Structural Reforms in Granular Economies

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Introduction

- Structural reforms designed to increase market flexibility are often advocated as part of policy menu to boost economic performance.
  - For instance, Draghi and Lagarde speeches, and many others...
- This paper focuses on product market reforms (reductions in barriers to producer entry) and their consequences in "granular" economies.

Introduction

- Granularity requires fat-tailed distribution of firm size.
- In this environment, idiosyncratic shocks to large firms have aggregate effects (Gabaix, 2011).
- Policy actions that affect the size distribution of operating firms matter for extent to which economy is granular.
  - di Giovanni-Levchenko (2012): Trade integration and Melitz reallocation of market share to large firms.

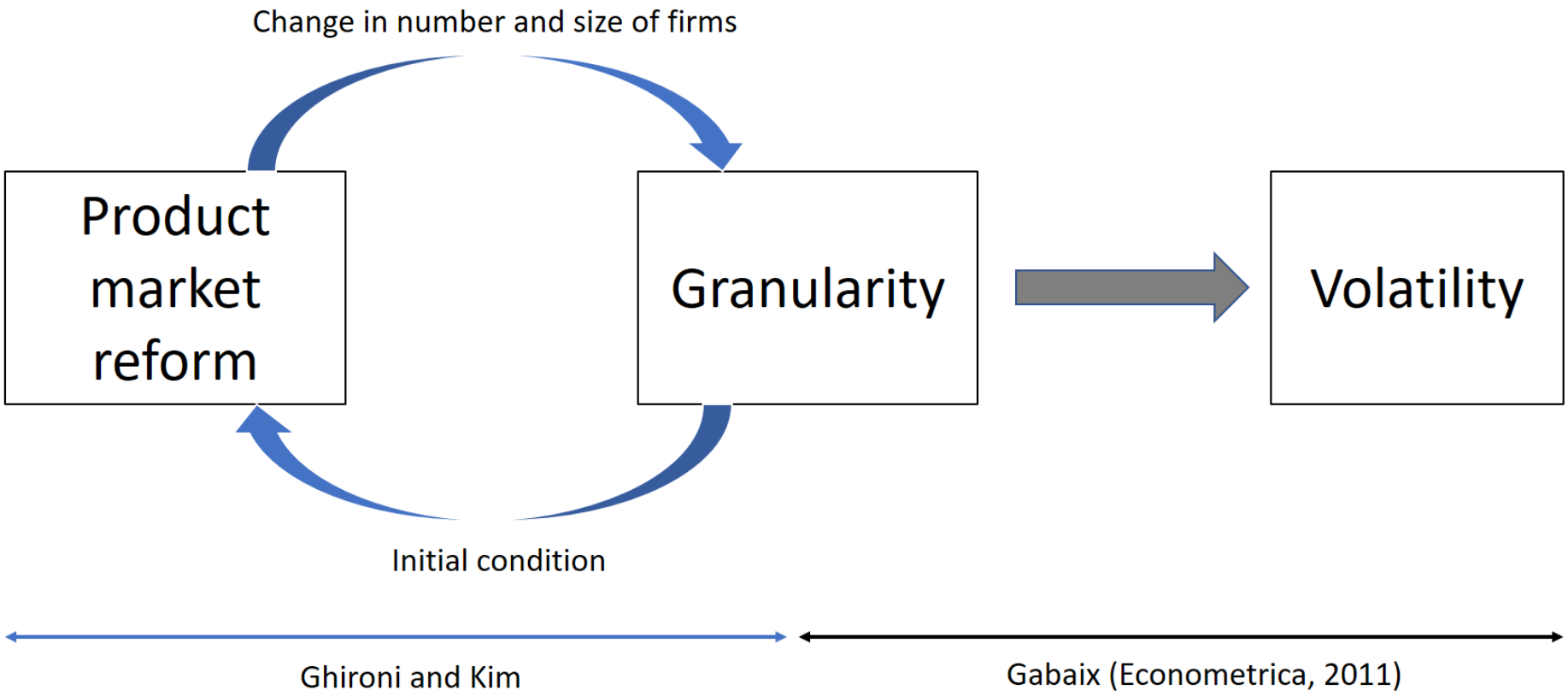
Research questions

- Our interest:

  (1) How do product market reforms propagate over time in granular vs non-granular economies?

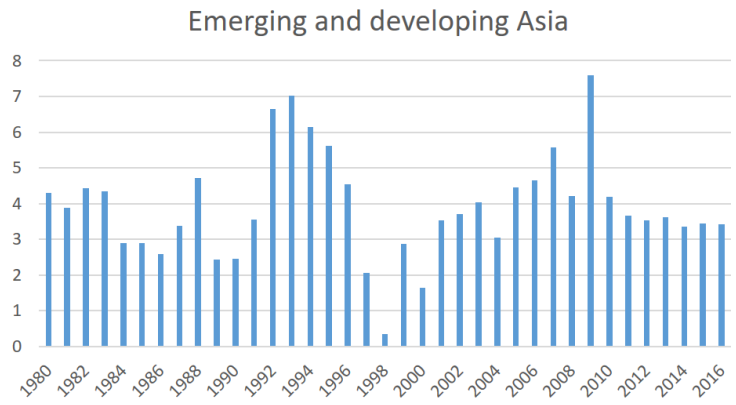
  (2) How do they affect granularity and its consequences?

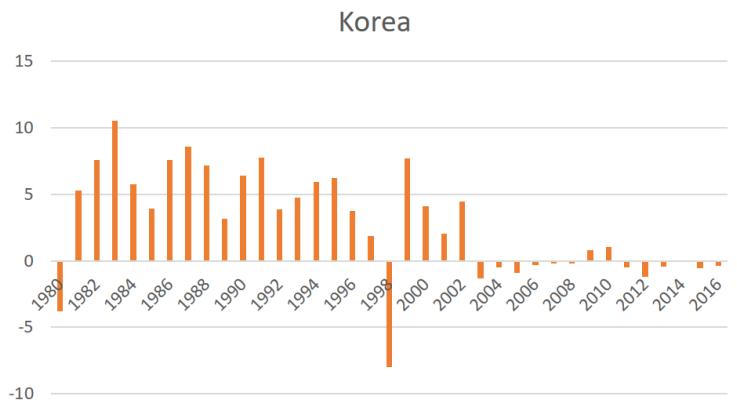
Overview

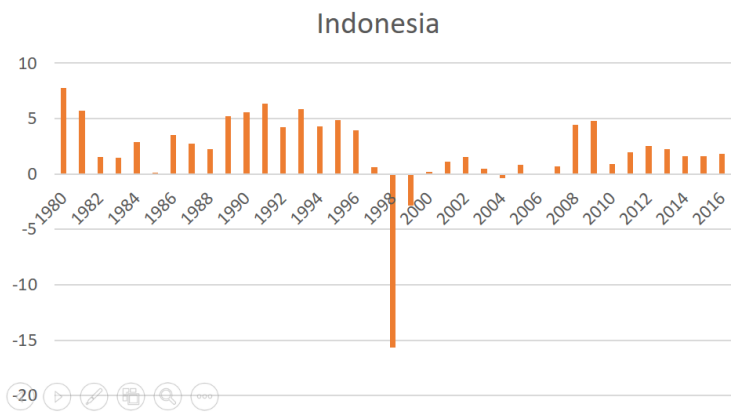

Change in number and size of firms
Product market reform
Granularity
Volatility
Initial condition
Ghironi and Kim
Gabaix (Econometrica, 2011)

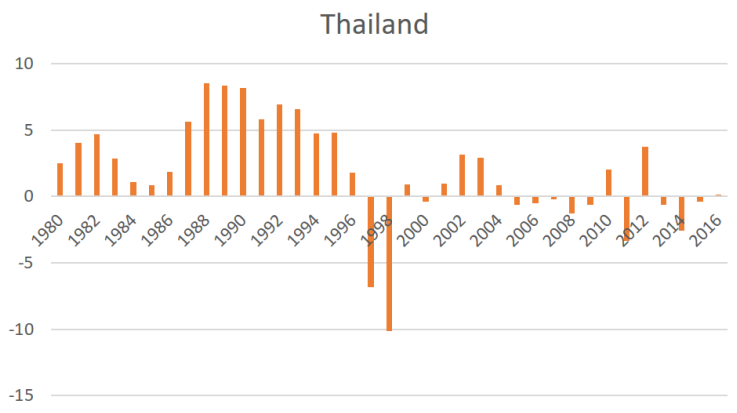
Motivation: Reforms after Asian financial crisis

- After the Asian crisis, countries were asked to implement pro-market reforms.
  - Transition appeared costly, particularly in Korea which is a prime example of granular economy.









Motivation: Entry costs and granularity

- From OECD, WB and Mini Global data for 44 countries, barriers to entry are positively correlated with market concentration.

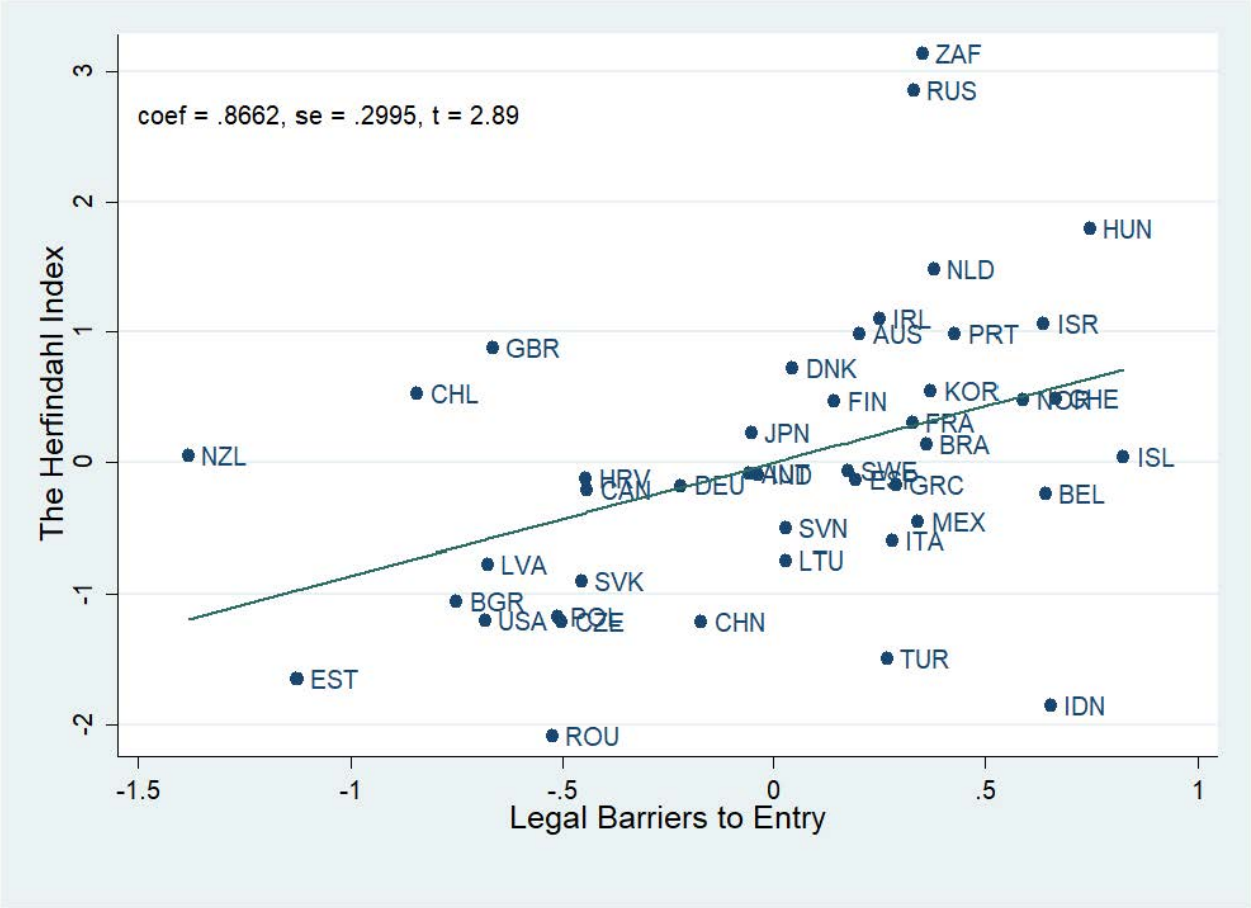


TABLE 1: GRANULARITY AND BARRIERS TO ENTRY

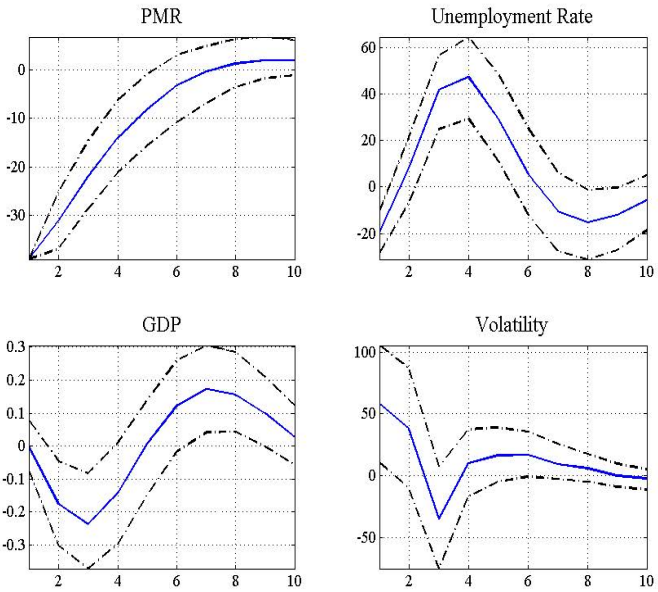
	(1)	(2)	(3)	(4)
Dep. Var: Log(Herfindahl index)				
Log(Legal barriers to entry)	0.536	0.866**	0.825*	0.793*
	(1.56)	(2.89)	(2.67)	(2.58)
Log(Trade-to-GDP ratio)		1.529***	1.715***	1.490**
		(4.26)	(3.67)	(3.01)
Log(GDP share)			0.0853	0.0239
			(0.63)	(0.17)
Log(GDP per capita)				0.222
				(1.29)
Constant	5.451***	-1.104	-1.859	-3.806
	(29.05)	(-0.71)	(-0.94)	(-1.42)
Observations	44	44	44	44
R^2	0.0548	0.3450	0.3514	0.3778

Note: t statistics in parentheses. * significant at 10%, ** at 5%, *** at 1%

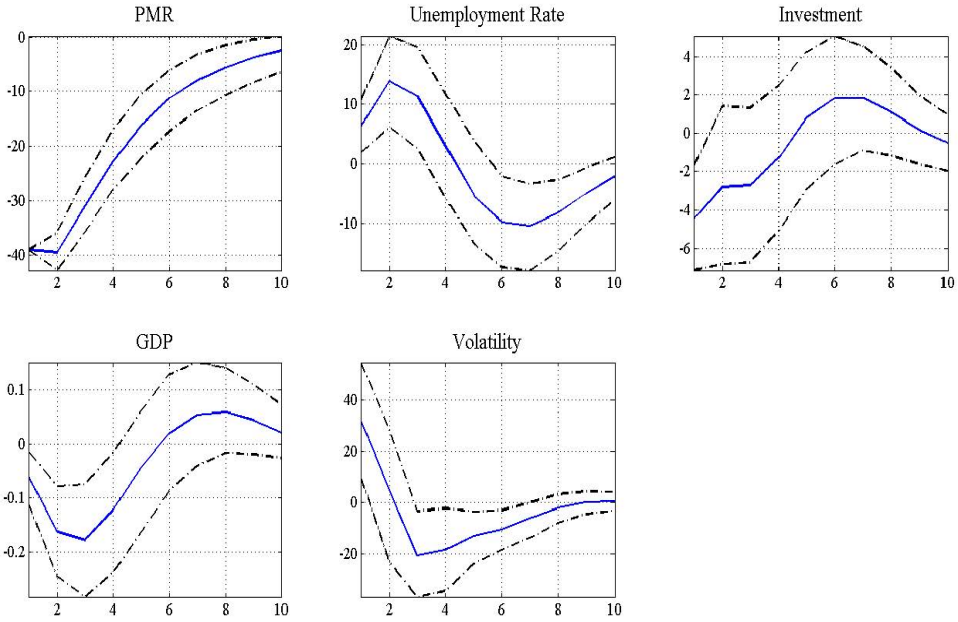
Motivation: Reforms and economic performance under granularity

- More granular group displays stronger "short-term pain" after reforms than less granular group.

(a) Impulse responses from relatively MORE granular countries

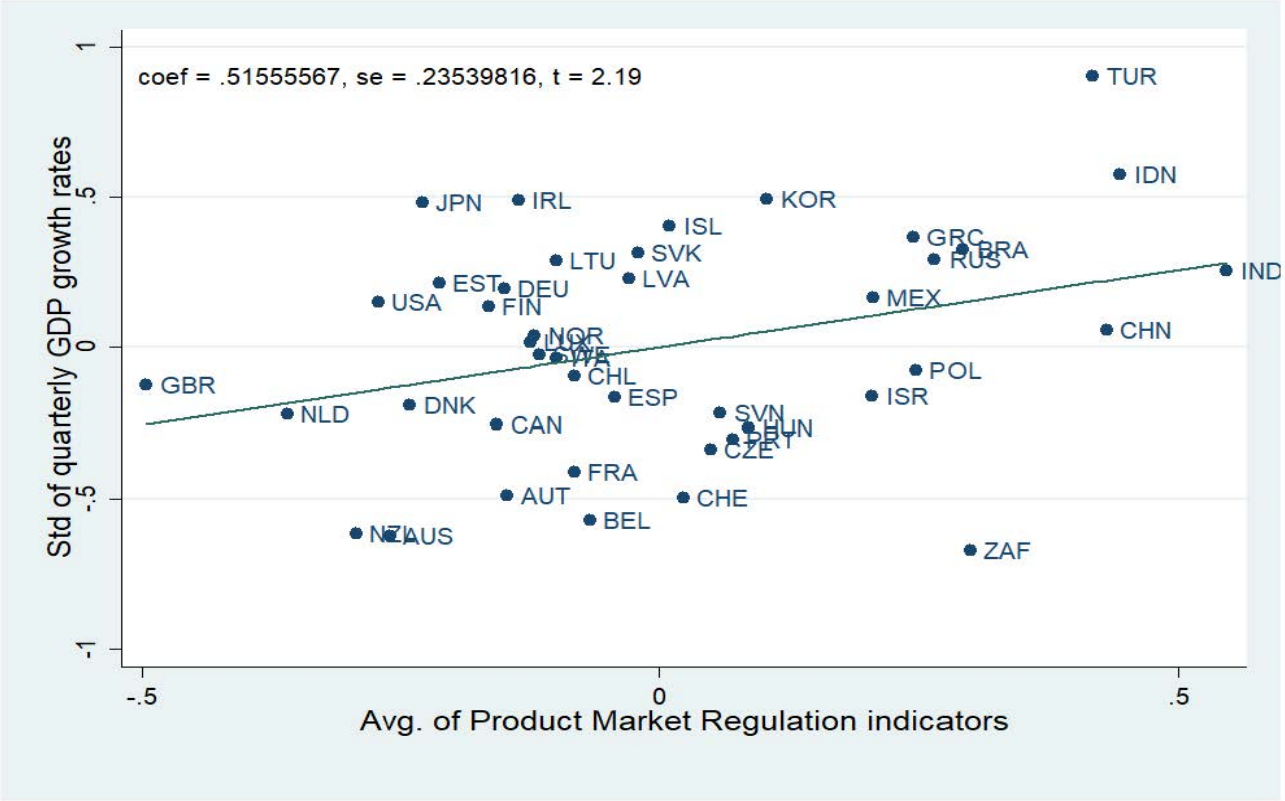


(b) Impulse responses from relatively LESS granular countries



Motivation: Entry costs and volatility

- From data for 42 OECD and non-OECD countries, 1998-2013, product market regulation is positively related to GDP volatility.



- Taken together, these observations suggest that granularity matters for the outcomes of reforms and that policies which affect granularity have implications for fluctuations.

Strategy

- We use a standard macro model with heterogeneous firm dynamics, building on Bilbiie, Ghironi, and Melitz (2012).
- We begin by studying how reforms are propagated and affect the distribution of firm size in absence of idiosyncratic volatility.
  - This is necessary to understand how reforms can affect the environment in which idiosyncratic shocks may have aggregate effects.
- Next, we extend the model to study the effects of idiosyncratic shocks (cheating).

Results

- In the long run, reforms reduce market concentration and are beneficial for productivity and economic performance.
  - Long-run benefits are larger if the economy is granular.
- In the short run, reforms imply transition costs and higher market concentration, the more so in granular economies.
- In the presence of idiosyncratic shocks, reforms can cause higher aggregate volatility along the transition dynamics before eventually delivering the benefit of lower volatility.
- Basic intuition: Immediate effects vs. gradual adjustment in competitive conditions as number of firms evolves over time

Literature

- Granularity and volatility
  - Gabaix (2011): aggregate fluctuations from idiosyncratic shocks under fat-tailed firm distribution.
  - di Giovanni and Levchenko (2012): country size and trade openness in Melitz-Pareto model.
- Structural reforms under various initial conditions
  - Cacciatore et al. (2015, 2016a, 2016b and 2017): Product and labor market reforms in different scenarios for business cycles and their interaction with macro policy.
  - Hamano and Zanetti (2017): Product market reforms with heterogeneity.
  - Patureau and Poilly (2017): Product market reforms, tax policy reforms, and pricing to market.
- No analysis of reforms in granular economies so far.

The model

- We use a modified Ghironi-Melitz (2005) model (or an extended BGM):

  1) Simplify as closed economy version.

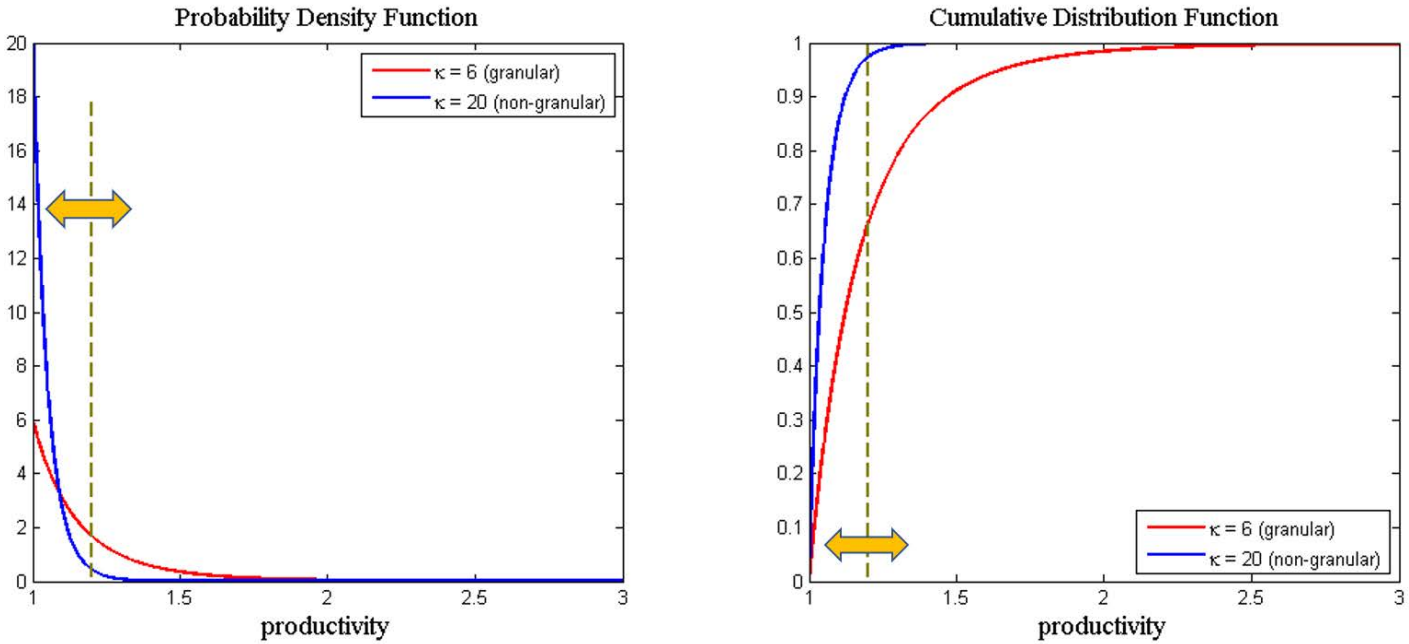
  2) Add fixed production costs.

  3) Control degree of exogenous granularity by varying Pareto shape parameter κ. (Economy is granular if $\frac{\kappa}{\theta-1} \approx 1$)

  4) Size distribution of operating firms will be endogenous.

cf. Pareto distribution

- As the shape parameter κ decreases, the distribution of possible productivity draws becomes fat-tailed.
- As reforms take place, the size distribution of operating firms changes.



Notes: Blue(non-granular), Red(granular), and Yellow(cutoff productivity) under the value of $\theta = 6$.

The model: households

- The representative household supplies L units of labor inelastically in each period and maximizes the expected intertemporal utility

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} \frac{C_s^{1-\gamma}}{1-\gamma}$$

subject to

$$C_t + \tilde{e}_t(N_t + N_{E,t})x_{t+1} = \left((1 - G(z_t^c))\tilde{d}_t + \tilde{e}_t\right) N_t x_t + w_t L$$

- The household consumes the basket of goods C_t, defined over a continuum of goods Ω

$$C_t = \left(\int_{\omega \in \Omega} c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}$$

The model: firms

- Each monopolistically competitive firm z produces a differentiated output with only labor and faces a fixed production cost of $f_{X,t}$ units of consumption.
- Firm-specific productivity z, drawn upon entry, is distributed Pareto with lower bound z_{min} and shape parameter $\kappa > \theta - 1$.
- A firm z sets profit maximizing price

$$\rho_t(z) = \frac{\theta}{\theta - 1} \frac{w_t}{z_t Z_t}$$

and its profit is given by

$$d_t(z) = \frac{1}{\theta} \rho_t(z)^{1-\theta} Y_t^c - f_{X,t}$$

where Z_t is an exogenous aggregate productivity.

The model: cutoff productivity

- Due to the existence of fixed production cost, firm z produces if and only if $d_t(z) > 0$. Otherwise, the firm is switched off without losing its sunk investment.
- Cutoff productivity z_t^c is defined by

$$z_t^c = inf\{z : d_t(z) > 0\}$$

- Then, average productivity of firms producing in period t is

$$\tilde{z}_t = \left(\frac{1}{1 - G(z_t^c)} \int_{z_t^c}^{\infty} z^{\theta-1} dG(z) \right)^{\frac{1}{\theta-1}} = \nu z_t^c$$

where $\nu = \left(\frac{\kappa}{\kappa-(\theta-1)} \right)^{\frac{1}{\theta-1}}$

The model: entry and exit

- Entry occurs until the expected post-entry value

$$\tilde{e}_t \equiv E_t \sum_{s=t}^{\infty} \beta_{t,s}(1-\delta)^{s-t}(1-G(z_s^c))\tilde{d}_s$$

  equals a sunk entry cost $f_{E,t}$ (in units of effective labor).
- Firms can be hit by exogenous exit shock with probability δ at the end of each period.
- Given one-period time-to-build lag, the total number of firms (active and idle) obeys the law of motion:

$$N_t = (1-\delta)(N_{t-1} + N_{E,t-1})$$

The model: aggregate accounting

- Define aggregate demand for the consumption bundle as the sum of household consumption and the use of the bundle by operating firms to cover fixed costs:

$$Y_t^c = C_t + N_t \left(\frac{z_{min}}{z_t^c} \right)^{\kappa} f_{X,t}$$

- Aggregating the budget constraint across households and imposing equity market equilibrium ($x_{t+1} = x_t = 1$) yields

$$Y_t^c + N_{E,t} \tilde{e}_t = w_t L + N_t \left(\frac{z_{min}}{z_t^c} \right)^{\kappa} \tilde{d}_t$$

  - Reminder: Only operating firms actually distribute dividends.

The model: summary

Model summary

Cutoff productivity	$z_t^c = \frac{\theta}{\theta-1}\frac{w_t}{Z_t}\left(\frac{\theta f_{X,t}}{Y_t^c}\right)^{\frac{1}{\theta-1}}$
Average productivity	$\tilde{z}_t = \nu z_t^c$
Average price of goods	$\tilde{\rho}_t = \frac{\theta}{\theta-1}\frac{w_t}{\tilde{z}_t Z_t}$
Average profit	$\tilde{d}_t = \frac{1}{\theta}\tilde{\rho}_t^{1-\theta} Y_t^c - f_{X,t}$
Free entry	$\tilde{e}_t = \frac{w_t}{Z_t} f_{E,t}$
Number of firms	$N_t = (1-\delta)(N_{t-1} + N_{E,t-1})$
Price index	$1 = \tilde{\rho}_t^{1-\theta} N_t \left(\frac{z_{min}}{z_t^c}\right)^{\kappa}$
Euler equation (shares)	$\tilde{e}_t = \beta(1-\delta)E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}(\tilde{e}_{t+1} + \left(\frac{z_{min}}{z_{t+1}^c}\right)^{\kappa}\tilde{d}_{t+1})\right]$
Aggregate accounting	$C_t + N_t\left(\frac{z_{min}}{z_t^c}\right)^{\kappa} f_{X,t} = w_t + N_t\left(\frac{z_{min}}{z_t^c}\right)^{\kappa}\tilde{d}_t - N_{E,t}\tilde{e}_t$
Agg. demand for consumption goods	$Y_t^c = C_t + N_t\left(\frac{z_{min}}{z_t^c}\right)^{\kappa} f_{X,t}$

Steady state

- The steady-state levels of key variables we are interested in are

1) $N = \frac{\alpha Z}{f_E}$

2) $N_o = N(\frac{z_{min}}{z^c})^{\kappa} = \left[(\alpha Z)^{\kappa+1} \frac{\zeta^{\kappa}}{f_X^{\kappa} f_E}\right]^{\frac{\theta-1}{\kappa(\theta-2)+(\theta-1)}}$

3) $\tilde{d} = (\nu^{\theta-1} - 1) f_X$

4) $z^c = \left[\frac{f_X^{\theta-1}}{\alpha \zeta^{\theta-1} f_E^{\theta-2} Z}\right]^{\frac{1}{\kappa(\theta-2)+(\theta-1)}}$

5) $C = (\theta \nu^{\theta-1} - 1)\left[\frac{\zeta^{\kappa(\theta-1)} (\alpha Z)^{(\kappa+1)(\theta-1)}}{f_E^{\theta-1} f_X^{\kappa-\theta+1}}\right]^{\frac{1}{\kappa(\theta-2)+(\theta-1)}}$

where $\alpha = \frac{(1-\nu^{1-\theta})\beta(1-\delta)}{\theta(1-\beta(1-\delta))-(1-\beta)(1-\nu^{1-\theta})} > 0$, $\zeta = \left(\frac{\theta-1}{\theta}\right)\left(\frac{1-\beta(1-\delta)}{\beta(1-\delta)}\right)\left(\frac{\nu}{\nu^{\theta-1}-1}\right) > 0$

Steady-state effects of reforms

- Lowering entry costs eventually leads to higher cutoff, larger number of firms and more consumption:

$$\frac{\partial z^c}{\partial f_E}, \frac{\partial N}{\partial f_E}, \frac{\partial N_o}{\partial f_E}, \text{ and } \frac{\partial C}{\partial f_E} < 0$$

$$\frac{\partial \tilde{d}}{\partial f_E} = 0$$

- According to the Herfindahl index definition:

$$HHI_t = \frac{\theta(\kappa - (\theta - 1))}{\kappa - 2(\theta - 1)} \frac{f_{X,t}}{Y_t^c}$$

$$\frac{\partial HHI}{\partial f_E} > 0$$

Intuition

- The intuition is straightforward.

  1) N increases as new firms enter following $f_E \downarrow$.

  2) Increased competition raises z^c and $\tilde{z}$, but expansion of N prevails in determining higher N_o.

  3) $N_o \uparrow$ with $\tilde{z} \uparrow$ leads to increase in production, wage and C.

  4) $\tilde{d}$ stands still because bigger Y^c and smaller market share per firm offset.

  5) Larger N_o prevails on higher z^c in inducing lower concentration in the long run, reforms make the economy more productive ($\tilde{z} \uparrow$) and increase in consumption ($C \uparrow$), they reduce granularity ($HHI \downarrow$).

Transition dynamics

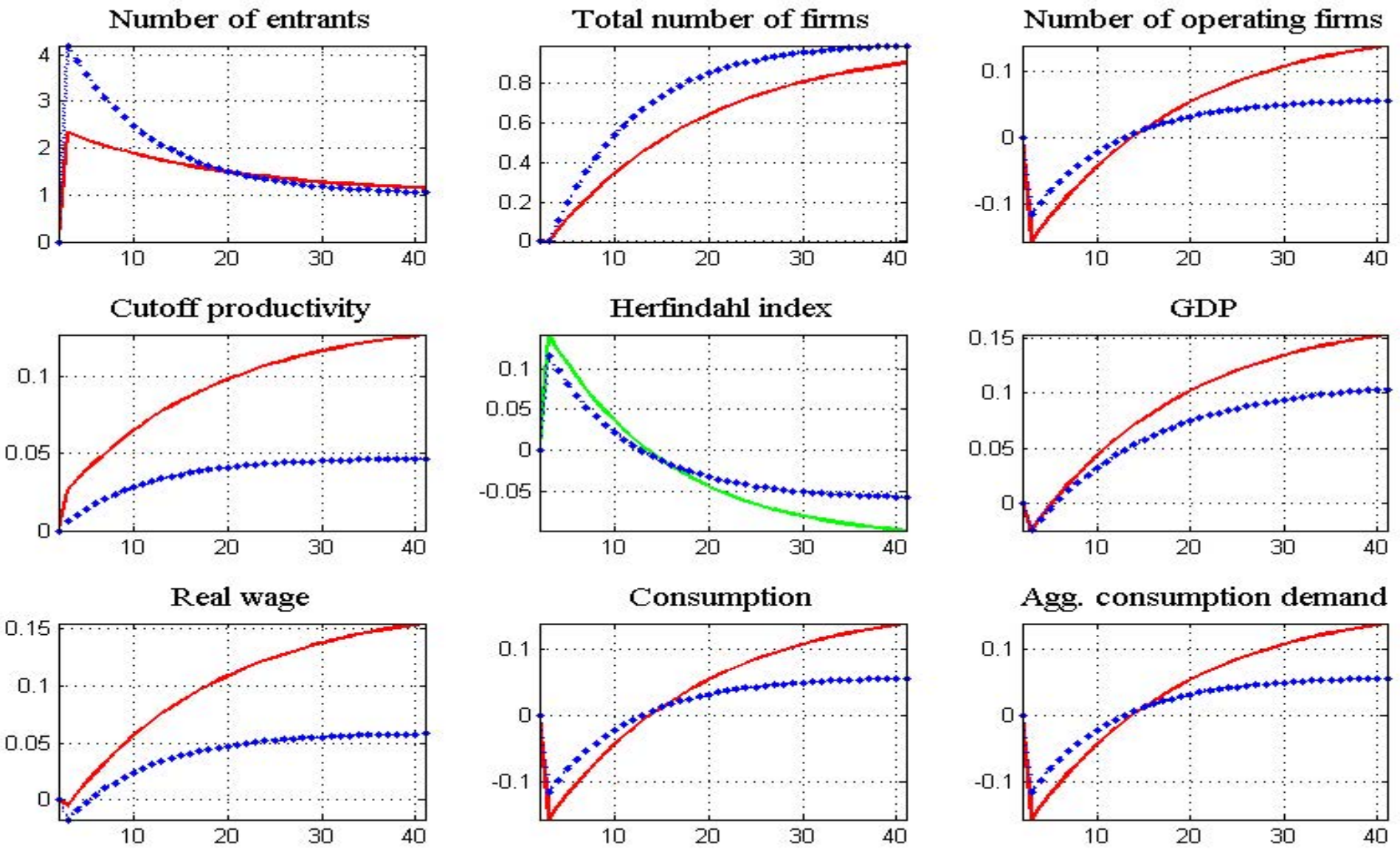
- We analyze short- to medium-term dynamics triggered by reform by means of simulation.
  - We can solve the log-linearized model analytically, but we focus on illustration here.
- We compare the dynamics in a "granular" (κ=6) scenario to those in a non-granular one (κ=20).
  - Granular economy: $1 < \kappa\,/(\theta\text{-}1) < 2$

Calibration

Table2. Parameter setting

Risk aversion	$\gamma = 2$	Discount factor	$\beta = 0.99$
Elasticity of substitution	$\theta = 6$	Producer exit	$\delta = 0.01$
Pareto support	$z_{min} = 1$	Aggregate productivity	$Z = 1$
Producer entry cost	$f_E = 1$	fixed production cost	$\mathrm{fE}/f_X = 4.5$

Simulation result



Intuition

- The changes in z^c and N are most important to understand the mechanism.

  1) In the short run, $N_o \downarrow$ because $z^c \uparrow$ is immediate and $N \uparrow$ is gradual.

$$N_{o,t} = N_t \left(\frac{z_{min}}{z_t^c} \right)^{\kappa}, \quad N_t = (1-\delta)(N_{t-1} + N_{E,t-1})$$

  2) Combined with $C \downarrow$ for financing new entrants, GDP $\downarrow$.

  3) $z^c \Uparrow$ in a granular economy: average size of entrants is bigger and so is the marginal impact of new entry on firms' survival.

  4) Due to $N_o \Downarrow$, the economu experiences deeper contraction as well as more concentration of activity in the immediate aftermath of reform.

Intuition: continued

- Over time,

  1) As the increase in z^c slows down, $N \uparrow$ leads into $N_o \uparrow$.

  2) The rate of increase in N_o is slower in the non-granular economy, due to its larger portion of small entrants.

  3) Also, the granular economy gains $\tilde{z} \Uparrow$ from $z^c \Uparrow$

  4) The $N_o \Uparrow$ and $\tilde{z} \Uparrow$ brings more expansionary effect, and market concentration decreases by more in the granular economy.

- Bottom line: Reforms in granular economies likely associated with larger long-run gain, but also more short-run pain.

Summary

Comparison short- and long-term effects of reforms

	Short-run		Long-run	
Degree of Granularity	granular	non-granular	granular	non-granular
Cutoff productivity	$z_t^c \Uparrow$	$z_t^c \uparrow$	$z_t^c \Uparrow$	$z_t^c \uparrow$
Average productivity	$\tilde{z}_t \Uparrow$	$\tilde{z}_t \uparrow$	$\tilde{z}_t \Uparrow$	$\tilde{z}_t \uparrow$
Number of firms	$N_t \uparrow$	$N_t \Uparrow$	$N_t \uparrow$	$N_t \Uparrow$
Number of operating firms	$N_{o,t} \Downarrow$	$N_{o,t} \downarrow$	$N_{o,t} \Uparrow$	$N_{o,t} \uparrow$
Consumption	$C_t \Downarrow$	$C_t \downarrow$	$C_t \Uparrow$	$C_t \uparrow$
Market concentration	$\Uparrow$	$\uparrow$	$\Downarrow$	$\downarrow$

Relevant empirical study

- Marrazzo and Terzi (2017) suggests that emerging economies experience bigger short-term pain from reforms, but reap more benefits than advanced countries in the long-run.

	post-reform effect		
		short term	*long term*
in p.p		[t, t+4]	[t+5, t+10]
23 reform episodes: full sample			
Divergence between reformers and control	1.022***	-0.336	1.556**
	(0.38)	(0.68)	(0.63)
18 reform episodes: emerging markets			
Divergence between reformers and control	1.123**	-0.651	1.831**
	(0.48)	(0.86)	(0.79)
5 reform episodes: advanced economies			
Divergence between reformers and control	0.656***	0.796**	0.570
	(0.18)	(0.40)	(0.38)

Notes: β_1 coefficients of Model [6] after the reform, subdivided in short- and long term. Positive values indicate a widening gap between reformers and control. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. See text for additional details.

Reforms and volatility

- By affecting N_o, z^c, and the economy's market concentration (HHI), reforms cause the extent to which the economy is granular to vary over time.
- Since HHI initially rises before its eventual decrease, the impact of idiosyncratic shocks on the aggregate economy in a granular environment may initially be magnified before eventually becoming smaller.
- We explore this intuition next by extending the model to account for idiosyncratic volatility.

Model extension: idiosyncratic shocks

- We add idiosyncratic shock $a_t(\omega)$, which is an i.i.d. draw from a time-invariant distribution.
- A firm's productivity is determined not only by $z_t(\omega)$, but also by $a_t(\omega)$.
- Firm ω's profit-maximizing price becomes

$$\rho_t(\omega) = \frac{\theta}{\theta - 1} \frac{w_t}{Z_t z_t(\omega) a_t(\omega)}$$

Model extension: assumptions

- di Giovanni and Levchenko (2012) assumptions:

  Assumption 1: The marginal firm is small enough that it ignores the impact of its own realization of $a_t(\omega)$ on the total expenditure (X_t) and the price level (P_t) of the economy.

  Assumption 2: The marginal firm treats X_t and P_t as fixed.

Gabaix (2011) and di Giovanni-Levchenko (2012): discrete environment.
Gabaix: no model of firm behavior.
di Giovanni-Levchenko shortcut: assumptions consistent with continuity.
We take continuity as (rough?) approximation to discrete environment.
See Al-Najjar (1995).

Aggregate volatility

- As di Giovanni and Levchenko (2012), we compute the economy's aggregate volatility as:

$$Var_a\left(\frac{\triangle X_t}{E_a X_t}\right) = \sigma^2 HHI_t$$

where σ is the standard deviation of the growth rate of individual firm sales.

- In the presence of idiosyncratic shocks, the Herfindahl index in our model can be calculated as follows:

$$\int_\omega \left(\frac{E_a\left[x_t(z,a)\right]}{E_a X_t}\right)^2 d\omega = N_{o,t}\frac{1}{1-G(z_t^c)}\int_{z_t^c}^{\infty}\left(\frac{E_a\left[x_t(z,a)\right]}{E_a X_t}\right)^2 dG(z)$$

The Herfindahl index

- Since the expected share of a firm's revenue is

$$\frac{E_a\left[x_t(z,a)\right]}{E_a X_t} = \frac{\left(\frac{\theta}{\theta-1}\frac{w_t}{Z_t z}\right)^{1-\theta} X_t}{X_t} = \left(\frac{\theta}{\theta-1}\frac{w_t}{Z_t z}\right)^{1-\theta}$$

- The Herfindahl index becomes

$$HHI_t = N_{o,t}\frac{1}{1-G(z_t^c)}\int_{z_t^c}^{\infty}\left(\frac{\theta-1}{\theta}\frac{Z_t z}{w_t}\right)^{2(\theta-1)} dG(z)$$

$$= N_{o,t}\left(\frac{\theta-1}{\theta}\frac{Z_t}{w_t}\right)^{2(\theta-1)}\frac{1}{1-G(z_t^c)}\int_{z_t^c}^{\infty} z^{2(\theta-1)} dG(z)$$

The Herfindahl index

- Then, if $\kappa / (\theta - 1) > 2$, $HHI_t = \frac{\theta(\kappa - (\theta - 1))}{\kappa - 2(\theta - 1)} \frac{f_{X,t}}{Y_t^c}$

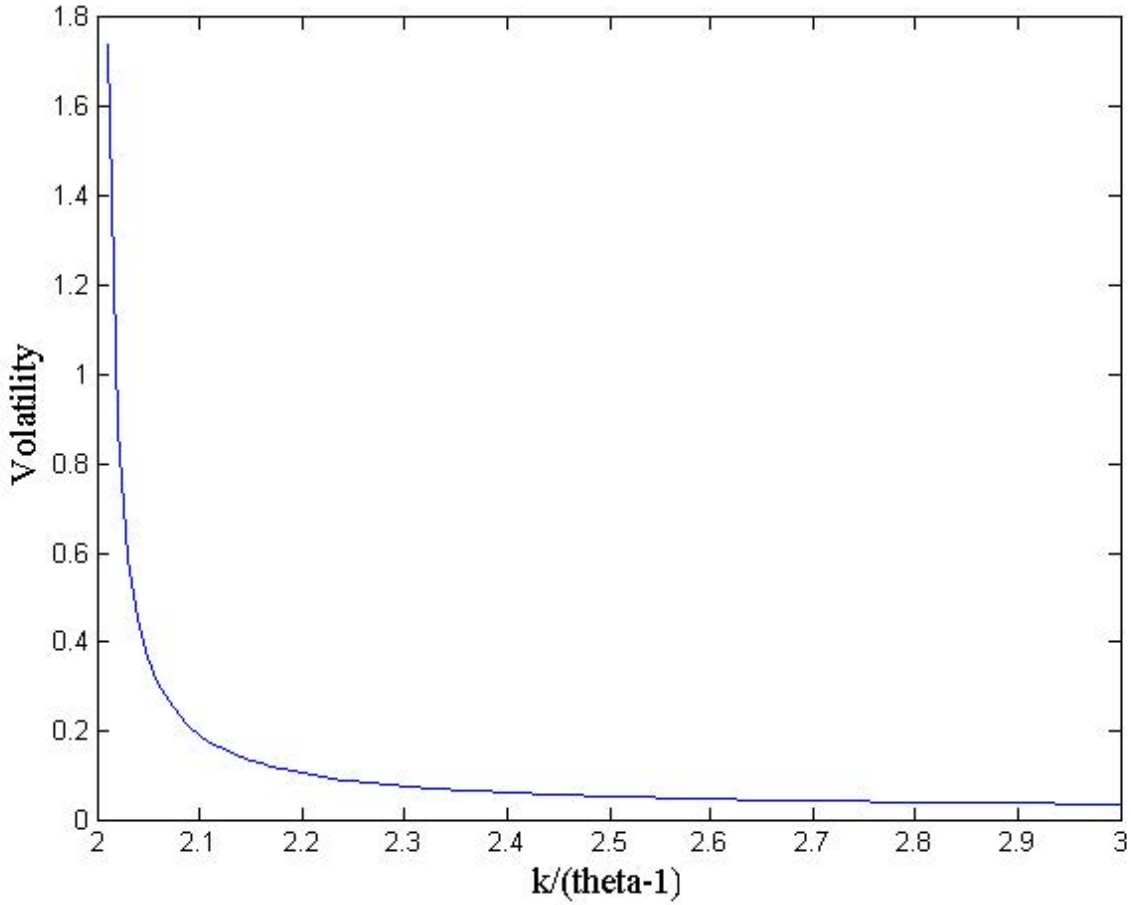
and

$$Var_a\left(\frac{\triangle X_t}{E_a X_t}\right) = \sigma^2\left(\frac{\theta(\kappa - (\theta - 1))}{\kappa - 2(\theta - 1)} \frac{f_{X,t}}{Y_t^c}\right)$$

- Note 1: Higher aggregate consumption demand is associated with lower HHI and volatility.
- Note 2: Higher fixed costs are intuitively associated with more concentration and volatility.

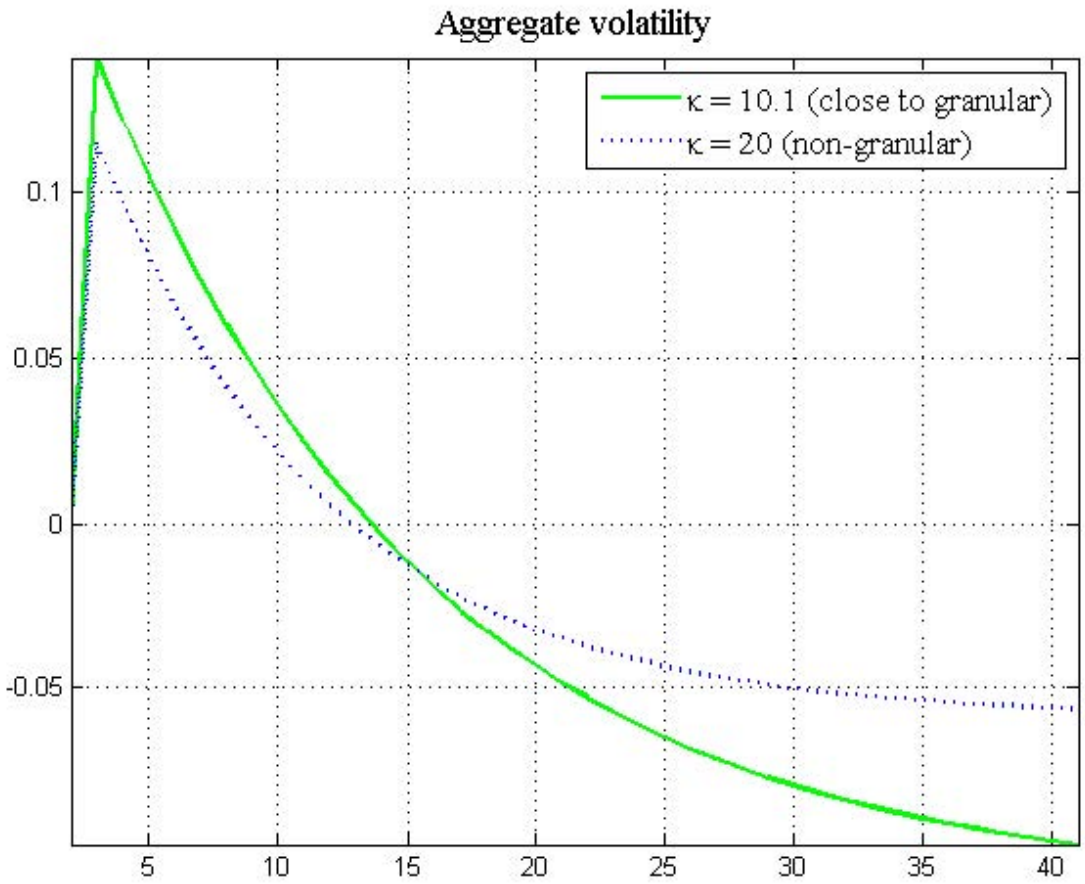
Volatility depending on the degree of granularity

- *Ceteris paribus*, holding Y^c and f_x constant, aggregate volatility increases exponentially as $\frac{\kappa}{\theta-1}$ approaches the threshold of granularity.



Aggregate volatility after reform

- Impulse response of aggregate volatility:



Intuition

- Product market reform affects volatility through its impact on Y^c and market concentration.

  1) Y^c initially falls (HHI rises), leading to initially larger exposure to idiosyncratic volatility.

  2) Over time, Y^c rises (HHI falls) making the economy more resilient to idiosyncratic shocks.

- The marginal impact of reform is larger in a (more) granular economy.

Conclusion

- We studied the effect of product market reforms in "granular" economies.
- Reforms are beneficial in terms of productivity, market concentration, consumption, and output in the long run.
- However, they can exacerbate the consequences of granularity in the short run.