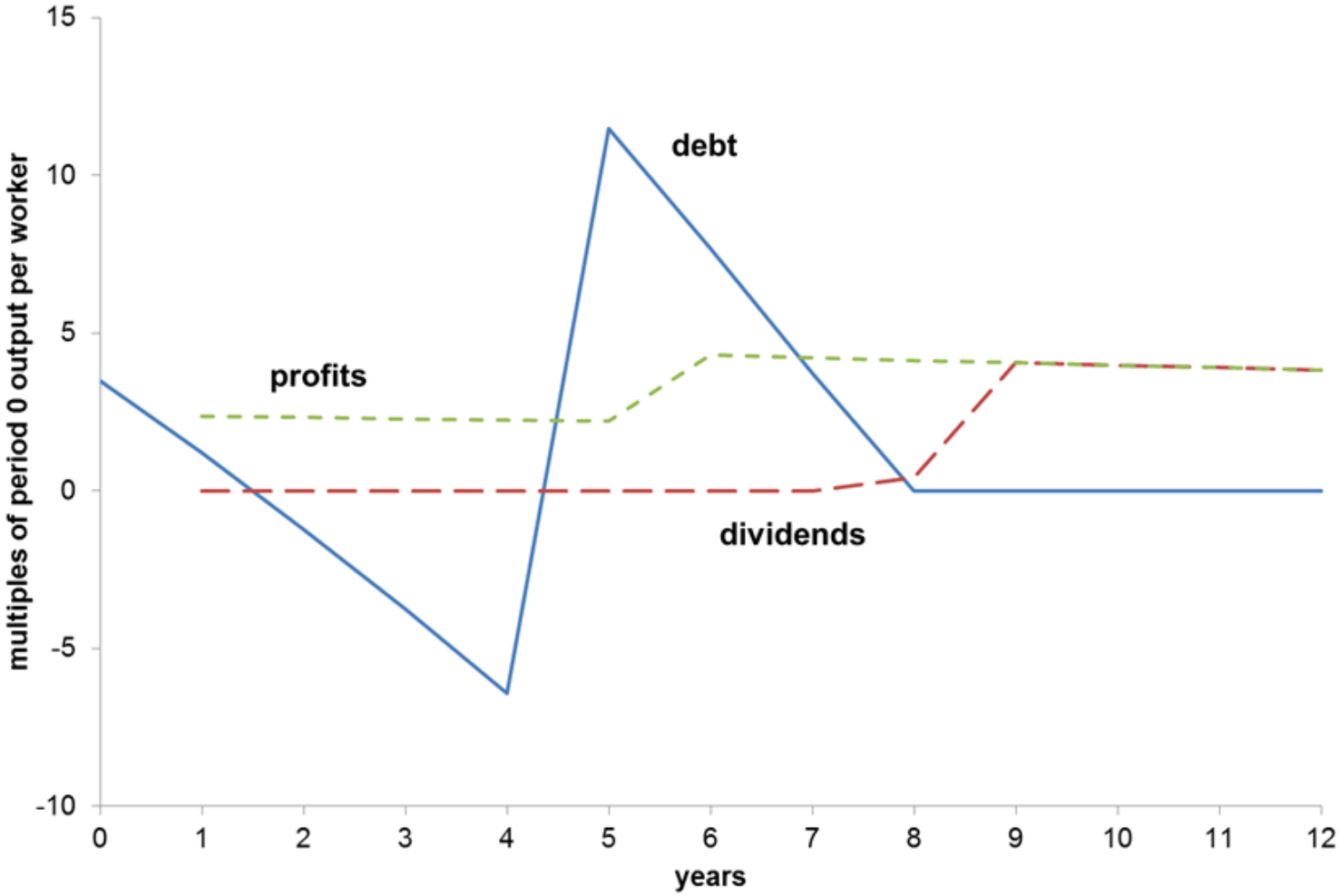
How does enforcement affect export cutoffs?

With perfect enforcement, any firm that will ever export pays the fixed cost at age 0 and 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 :

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

Debt, profits, and dividends of an eventual exporter



Numerical experiment

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	40.9	fraction of exporting firms: 21.0 percent
enforcement	θ	0.39	debt / revenue of firms of age less than 5: 0.27
Pareto parameter	γ	4.04	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

Numerical experiment

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

In these three economies

- Entry cost increase from 8.6 to 10.0.
- Enforcement decreases from 0.39 to 0.32.
- Trade cost increase from 40.9 to 91.9.

Numerical experiment

We begin with an economy with all 3 distortions.

We consider transition paths of 6 possible reforms sequences that converge to balanced growth path with no distortions.

Each sequence involves first unanticipated reform followed by second and third anticipated reforms 4 years apart.

Comparing balanced growth paths

Changes in income levels — one reform

reform	output gain (percent)
trade cost	3.71
entry cost	3.44
enforcement	3.17

Trade reform delivers the highest income level as the first reform.

Interaction of reforms

reform #1	reform #2	
trade cost	entry cost	substitutable
trade cost	enforcement	substitutable
enforcement	entry cost	complementary

Substitutable: once a country has enacted one reform, the percentage increase in GDP from enacting the other reform decreases.

Complementary: once a country has enacted one reform, the percentage increase in GDP from enacting the other reform increases.

Varieties available to consumers

The total varieties available to consumers are

$$\underbrace{V}_{\text{total varieties}} = \underbrace{D^{NE}}_{\text{domestic non-exporting}} + \underbrace{D^{E}}_{\text{domestic exporting}} + \underbrace{F^{E}}_{\text{foreign exporting}} .$$

We decompose the percentage change in varieties into the corresponding components

$$\frac{\Delta V}{V} = \frac{\Delta D^{NE}}{V} + \frac{\Delta D^{E}}{V} + \frac{\Delta F^{E}}{V}.$$

Decomposing changes in varieties

	percent change			
	varieties available to consumer	domestic non-exporting firms	domestic exporting firms	foreign exporting firms
enforcement	22.3	23.2	−0.5	−0.5
entry cost	17.9	19.5	−0.8	−0.8
trade cost	0.4	−38.4	19.4	19.4

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

General equilibrium effect is stronger.

Welfare effects with transition dynamics

Consider welfare effects of all possible sequences with

- 1 reform,
- 2 reforms,
- 3 reforms.

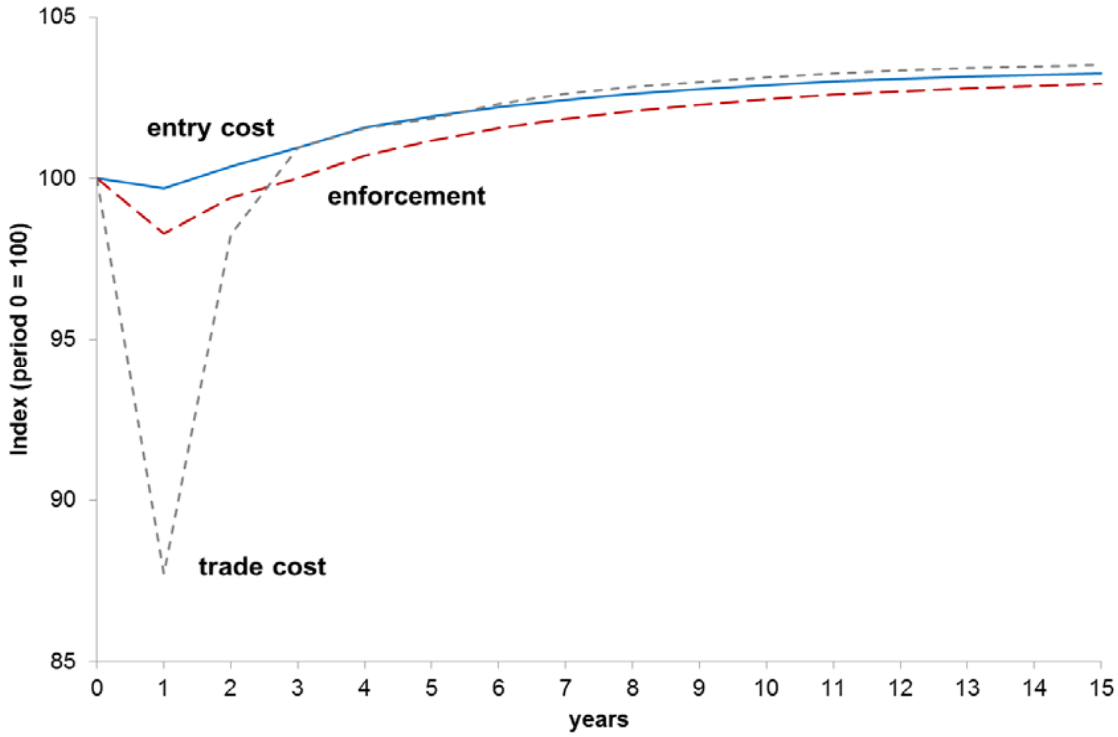
Welfare gains from 1 reform

reform	real income (100 = no reform)
entry cost	103.09
trade cost	103.02
enforcement	102.71

Entry cost reform yields highest welfare gain.

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

Detrended consumption paths



Consumption path with trade reform has large drop.

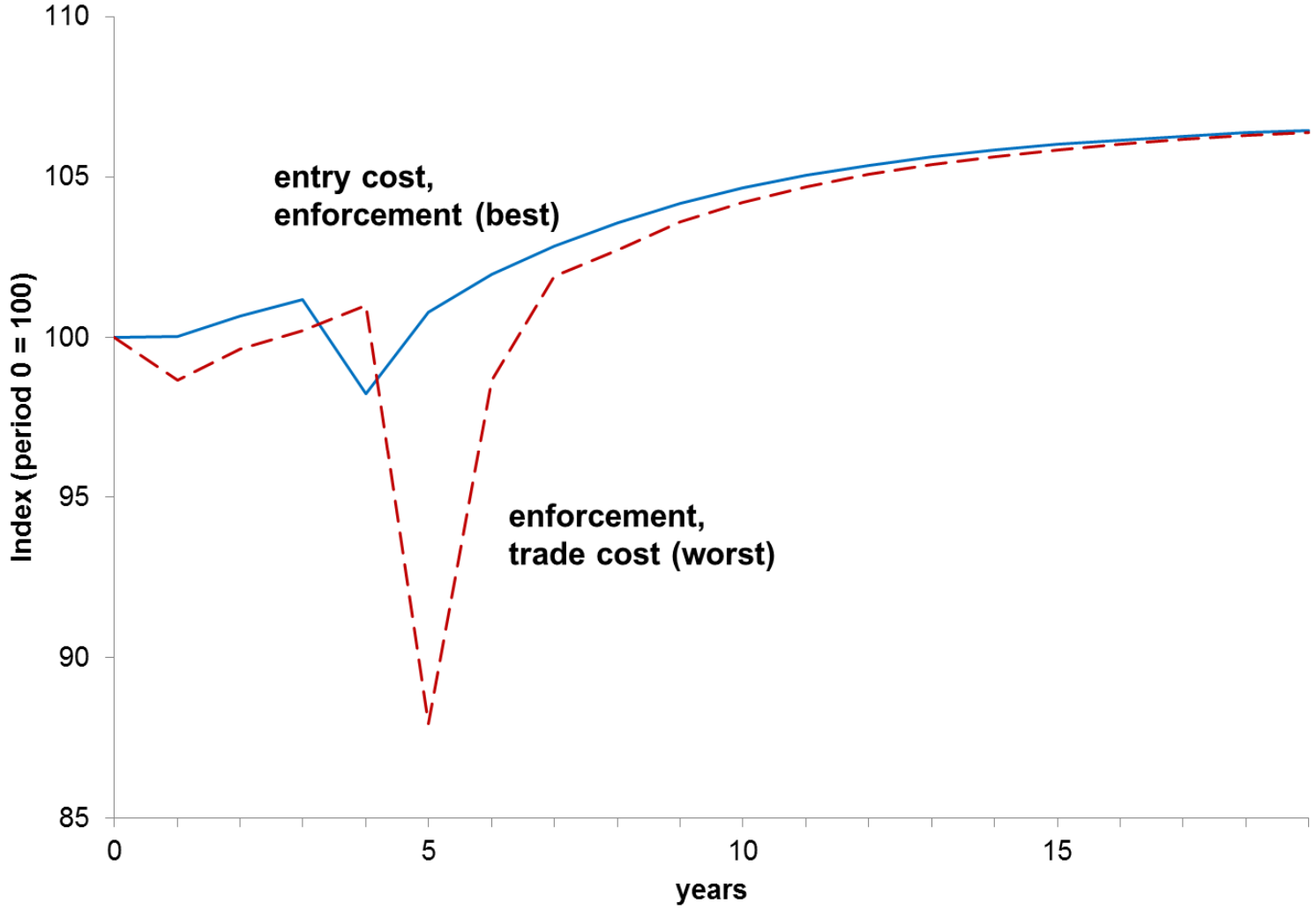
Entry cost reform preferred even though it has a lower balanced growth path consumption level.

Welfare gains from 2 reforms

reform #1	reform #2	real income (100 = no reform)
entry cost	enforcement	105.69
enforcement	entry cost	105.63
trade cost	enforcement	105.41
trade cost	entry cost	105.31
entry cost	trade cost	105.30
enforcement	trade cost	105.27

Best sequences involve entry cost and enforcement reforms, which are complementary. Trade reform is substitutable with other reforms and has large initial drop in consumption.

Detrended consumption paths



Welfare gains from 3 reforms

reform #1	reform #2	reform #3	real income (100 = no reform)
trade cost	enforcement	entry cost	107.86
entry cost	trade cost	enforcement	107.85
trade cost	entry cost	enforcement	107.83
entry cost	enforcement	trade cost	107.79
enforcement	entry cost	trade cost	107.73
enforcement	trade cost	entry cost	107.71

Best sequence is trade cost, enforcement, entry cost

Best sequences involve reforming trade cost followed by enforcement.

Welfare gains from 3 reforms

reform #1	reform #2	reform #3	real income (100 = no reform)
trade cost	enforcement	entry cost	107.86
entry cost	trade cost	enforcement	107.85
trade cost	entry cost	enforcement	107.83
entry cost	enforcement	trade cost	107.79
enforcement	entry cost	trade cost	107.73
enforcement	trade cost	entry cost	107.71

Welfare differences are large: 0.14 percent permanent real income, equivalent to 7.3 percent of period 1 consumption to compensate worst sequence.

Compare best and worst reform sequence

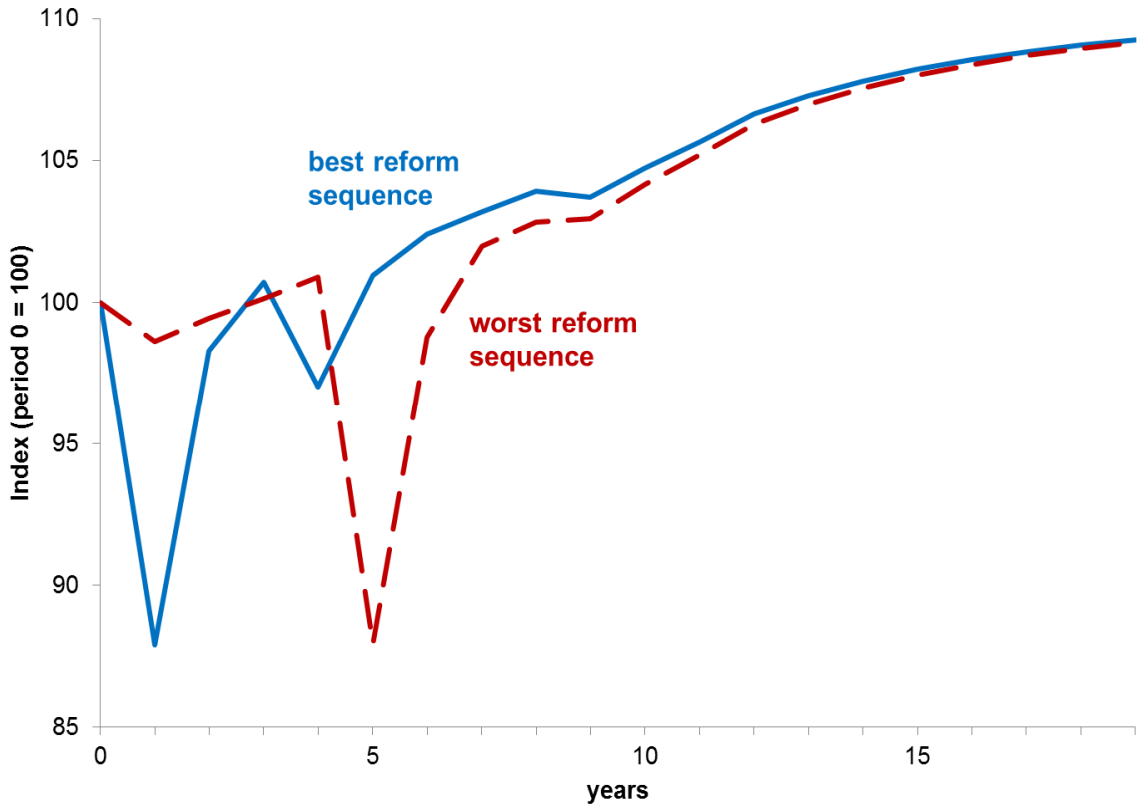
We compare the transition path for the most and least beneficial reform sequence

- best: trade cost, entry cost, enforcement
- worst: enforcement, trade cost, entry cost

We find reducing trade reform increases the mass of exporters and reduces the mass of domestic-only firms.

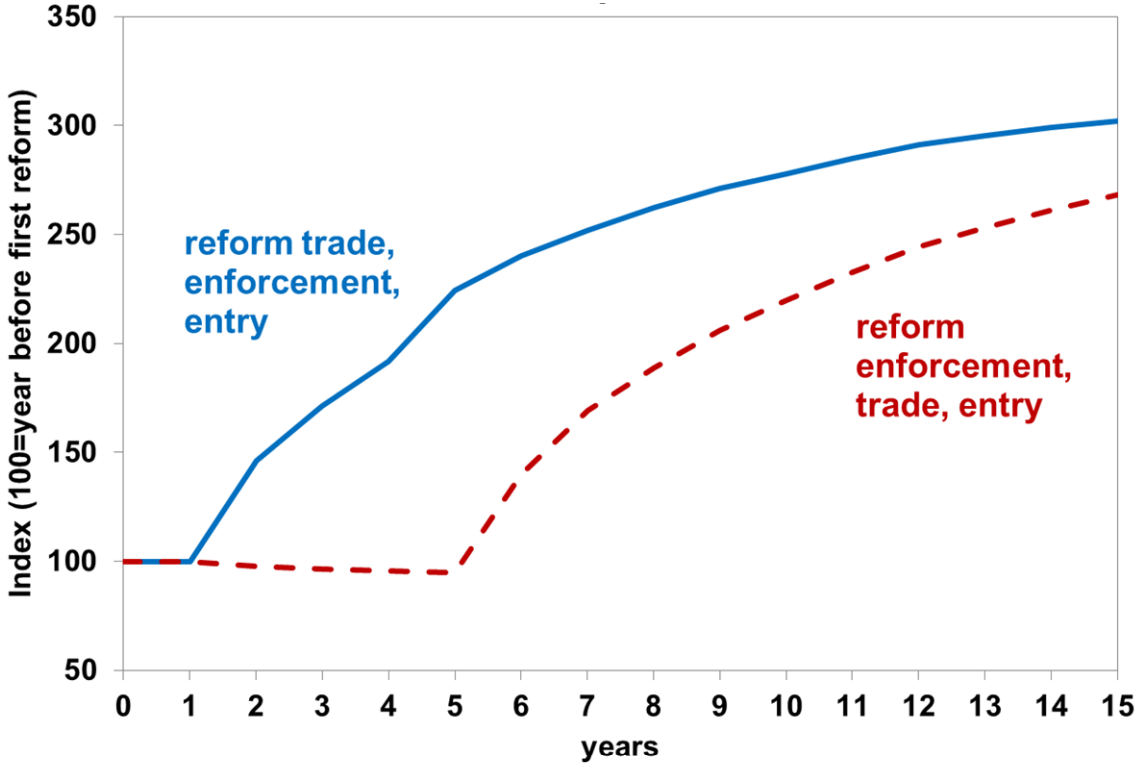
We find enforcement reform increases the mass of domestic-only firms.

Detrended consumption



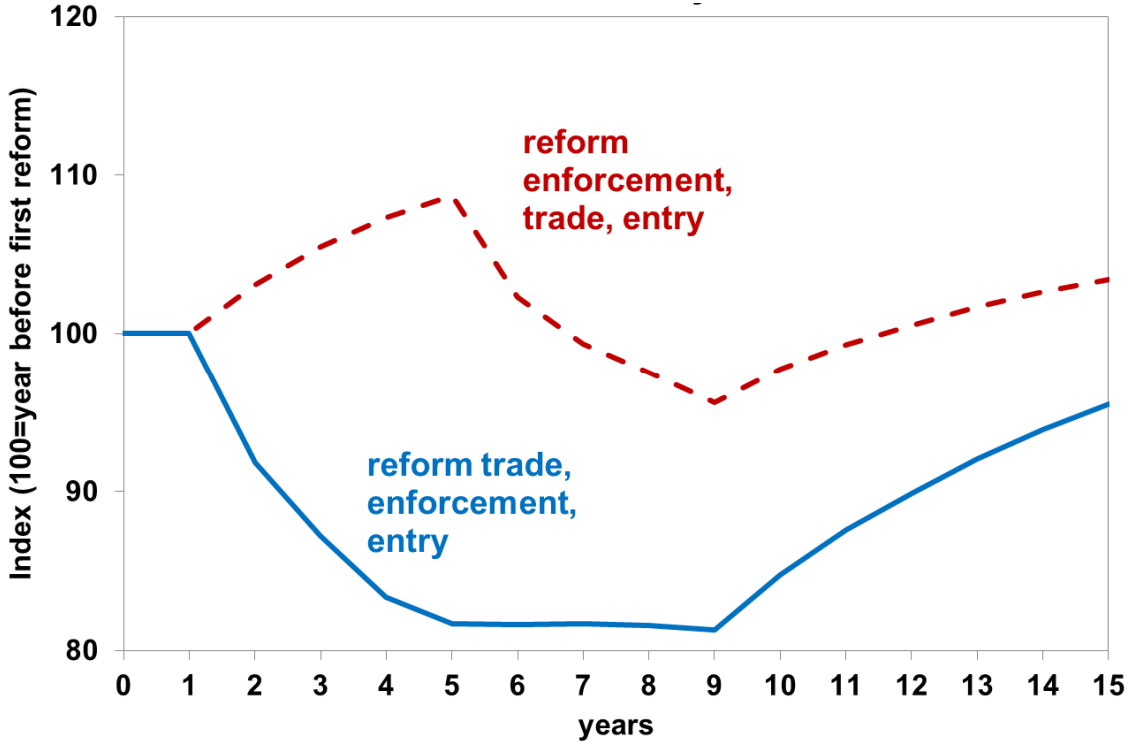
Initial drop in consumption after export reform, but consistently higher consumption afterwards.

Mass of exporters



Trade cost reform leads to increase in the mass of exporters. Differences in timing of trade reform leads to large and persistent differences in the mass of exporters.

Mass of domestic-only firms



Trade reform decreases the mass of unproductive domestic-only firms. Enforcement reform increases the mass of unproductive domestic-only firms.

Conclusion

We construct and calibrate a model with three potential reforms that a government can undertake.

We find that the order in which reforms are implemented matters and that the best reforms are those that reduce trade costs first.

The timing of reforms can lead to welfare differences of 0.14 percent in life-time consumption, equivalent to 7.3 percent of year 1 consumption.