Country Size, International Trade and Aggregate Fluctuations in Granular Economies

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Motivation I

- Macroeconomic volatility affects:
  - Long-run growth (Ramey and Ramey 1995)
  - Welfare (Pallage and Robe 2003, Barlevy 2004)
  - Inequality and poverty (Gavin and Hausmann 1998, Laursen and Mahajan 2005)
- What is the relationship between trade openness and macroeconomic volatility?
  - Rodrik (1997) among others argue that there is a positive relationship
- Two features of the data:
  - Smaller countries tend to be more volatile
  - More open countries tend to be more volatile

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Motivation II

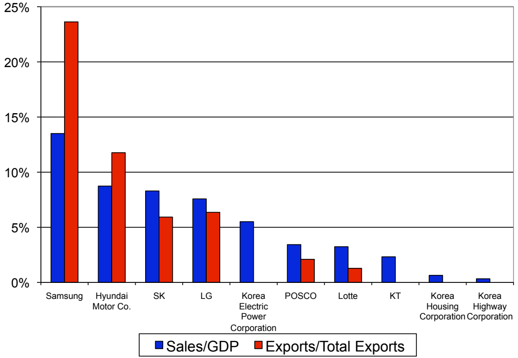
- *In macroeconomics*, the role of large firms in generating aggregate fluctuations has received renewed attention (Gabaix, 2010, Comin and Philippon, 2005)
  - Empirically, is appears that the firm size distribution follows a power law with exponent close to -1
  - With such a skewed distribution of firm size, shocks to individual firms can generate aggregate fluctuations: *granular fluctuations*
- *In international trade*, the role of (large) firms has been the focus, both theoretically (e.g. Melitz, 2003), and empirically (e.g. Bernard et al., 2007)
  - Openness to trade allows the largest firms to grow even larger relative to the domestic economy

Example 1

- In New Zealand one firm – Fonterra – is responsible for a full one-third of global dairy exports (it is the world's single largest exporter of dairy products)
- The macroeconomy:
  - Fonterra accounts for 20% of New Zealand's overall exports, and 7% of its GDP
- International trade:
  - 95% of Fonterra's output is exported
  - The second largest producer of dairy products in New Zealand is 1.3% the size of Fonterra

Example 2

- In Korea, the 10 largest business groups account for 54% of GDP, and 51% of total exports
- Even within the top 10, the distribution of firm size and total exports is extremely skewed
  - The largest one, Samsung, is responsible for 23% of exports and 14% of GDP



This Paper

- Main idea: openness to trade will increase aggregate volatility by making the largest firms more important, and therefore the economy more granular
- Size of the economy also plays a crucial role in explaining how important granularity is, and what impact trade will have
- Study the quantitative relationship between country size, openness, and firm-level and aggregate volatility in a 50-country calibrated model of trade

Preview of Results

The model fits the data well:

- It matches
  - Bilateral and overall trade volumes
  - Relationship between firm-level distribution and country size across countries
  - Firm export participation for several countries
- Reproduces the observed relationship between country size and volatility
  - A country that accounts for 0.5% of world GDP (Poland, South Africa) is predicted to have granular volatility 2 times higher than the U.S.

Preview of Results: Quantitative Implications

- Compared to complete autarky, the contribution of international trade to aggregate volatility depends strongly on country size and remoteness
  - Granular volatility in the U.S. is only 1.035 times what it would have been in autarky
  - Granular volatility in South Africa, or New Zealand (small open economy, but remote) is about 1.1 times its autarky value
  - Granular volatility in Denmark, Romania (small open economy, close) is about 1.2 times its autarky value
- A further 50% reduction in iceberg trade costs has a non-mononotic impact on granular volatility: –2.7%-8.4%
  - "Net entry effect": –ve impact
  - "Selection effect": +ve impact

Related Literature

- Key building blocks: Melitz (2003), Gabaix (2010)/Axtell (2001)
- Trade, production structure, and the macroeconomy:
    - di Giovanni and Levchenko (2009, 2010): trade openness, specialization, and volatility
    - Ghironi and Melitz (2005), Alessandria and Choi (2007): extensive margin of trade and pricing puzzles
    - Canals, Gabaix, Vilarrubia, and Weinstein (2007): undiversified trade and current account movements

Preferences

- Melitz (2003), with an explicit non-traded sector
- $\mathcal{C}$ countries, indexed by $i, j = 1, \ldots, \mathcal{C}$
- In country i, consumers maximize:

$$\max_{\{c_i^N, c_i^T\}} \left(\sum_{k=1}^{J_i^N} c_i^N(k)^{\frac{\varepsilon_N - 1}{\varepsilon_N}} \right)^{\frac{\alpha \varepsilon_N}{\varepsilon_N - 1}} \left(\sum_{k=1}^{J_i^T} c_i^T(k)^{\frac{\varepsilon_T - 1}{\varepsilon_T}} \right)^{\frac{(1-\alpha)\varepsilon_T}{\varepsilon_T - 1}}$$

$$s.t.$$

$$\sum_{k=1}^{J_i^N} p_i^N(k)\, c_i^N(k) + \sum_{k=1}^{J_i^T} p_i^T(k)\, c_i(k) = Y_i,$$

Technology I

- One factor of production, labor, with country endowments L_i, $i = 1, \ldots, \mathcal{C}$
- Production in both sectors uses both labor and CES composites of N and T as intermediate inputs $\Longrightarrow$ an input bundle in country i and sector s has a cost

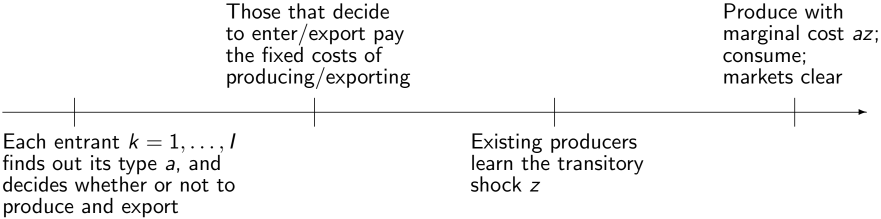
$$c_i^s = w_i^{\beta_s} \left[\left(P_i^N \right)^{\eta_s} \left(P_i^T \right)^{1-\eta_s} \right]^{1-\beta_s}$$

- Each country has an endogenous number of potential (but not actual) entrepreneurs in each sector, $s = N, T$, $\bar{I}_i^s$
  - Each potential entrepreneur can produce a unique CES variety, and thus has some market power
  - Productivity is heterogeneous across entrepreneurs

Technology II

- Sunk cost, f_e paid to discover productivity type
- Both fixed and variable costs of production and trade. Entrepreneur in country i:
  - decides whether to pay f_{ii} to start producing/selling at home
  - decides whether to pay f_{ji} to serve market j
  - trade from i to j is subject to iceberg costs $\tau_{ji} > 1$ ($\tau_{ii} = 1$)

Timing


Those that decide to enter/export pay the fixed costs of producing/exporting
Produce with marginal cost az; consume; markets clear
Each entrant $k = 1, \ldots, I$ finds out its type a, and decides whether or not to produce and export
Existing producers learn the transitory shock z

Assumptions

Assumption 1

The marginal entrepreneur is small enough that it ignores the impact of its own realization of $z(k)$ on the total expenditure X_i and the price level P_i in all potential destination markets $i = 1, \ldots, N$

Assumption 2

The marginal entrepreneur treats X_i and P_i as fixed (non-stochastic)

Assumption 3

Labor productivity, $1/a$, is Pareto(b, θ), where b is the minimum value labor productivity can take, and θ regulates dispersion

Production Allocation I

- Cutoff for exporting from j to i:

$$a_{ij}^s = \frac{\varepsilon_s - 1}{\varepsilon_s} \frac{P_i^s}{\tau_{ij} c_j^s} \left(\frac{X_i^s}{\varepsilon_s c_j f_{ij}^s} \right)^{\frac{1}{\varepsilon_s - 1}} \left[\mathrm{E}_z \left(z^{1-\varepsilon} \right) \right]^{\frac{1}{\varepsilon_s - 1}}$$

$$= \frac{\varepsilon_s - 1}{\varepsilon_s} \frac{P_i^s}{\tau_{ij} c_j^s} \left(\frac{X_i^s}{\varepsilon_s c_j^s f_{ij}^s} \right)^{\frac{1}{\varepsilon_s - 1}}$$

- The price levels:

$$P_i^N = \frac{1}{b_N} \left[\frac{\theta_N}{\theta_N - (\varepsilon_N - 1)} \right]^{-\frac{1}{\theta_N}} \frac{\varepsilon_N}{\varepsilon_N - 1} \left(\frac{X_i^N}{\varepsilon_N} \right)^{-\frac{\theta_N - (\varepsilon_N - 1)}{\theta_N (\varepsilon_N - 1)}}$$

$$\times \left(\bar{I}_i^N \left(\frac{1}{c_i^N} \right)^{\theta_N} \left(\frac{1}{c_i^N f_{ii}^N} \right)^{\frac{\theta_N - (\varepsilon_N - 1)}{\varepsilon_N - 1}} \right)^{-\frac{1}{\theta_N}}$$

Production Allocation II

and

$$P_i^T = \frac{1}{b_T}\left[\frac{\theta_T}{\theta_T-(\varepsilon_T-1)}\right]^{-\frac{1}{\theta_T}} \frac{\varepsilon_T}{\varepsilon_T-1}\left(\frac{X_i^T}{\varepsilon_T}\right)^{-\frac{\theta_T-(\varepsilon_T-1)}{\theta_T(\varepsilon_T-1)}}$$
$$\times\left(\sum_{j=1}^{\mathcal{C}} \bar{I}_j^T \left(\frac{1}{\tau_{ij}c_j^T}\right)^{\theta_T}\left(\frac{1}{c_j^T f_{ij}^T}\right)^{\frac{\theta_T-(\varepsilon_T-1)}{\varepsilon_T-1}}\right)^{-\frac{1}{\theta_T}}$$

- Total expenditures:

$$X_i^N = \alpha w_i L_i + (1-\beta_N)\,\eta_N X_i^N + (1-\beta_T)\,\eta_T X_i^T$$
$$X_i^T = (1-\alpha) w_i L_i + (1-\beta_N)\,(1-\eta_N)\,X_i^N + (1-\beta_T)\,(1-\eta_T)\,X_i^T$$

Production Allocation III

- Wages:

$$w_i L_i = \sum_{j=1}^{\mathcal{C}} \frac{\bar{I}_i^T \left(\frac{1}{\tau_{ji} w_i^{\beta_T} \left[\left(P_i^N\right)^{\eta_T} \left(P_i^T\right)^{1-\eta_T} \right]^{1-\beta_T}} \right)^{\theta_T} \left(\frac{1}{w_i^{\beta_T} \left[\left(P_i^N\right)^{\eta_T} \left(P_i^T\right)^{1-\eta_T} \right]^{1-\beta_T} f_{ji}^T} \right)^{\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}}{\sum_{l=1}^{\mathcal{C}} \bar{I}_l^T \left(\frac{1}{\tau_{jl} w_l^{\beta_T} \left[\left(P_l^N\right)^{\eta_T} \left(P_l^T\right)^{1-\eta_T} \right]^{1-\beta_T}} \right)^{\theta_T} \left(\frac{1}{w_l^{\beta_T} \left[\left(P_l^N\right)^{\eta_T} \left(P_l^T\right)^{1-\eta_T} \right]^{1-\beta_T} f_{jl}^T} \right)^{\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}} w_j L_j$$

Power Law in the Melitz-Pareto Framework

Consider a simplified one-sector model

- The distribution in firm sales x follows a power law if:

$$\Pr(x > q) = \delta q^{-\zeta}$$

  - The economy will exhibit granular fluctuations when ζ is close to 1
- In our model, $\Pr(1/a < y) = 1 - \left(\frac{b}{y}\right)^{\theta}$, and therefore

$$\Pr(x > q) = \left(b^{\varepsilon-1} D\right)^{\frac{\theta}{\varepsilon-1}} q^{-\frac{\theta}{\varepsilon-1}}$$

  - The distribution of firm sales follows a power law with exponent $\frac{\theta}{\varepsilon-1}$
  - Available estimates (Axtell, 2001) put $\frac{\theta}{\varepsilon-1}$ around 1

Aggregate Granular Volatility

- The total sales in the economy is defined by:

$$X = \sum_{k=1}^{I} x(a(k), z(k))$$

where I is the total number of firms operating in the tradeable and non-tradeable sectors

- Aggregate volatility given simply by

$$\text{Var}_z \left(\frac{\Delta X}{\text{E}_z\left(X\right)} \right) = \sigma^2 h,$$

where h is the Herfindahl index of of production shares of firms in this economy, $h = \sum_{k=1}^{I} h(k)^2$, and σ^2 is the variance of firm-level idiosyncratic shocks

Analytic Results in Simplified Framework

- In a one-sector economy ($\alpha = \eta_N = \eta_N = 0$), larger countries have lower volatility in the autarky equilibrium – will have a larger number of firms:

$$\bar{I}_{aut} \sim L^{\frac{1}{1-\frac{1-\beta}{\beta}\frac{1}{\varepsilon-1}}}$$

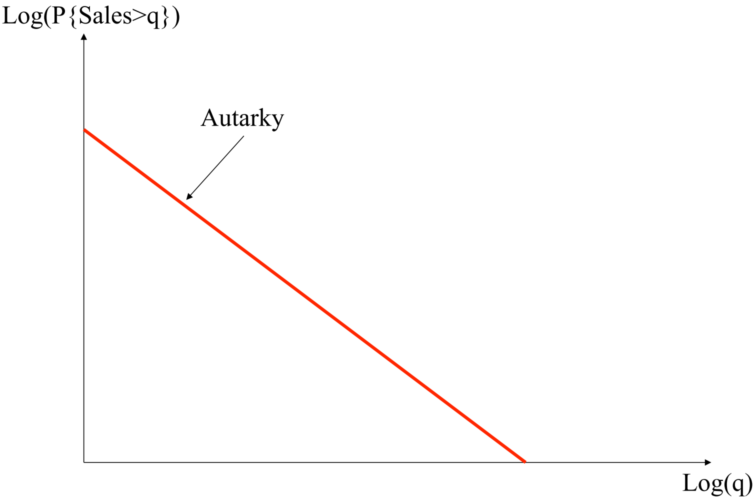
- Assuming symmetry across countries ($L_i = L$, $f_{ii} = f$, $\tau_{ij} = \tau \forall i, j$, and $f_{ij} = f^X \forall i, j$, with $\tau_{ii} = 1$), when opening to trade larger countries will have more firms that autarky due to "net entry":

$$\bar{I}_{trade} = \left[1 + (\mathcal{C} - 1)\,\tau^{-\theta}\left(\frac{f}{f^X}\right)^{\frac{\theta-(\varepsilon-1)}{\varepsilon-1}}\right]^{\frac{1-\beta}{\beta\theta}\frac{1}{1-\frac{1-\beta}{\beta}\frac{1}{\varepsilon-1}}} \bar{I}_{aut}$$

But, volatility can still increase due to "selection effect" as large firms grow larger, and small firms shrink

Autarky: Analytical Power Law

In the data, the slope of this line is approximately -1



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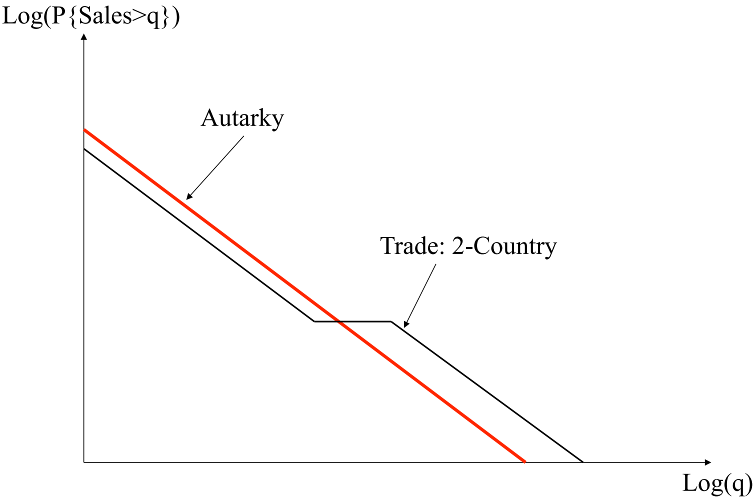

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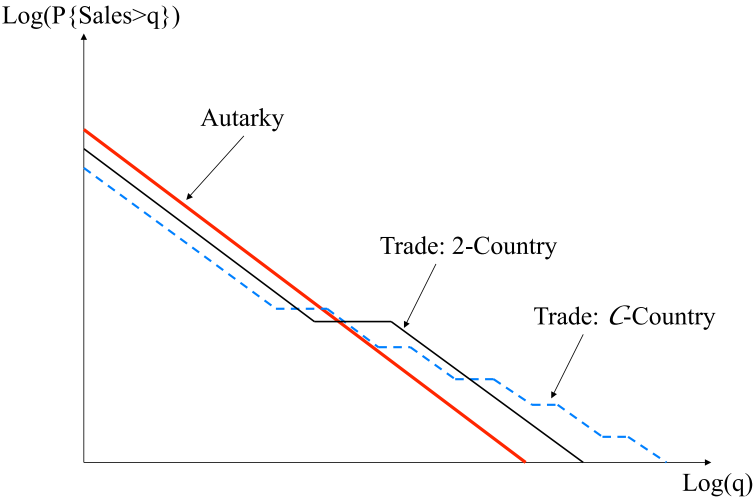


Multi-Sector Pareto & Firm-Level Varying Volatility

- How does the aggregate distribution of firms look with two sectors? Let Z be a r.v. that is a power law with exponent ζ_1 with probability p, and a power law with exponent ζ_2 with probability $1-p$: $\Pr(Z > z) = pC_1 z^{-\zeta_1} + (1-p)C_2 z^{-\zeta_2}$. When $\zeta_1 = \zeta_2 = \zeta$, Z is a power law with exponent ζ
    - di Giovanni, Levchenko and Rancière (2010): $\zeta_N \approx \zeta_T$
- Available evidence suggests that firm-size and volatility relationship is quite flat when estimating $\sigma = Ax^{-\xi}$
    - Estimates of $\xi \approx 1/6$ for firms in COMPUSTAT (Stanley et al., 1996, Sutton, 2002)
    - The largest firm in a small country is not as large as the largest firm in a larger country, so no clear prediction on direction of potential bias
    - We run simulations assuming that the relationship estimated for U.S. firms applies to all countries and results are robust

Calibration with Country Data

- To simulate the fully asymmetric model, we must solve for w_i, $\{P_i^N, P_i^T\}$ and $\{\bar{I}_i^N, \bar{I}_i^T\}$ given calibrated values of L_i, τ_{ij}, f_{ij}, and f_e
- As the country sample, we use 49 largest economies by total GDP (97% of world GDP), plus the 50th "Rest of the World"

Country Sample

Country	GDP/ World GDP	Country	GDP/ World GDP
United States	0.300	Indonesia	0.006
Japan	0.124	South Africa	0.006
Germany	0.076	Norway	0.006
France	0.054	Poland	0.005
United Kingdom	0.044	Finland	0.005
Italy	0.041	Greece	0.004
China	0.028	Venezuela, RB	0.004
Canada	0.026	Thailand	0.004
Brazil	0.021	Portugal	0.003
Spain	0.020	Colombia	0.003
India	0.017	Nigeria	0.003
Australia	0.016	Algeria	0.003
Russian Federation	0.015	Israel	0.003
Mexico	0.015	Philippines	0.003
Netherlands	0.015	Malaysia	0.002
Korea, Rep.	0.011	Ireland	0.002
Sweden	0.010	Egypt, Arab Rep.	0.002
Switzerland	0.010	Pakistan	0.002
Belgium	0.009	Chile	0.002
Argentina	0.008	New Zealand	0.002
Saudi Arabia	0.007	Czech Republic	0.002
Austria	0.007	United Arab Emirates	0.002
Iran, Islamic Rep.	0.007	Hungary	0.002
Turkey	0.007	Romania	0.002
Denmark	0.006	Rest of the World	0.027

Calibration with Country Data (cont'd)

Parameter	Baseline	Source
ε [a]	6	Anderson and van Wincoop (2004)
θ [b]	5.3	Axtell(2001): $\frac{\theta}{\varepsilon-1}=1.06$
α	0.65	Yi and Zhang (2010)
$\{\beta_N,\beta_T\}$	$\{0.65, 0.35\}$	1997 U.S. Benchmark Input-Output Table
$\{\eta_N,\eta_T\}$	$\{0.77, 0.35\}$	
τ_{ij} [c,d]	2.30	Helpman et al. (2008)
f_{ii} [c]	14.24	The World Bank (2007a); normalizing $f_{US,US}$
f_{ij} [c]	7.20	so that nearly all firms in the U.S. produce
f_e	34.0	To match 7,000,0000 firms in the U.S. (U.S. Economic Census)
σ [e]	0.1	Standard deviation of sales growth of the top 100 firms in COMPUSTAT

Notes:

[a] Robustness checks include $\varepsilon = 4$ and $\varepsilon = 8$.

[b] Robustness checks include $\frac{\theta}{\varepsilon-1} = 1.5$ and $\varepsilon = 6$, so that $\theta = 6.5$.

[c] Average in our sample of 50 countries.

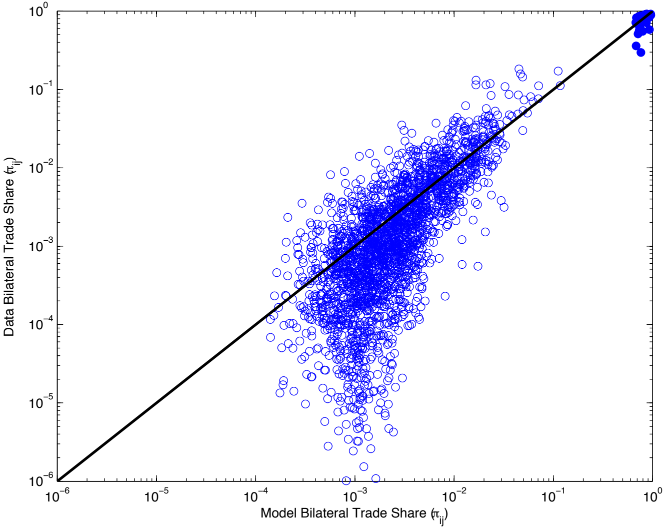
[d] $\tau_{ij} = \tau_{ji}$. Adjusted by a constant ratio to match the median-level of openness across the 50-country sample.

[e] Robustness checks include σ varying with firm sales: $\sigma = Ax^{-\xi}$, where $\xi = 1/6$.

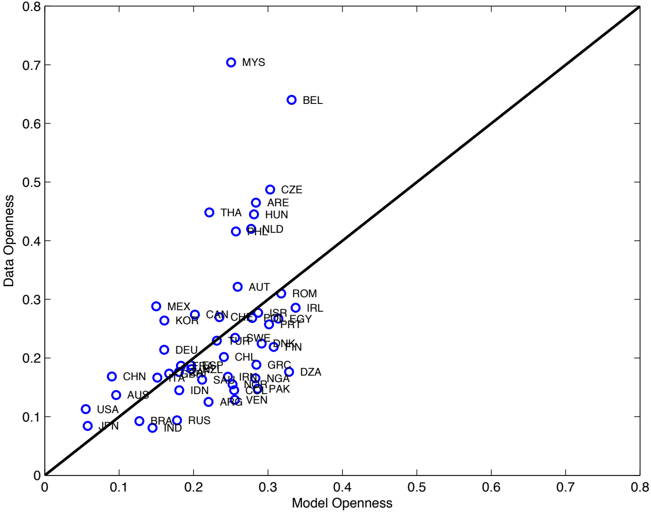
Calibration with Country Data (cont'd)

- L_i are found following Alvarez and Lucas (2007)
  - L_i is "equipped labor," not population; account for differences in TFP and capital endowment
- Iterative procedure:
  - for a guess of L_i, solve for w_i, $\{P_i^N, P_i^T\}$ and $\{\bar{I}_i^N, \bar{I}_i^T\}$
  - given w_i, $\{P_i^N, P_i^T\}$ and $\{\bar{I}_i^N, \bar{I}_i^T\}$ set the new guess for L_i so that the relative GDP's in the model between any two countries match the relative GDP's in the data
  - iterate to convergence
- In practice, makes minimal difference relative to just assuming L_i=GDP

Model Fit: Bilateral Trade Shares



Model Fit: Overall Trade Openness



Model Fit: Trade Volumes

	Model	Data
Domestic sales as a share of domestic absorption (π_{ii})		
mean	0.7900	0.7520
median	0.7717	0.7921
corr(model,data)	0.4783	
Export sales as a share of domestic absorption (π_{ij})		
mean	0.0043	0.0047
median	0.0021	0.0047
corr(model,data)	0.7799	

Model Fit: Export Participation

	(1)	(2)	(3)	(4)
	Model		Data	
Country	Total	Tradeable	Total	Tradeable
United States	0.010	0.018	0.040	0.150
Germany	0.111	0.238	0.100	...
France	0.029	0.065	0.040	0.090
Argentina	0.112	0.352	...	0.422
Colombia	0.148	0.548	...	0.226
Ireland	0.332	1.000	...	0.740
Chile	0.095	0.335	0.105	...
New Zealand	0.062	0.189	0.051	0.135

Notes: This table presents the ratio of the number exporting firms relative to the number of firms in the whole economy ('Total') or the tradeable sector ('Tradeable'), in the model and calculated from various data sources.

Model Fit: Size of Large Firms, Herfindahl

	(A) Dep. Variable: Log(Herfindahl)			
	(1)	(2)	(3)	(4)
		Data		*Model*
	All	obs(S)≥100	obs(S)≥1000	All
Log(Size)	-0.305**	-0.284**	-0.114**	-0.135**
	(0.017)	(0.038)	(0.037)	(0.010)
Log(GDP per capita)	0.000	0.009	-0.015	...
	(0.012)	(0.031)	(0.032)	...
Constant	-3.855**	-3.932**	-3.045**	-2.775**
	(0.190)	(0.428)	(0.422)	(0.052)
Observations	139	81	52	49
R^2	0.609	0.377	0.161	0.784

Notes: + significant at 10%; * significant at 5%; ** significant at 1%.

Model Fit: Size of Large Firms, Top Ten Firms

	(B) Dep. Variable: Log(Sales of 10 Largest Firms)			
	(1)	(2)	(3)	(4)
		Data		*Model*
	All	obs(S)≥100	obs(S)≥1000	All
Log(Size)	1.006**	0.933**	0.888**	0.903**
	(0.059)	(0.047)	(0.049)	(0.028)
Log(GDP per capita)	0.054*	0.054	0.075*	...
	(0.026)	(0.039)	(0.033)	...
Constant	22.638**	22.540**	22.177**	18.865**
	(0.440)	(0.450)	(0.451)	(0.139)
Observations	139	81	52	49
R^2	0.753	0.770	0.800	0.958

Notes: + significant at 10%; * significant at 5%; ** significant at 1%.

Simulation

- Draw $\overline{I}_i^N$ and $\overline{I}_i^T$ firm productivities (independently) in each country i
- Given the solution to the model, use the cutoffs a_{ji}^s to determine which, if any, markets the firm serves
- Compute the firm-level Herfindahls in each country, which will also give aggregate volatility
- $\sigma = 0.1$ (Gabaix, 2010)

Results: Model

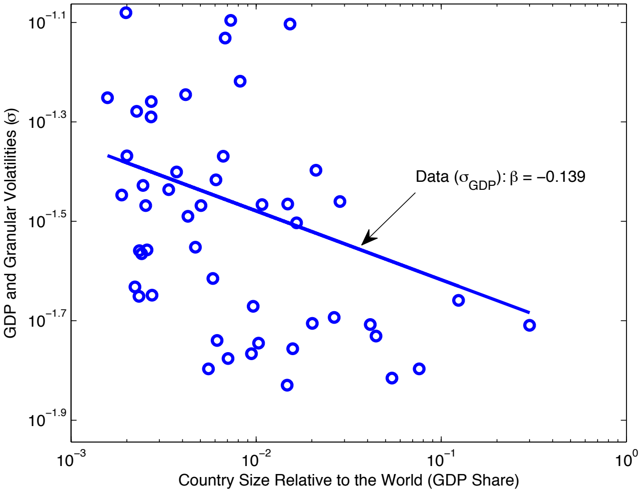
- A country accounting for 0.5% of GDP (Poland, South Africa) has granular volatility 70-100% higher than a country that accounts for 30% of world GDP (the U.S.)
- Granular volatility accounts for 14-70% of actual observed volatility of countries
  - 38% for the U.S., same as in Gabaix (2010), but very different methodology

Aggregate Volatility: Model vs. Data

Dep. Var: Log(GDP Volatility)	(1)	(2)	(3)	(4)
Log(σ_T)	1.578**	1.365**	1.099**	0.765**
	(0.244)	(0.321)	(0.287)	(0.274)
Log(GDP per capita)		-0.093	-0.098	-0.146*
		(0.073)	(0.065)	(0.060)
Log(Risk Content of Exports)			0.100+	-0.064
			(0.053)	(0.052)
Log(Herfindahl of Production)				-0.134
				(0.217)
Constant	3.490**	3.417**	2.994**	0.282
	(1.092)	(1.145)	(1.079)	(1.045)
Observations	49	49	47	35
R^2	0.353	0.378	0.477	0.450

Notes: + significant at 10%; * significant at 5%; ** significant at 1%.

Country Size and Aggregate Volatility: Model vs. Data



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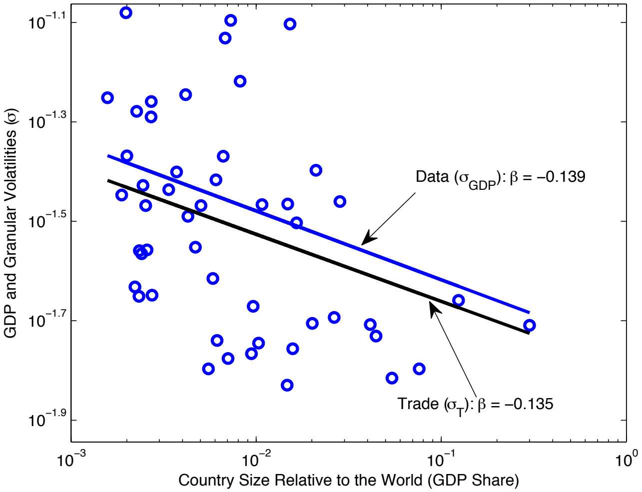

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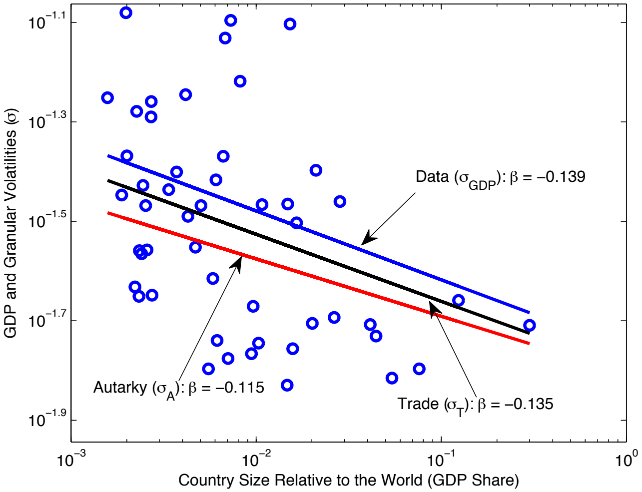

Counterfactual I: The Contribution of Trade Openness to Granular Volatility

- We can use our model to compare aggregate volatility under the current trade regime to what the volatility would have been in autarky
  - This will give us the contribution of international trade to the different countries' aggregate fluctuations
- Both country size and remoteness matter
  - In a large country like the U.S. or Japan, international trade increases granular volatility by about 3.5% compared to autarky
  - In a small but remote country (South Africa, New Zealand), international trade raises granular volatility by 10%
  - In a small, close country (Denmark, Romania), international trade raises granular volatility by 15-20%

Counterfactual I: The Contribution of Trade Openness to Granular Volatility

Country	Trade/ Autarky	Country	Trade/ Autarky
United States	1.035	Indonesia	1.060
Japan	1.014	South Africa	1.109
Germany	1.080	Norway	1.137
France	1.098	Poland	1.114
United Kingdom	1.076	Finland	1.109
Italy	1.098	Greece	1.116
China	1.024	Venezuela, RB	1.070
Canada	1.077	Thailand	1.099
Brazil	1.045	Portugal	1.068
Spain	1.061	Colombia	1.118
India	1.064	Nigeria	1.172
Australia	1.051	Algeria	1.156
Russian Federation	1.099	Israel	1.131
Mexico	1.052	Philippines	1.107
Netherlands	1.104	Malaysia	1.095
Korea, Rep.	1.059	Ireland	1.087
Sweden	1.099	Egypt, Arab Rep.	1.192
Switzerland	1.107	Pakistan	1.165
Belgium	1.072	Chile	1.119
Argentina	1.091	New Zealand	1.114
Saudi Arabia	1.069	Czech Republic	1.095
Austria	1.066	United Arab Emirates	1.089
Iran, Islamic Rep.	1.097	Hungary	1.114
Turkey	1.157	Romania	1.218
Denmark	1.156		

Counterfactual II: The Impact of A Reduction in Trade Costs

- Suppose that the τ_{ij} decrease by 50% between countries
- For the median country, volatility increase of 0.1%. Two off-setting effects:
    - Net entry: $\bar{I}_i^s$ increases, which will lower granular volatility
    - Selection: most productive firms expand their sales abroad and become larger, which will make distribution of firm size more fat-tailed and increase granular volatility
- Given these two effects, smaller countries' volatility will tend to *decrease* while larger countries' volatility will *increase*

Robustness

	(1) β_{Size}	(2) Trade/Autarky
Baseline	-0.135	1.097
Vol. Decr. in Firm Size	-0.286	1.291
$\zeta = 1.5$	-0.123	1.116
$\varepsilon = 4$	-0.119	1.099
$\varepsilon = 8$	-0.138	1.111

Conclusion

- Recent research in both international trade and macro emphasizes the role of large firms
- This paper studies the quantitative relationship between country size, international trade, large firms, and macroeconomic fluctuations in a calibrated 50-country model of world trade
- Consistent with the data, the model matches well the relationship between country size, trade openness, and aggregate volatility
- Counterfactual experiments show that international trade has a negligible impact on aggregate volatility in the largest countries (U.S., Japan), but can increase aggregate volatility by some 20% in small open economies
- However, given endogenous entry, the potential for additional impact on volatility from trade opening depends on country size

Further Work

- Examine empirically the impact of firm-level shocks on aggregate behavior, and how openness plays a role
- Study the contribution of firm-level shocks to aggregate fluctuations in dynamic general equilibrium models