Credit Constraints, Heterogeneous Firms, and International Trade

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Links: Kalina Manova's webpage and research portfolio, this paper, and these slides

Motivation

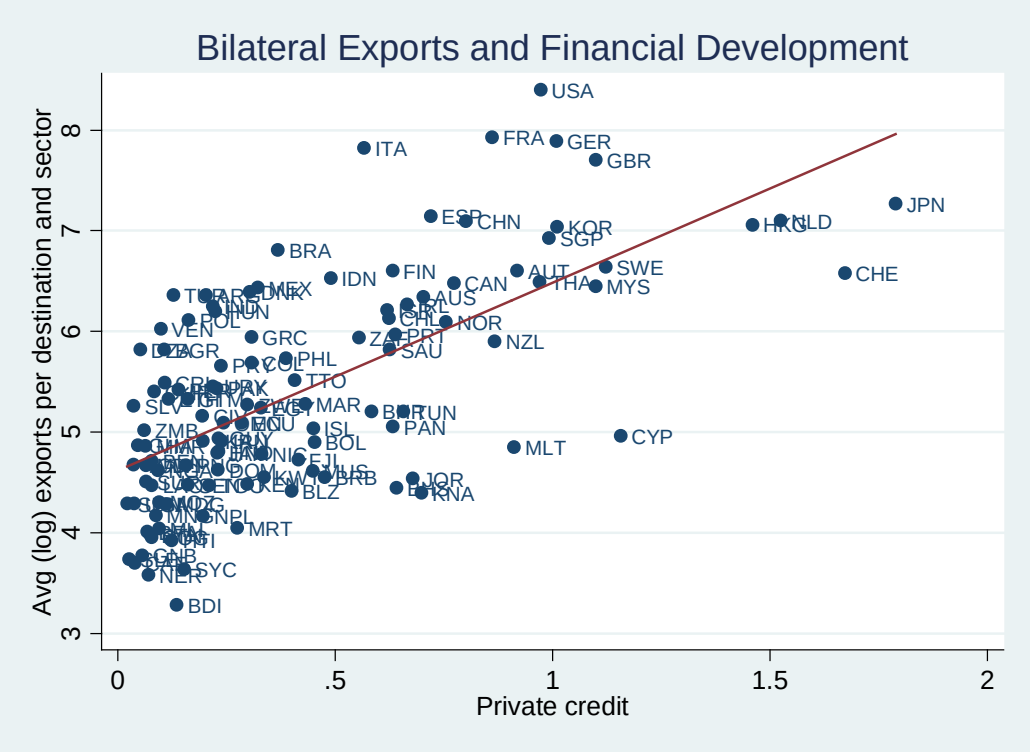
- International trade models traditionally assume that resources are perfectly and instantaneously allocated in an economy
  - Comparative advantage based on cross-country differences in factor endowments and productivity leaves many trade patterns unexplained
- An important recent advance in the trade literature is the study of different market and institutional frictions
  - Rule of law, labor market rigidities, financial market imperfections
  - Motivated by results in the development, growth and finance literatures on the disruptive effects of financial constraints
- Growing evidence that credit conditions have a first-order effect on international trade and investment activity

This Paper

- Provide an integrated model of international trade with firm heterogeneity and financial market imperfections
  - Financial development is an important source of comparative advantage
  - Credit constraints interact with firm heterogeneity and reinforce the selection of only the most productive firms into exporting
- Empirical evidence and decomposition of the disruptive effects of credit constraints on trade
  - Establish causality by exploiting the variation in financial development across countries and in financial vulnerability across sectors
  - 80% of the impact of credit constraints on trade is above and beyond that on overall production
  - 1/3 of the trade-specific effect is due to less entry into exporting and 2/3 due to lower firm-level exports

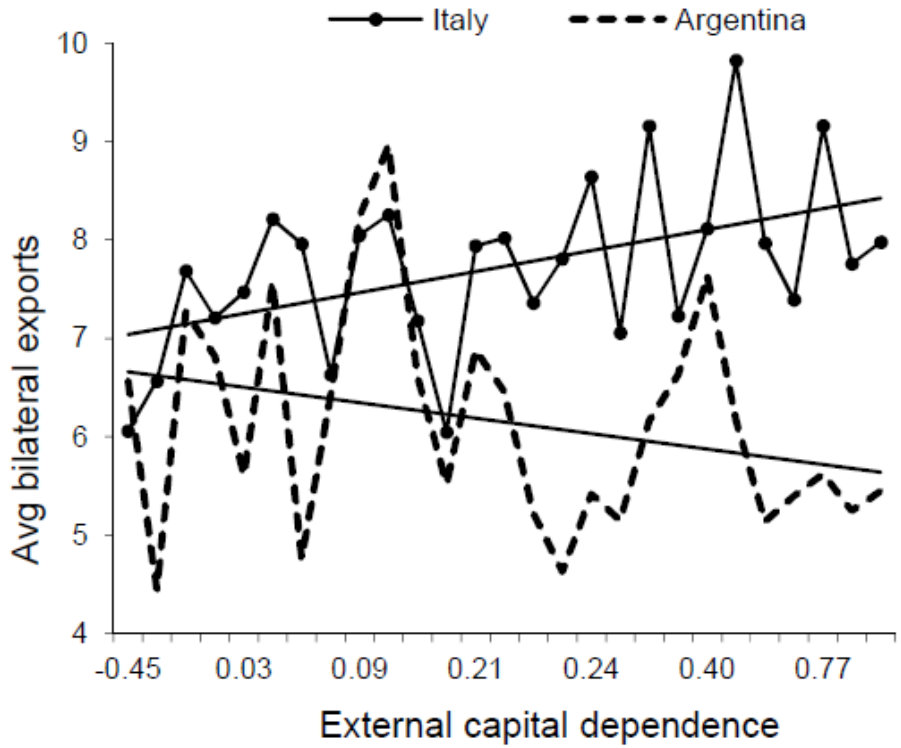
Exports and Countries' Financial Development

- Financially more advanced countries export more in the average sector and destination (correlation coefficient 0.66)



Exports and Sectors' Financial Vulnerability

- Financially advanced country (Italy) sells more than financially less developed country (Argentina), especially in financially more vulnerable industries



Policy Implications

- Exporters depend more on external financing than domestic producers
  - Trade flows more sensitive than GDP to credit tightening during financial crises
- Important policy implications for developing countries that typically rely on trade for growth but suffer from weak financial institutions
- Under inefficient allocation of financial capital, the presence of heterogeneous firms can affect the welfare gains from trade

Why Exporters Require External Finance

- Firms routinely rely on external capital to cover upfront costs that cannot be financed out of retained earnings or cash flows from operations
- Exporting even more dependent on external finance than manufacturing for the home country
  - Additional upfront costs specific to export activities
  - Cross-border shipments take 30-90 days longer to process
  - International transactions are riskier
- Very active market for the financing and insurance of international transactions, worth $10-$12 trillion in 2008
  - 90% of world trade relies on some form of trade finance

Outline

1. Introduction and motivation
2. **Theoretical framework**
3. Data and empirical strategy
4. Results
5. Conclusion

Model Overview

- Exporters pledge collateral to raise required external capital, but financial contracts are not always enforced
  - More productive firms are less credit constrained because they can offer investors higher repayment when contracts are enforced
- Key implications
  - Financial frictions reinforce the selection of only the most productive firms into exporting and preclude potentially profitable firms from exporting
  - If firms require external finance for both fixed and variable costs, credit constraints also restrict the value of firm exports
  - With repeated fixed costs of exporting at the destination-product level, credit constraints limit firms' export product scope and number of destinations
  - Bigger distortions in financially more dependent sectors

Model Set-Up

- A continuum of heterogeneous firms produce differentiated goods in each of J countries and S sectors
  - CES utility with elasticity $\varepsilon > 1$ summarizes consumers' love of variety
- Production
  - Firms draw productivity $1/a$ from $G(a)$ with support $[a_L, a_H]$, $a_H > a_L > 0$
  - $c_{js}a$: cost of producing 1 unit in country j in sector s
  - Sunk entry cost $c_{js}f_{ej}$
  - Measure N_{js} of firms in country j and sector s
- Exporting
  - $c_{js}f_{ij}$: fixed cost of exporting from j to i
  - τ_{ij} : variable iceberg cost of exporting from j to i

Financing Constraints

- Firms require external finance for a fraction d_s of the fixed trade cost, which they can raise by pledging a fraction t_s of the entry cost as collateral
  - d_s and t_s are technologically determined sector characteristics
- Financial contracting is imperfect and depends on countries' institutions
  - With probability λ_j the financial contract is enforced and investors are repaid
  - With probability $(1 - \lambda_j)$ the firm defaults, investors claim collateral, and firms keep all revenues but need to replace collateral to continue operations

Firm Problem

- Credit constrained exporters in country j maximize profits for each market i

$$\max_{p,q,F} \pi_{ijs}(a) = p_{ijs}(a)q_{ijs}(a) - q_{ijs}(a)\tau_{ij}c_{js}a - (1-d_s)c_{js}f_{ij} - \lambda_j F(a) - \left(1-\lambda_j\right)t_s c_{js} f_{ej}$$

subject to

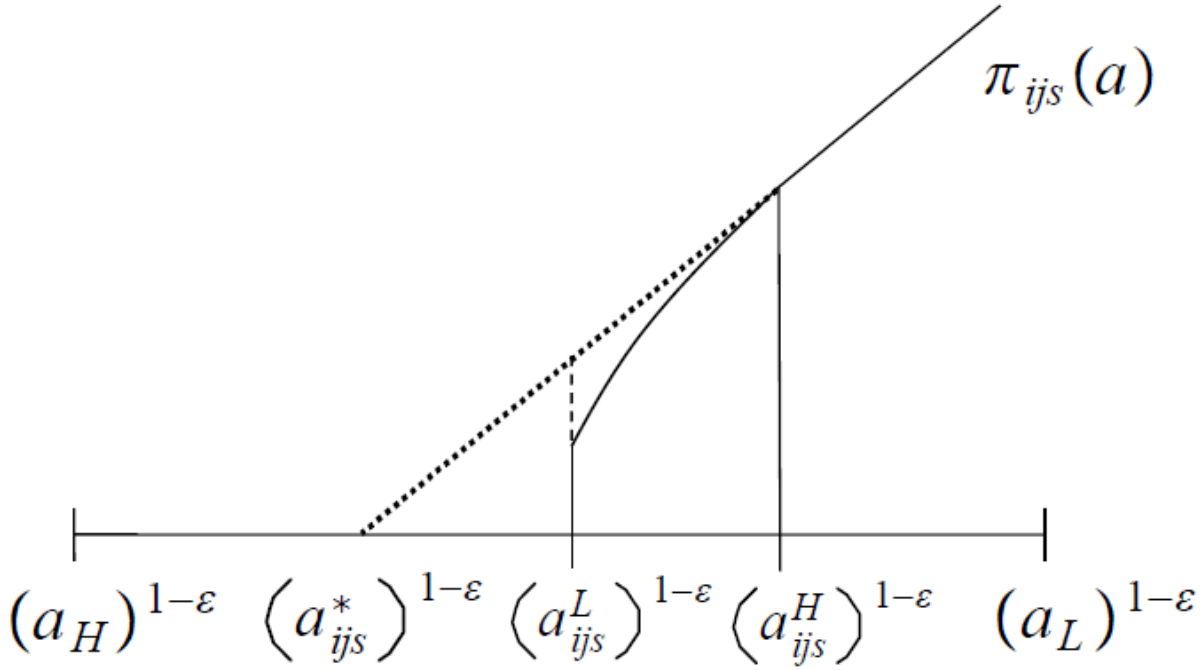
(1) $$q_{ijs}(a) = \frac{p_{ijs}(a)^{-\varepsilon}\theta_s Y_i}{P_{is}^{1-\varepsilon}}$$

(2) $$A_{ijs}(a) \equiv p_{ijs}(a)q_{ijs}(a) - q_{ijs}(a)\tau_{ij}c_{js}a - (1-d_s)c_{js}f_{ij} \geq F(a)$$

(3) $$B_{ijs}(a) \equiv -d_s c_{js} f_{ij} + \lambda_j F(a) + \left(1-\lambda_j\right)t_s c_{js} f_{ej} \geq 0$$

Trade Distortion

- Credit constraints increase the productivity cut-off for exporting $(a^* \rightarrow a^L)$ and preclude some firms $[1/a^L, 1/a^H)$ from exporting at their first-best level
  - Financial development mitigates both distortions, with a disproportionately stronger effect in financially vulnerable sectors



Selection into Exporting

- Country j is more likely to export to country i in a financially more vulnerable sector s if j is more financially developed

- Latent variable Z_{ijs}: j exports to i in sector s if $Z_{ijs} > 1$

$$Z_{ijs} = \left(\frac{a_{ijs}^{L}}{a_{L}} \right)^{\varepsilon - 1}$$

- Estimating equation

$$z_{ijs} = \gamma_0 + \gamma_1 FinDevt_j \cdot ExtFin_s - \gamma_2 FinDevt_j \cdot Tang_s + \\ + (\varepsilon - 1) p_{is} - \mu d_{ij} - \kappa \varphi_{ij} + \phi_i + \phi_j + \phi_s + \eta_{ijs}$$

Product Variety

- Country j exports a wider range of products to country i in a financially more vulnerable sector s if j is more financially developed

- Mass of firms exporting from j to i in sector s

$$X_{ijs} = N_{js} G\left(a_{ijs}^{L}\right)$$

- Estimating equation

$$x_{ijs} = \xi_0 + \xi_1 FinDevt_j \cdot ExtFin_s - \xi_2 FinDevt_j \cdot Tang_s + \\ + \xi_3 n_{js} + \xi_4 p_{is} - \xi_5 d_{ij} - \xi_6 \varphi_{ij} + \xi_i + \xi_j + \xi_s + \iota_{ijs}$$

Trade Partners

- Country j exports to more destinations in a financially more vulnerable sector s if j is more financially developed
  - Firms require outside capital for all their cross-border operations, and use limited financial resources to maximize total profits from global sales
  - Firms observe a pecking order of export destinations, and financial development allows firms to go further down this pecking order

- Estimating equation

$$I_{js} = \mu_0 + \mu_1 FinDevt_j \cdot ExtFin_s - \mu_2 FinDevt_j \cdot Tang_s + \mu_j + \mu_s + \epsilon_{js}$$

Export Volumes

- Aggregate firm-level exports from country j to country i in a financially more vulnerable sector s are higher if j is more financially developed

$$M_{ijs} = \left(\frac{\tau_{ij} c_{js}}{a P_{is}}\right)^{1-\varepsilon} \theta_s Y_i N_{js} V_{ijs} E_{ijs}$$

$$V_{ijs} = \begin{cases} \int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon}\, dG(a) & \text{for } a_{ijs}^L \geq a_L \\ 0 & \text{otherwise} \end{cases}$$

$$E_{ijs} = \left[\frac{\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon}\, dG(a) + \int_{a_{ijs}^H}^{a_{ijs}^L} \beta_{ijs}(a) a^{1-\varepsilon}\, dG(a)}{\int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon}\, dG(a)}\right]$$

- Estimating equation

$$m_{ijs} = \varsigma_0 + n_{js} + w_{ijs} + e_{ijs} + (\varepsilon - 1) p_{is} - \mu d_{ij} + \varsigma_j + \varsigma_i + \varsigma_s + u_{ijs}$$

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Data

- 107 countries, 27 sectors, 1985-1995
- Financial development
  - Private credit (Beck et al 2000), repudiation of contracts, accounting standards, risk of expropriation (La Porta et al 1998)
- Trade data
  - Bilateral exports by sector (Feenstra 2000)

Sectors' Financial Vulnerability

- Two commonly used indicators of sectors' technologically determined level of financial vulnerability
  - Liquidity needs: external finance dependence
  - Availability of collateral: asset tangibility
- Measures constructed from data on all publicly traded US-based companies from Compustat
  - Standard practice in the literature
  - Median firm's value of 1980-1999 average across firms in a sector
  - Measures and sector ordering stable over time

Sectors' Financial Vulnerability

- Three advantages to constructing sector measures from US firm-level data
  1. Sophisticated financial systems, so that the measure reflect firms' optimal choice over external financing and asset structure
  2. Sector measures are not endogenous to countries' level of financial development (possible downward bias)
  3. Identification requires that ranking of sectors, not levels, remain stable across countries

Trade Volume Decomposition

- Decompose the effect of capital market friction on export volume
  - Selection into domestic production n_{js}
  - Selection into exporting w_{ijs}
  - Firm-level exports e_{ijs}
- Estimating equation

$$m_{ijs} = \varsigma_0 + n_{js} + w_{ijs} + e_{ijs} + (\varepsilon - 1)p_{is} - \mu d_{ij} + \varsigma_j + \varsigma_i + \varsigma_s + u_{ij}$$

- Regression without n_{js} and w_{ijs} terms estimates the overall effect
- Controlling for the number of firms n_{js} isolates the trade-specific effect

Two Stage Estimation

- Two challenges
  - w_{ijs} and e_{ijs} are not unobserved
  - selection bias due to unobserved trade costs

- Address both challenges with a two-stage structural procedure similar to Helpman et al (2008)
  1. Estimate the impact of financial frictions on the probability of exporting and use the predicted probability of exporting to infer the latent variable z_{ijs}, the extensive margin term w_{ijs}, and a Heckman-style selection correction
  2. Include n_{ijs}, imputed w_{ijs} and Heckman correction in the regression for export volumes, so that the residual impact of financial frictions on trade reflects distortions to the intensive margin e_{ijs}

- Baseline second-stage MLE assumes normality of unobserved trade costs and Pareto distribution of firm productivity (relaxed in robustness checks)

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Bilateral Exports

Dependent variable: m_{ijst}, (log) bilateral exports by sector
Financial development measure: private credit

	Total effect of credit constraint	Controlling for selection into domestic production	
Fin devt	0.167 (3.14)***	0.251 (4.25)***	0.022 (0.37)
Fin devt × Ext fin dep	**1.752** **(43.29)***	**1.296** **(28.31)***	**1.489** **(30.47)***
Fin devt × Tang	**-2.624** **(-24.65)***	**-2.130** **(-16.41)***	**-2.077** **(-17.75)***
(Log) # Establish		0.318 (40.47)***	
(Log) Output			0.316 (18.52)***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Sector FE		
R^2	0.57	0.57	0.59
# observations	861,380	621,333	703,743
# exp-imp clusters	9343	7867	8031

Bilateral Exports: Robustness

Dependent variable: m_{ijst}, (log) bilateral exports by sector

Fin devt measure:	Private credit		Repudiation of contracts	Accounting standards	Risk of expropriation
Fin devt	0.225 (3.64)***	-0.019 (-0.24)			
Fin devt × Ext fin dep	**1.343** **(29.01)***	**1.101** **(15.38)***	**0.576** **(19.34)***	**0.025** **(11.46)***	**0.551** **(14.38)***
Fin devt × Tang	**-2.204** **(-16.64)***	**-1.334** **(-6.64)***	**-1.488** **(-15.78)***	**-0.071** **(-11.12)***	**-1.474** **(-12.58)***
(Log) # Establish	0.321***	0.314***	0.302***	0.306***	0.305***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Sector FE, CPI, CPI × Sector FE K, H, N, LGDPCE, Institutions, and Interactions				
R^2	0.58	0.59	0.59	0.61	0.59
# observations	579,485	428,444	436,931	396,112	436,931
# exp-imp clusters	7452	4130	4132	3374	4132

Probability of Exporting

Dependent variable: T_{ijst}, indicator variable equal to 1 when positive bilateral exports in a sector

Fin devt measure:	Private credit	Repudiation of contracts	Accounting standards	Risk of expropriation
Fin devt	-0.110 (-2.09)**			
Fin devt × Ext fin dep	**1.029** **(19.86)*** **	**0.320** **(19.51)*** **	**0.022** **(17.46)*** **	**0.435** **(21.06)*** **
Fin devt × Tang	**-0.823** **(-8.23)*** **	**-0.537** **(-14.00)*** **	**-0.028** **(-8.79)*** **	**-0.522** **(-11.08)*** **
(Log) # Procedures	0.007***	0.007***	0.007***	0.007***
(Log) # Days	4.682***	4.972***	7.388***	4.966***
(Log) Cost	0.369***	0.382***	0.403***	0.383***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI × Sector FE K, H, N, LGDPCE, Institutions, and Interactions			
Pseudo R^2	0.51	0.51	0.51	0.51
# observations	1,079,865	1,103,274	906,390	1,103,274
# exp-imp clusters	3965	3965	3259	3965

Product Variety

Dependent variable: x_{ijst}, (log) # SITC-4 products exported bilaterally by sector

Fin devt measure:	Private credit	Repudiation of contracts	Accounting standards	Risk of expropriation
Fin devt	-0.089 (-3.17)***			
Fin devt × Ext fin dep	**0.335** **(16.37)*** **	**0.176** **(18.45)*** **	**0.008** **(11.74)*** **	**0.190** **(16.32)*** **
Fin devt × Tang	**-0.400** **(-6.07)*** **	**-0.272** **(-10.10)*** **	**-0.014** **(-7.14)*** **	**-0.268** **(-8.00)*** **
(Log) # Establish	0.092***	0.090***	0.091***	0.091***
Importer's CPI	0.008***	0.008***	0.009***	0.008***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI × Sector FE K, H, N, LGDPCE, Institutions, and Interactions			
R^2	0.64	0.64	0.65	0.64
# observations	428,444	436,931	396,112	436,931
# exp-imp clusters	4130	4132	3374	4132

Trade Partners

Dependent variable: I_{js}, number of trade partners by sector

Fin devt measure:	Private credit		Repudiation of contracts	Accounting standards	Risk of expropriation
Fin devt	-2.23 (-0.46)	-0.96 (-0.14)			
Fin devt × Ext fin dep	**41.94** **(13.44)*****	**24.04** **(3.66)*****	**9.57** **(4.37)*****	**0.59** **(3.58)*****	**12.86** **(5.40)*****
Fin devt × Tang	**-17.04** **(-2.12)****	**-22.68** **(-1.55)**	**-15.11** **(-3.90)*****	**-0.87** **(-2.72)*****	**-18.15** **(-3.44)*****
LRGDPE	19.99 (3.88)***	111.00 (2.56)**	117.36 (2.67)**	227.55 (5.42)***	117.75 (2.68)**
Controls:	Exporter, Year and Sector Fixed effects K, H, N, LGDPCE, Institutions, and Interactions				
R^2	0.90	0.87	0.87	0.88	0.87
# observations	26,900	12,170	12,440	10,088	12,440
# exporters	107	42	42	34	42

Imputed Firm Exports

Dependent variable: m_{ijst}, (log) bilateral exports by sector (MLE)

Fin devt measure:	Private credit	Repudiation of contracts	Accounting standards	Risk of expropriation
Fin devt	0.028 (0.34)			
Fin devt × Ext fin dep	**0.409** **(4.07)*****	**0.369** **(10.22)*****	**0.012** **(4.71)*****	**0.277** **(5.80)*****
Fin devt × Tang	**-0.803** **(-3.72)*****	**-1.182** **(-11.40)*****	**-0.052** **(-7.78)*****	**-1.123** **(-9.05)*****
delta (from w_{ijs})	0.806 (7.91)***	0.820 (8.25)***	0.758 (8.55)***	0.817 (8.24)***
eta_{ijs}	0.909 (9.63)***	0.877 (9.49)***	0.874 (10.86)***	0.875 (9.55)***
(Log) # Establish	0.305***	0.294***	0.297***	0.297***
Importer's CPI	0.004***	0.004***	0.005***	0.004***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI × Sector FE K, H, N, LGDPCE, Institutions, and Interactions			
# observations	398,726	406,677	367,634	406,677
# exp-imp clusters	3681	3682	2995	3682

Decomposition

- Isolating trade-specific effect
  - Compare the effect with and without the control for the number of establishments
  - Around 75–80% of the total effect of credit market imperfections on exports is independent of their effect on output
- Extensive and intensive margins of trade
  - Credit constraints significantly affect firm selection into exporting in terms of export probability, number of varieties shipped, and number of markets served
  - Second stage MLE suggests exporting firms from financially developed countries earn significantly larger foreign revenues on average
  - 30–40% of the trade-specific effect of financial development on export volumes results from extensive margin, 60–70% due to intensive margin
  - Implies credit constraints in the financing of both fixed and variable export costs

Economic Magnitudes

- When financial development increases by one standard deviation, the sector at the 75th percentile by external finance dependence …
  - increases exports by 15 percentage points
  - increases the probability of positive exports by 14 percentage points
  - increases export product variety by 5 percentage points
  - increases firm level exports by 6 percentage points

  … more than the sector at the 25th percentile

- Financial development has similar magnitude of effect as human capital endowment and larger effect than the physical capital stock

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Conclusion

- Weak financial institutions lead to trade distortions, especially in financially vulnerable sectors
  - Fewer destinations markets
  - Reduced export product variety
  - Lower aggregate trade volumes
- Export activity disproportionately more affected by credit constraints
  - Only 20-25% of the disruptions to trade flows due to reductions in total output
- Credit constraints affect both the extensive and the intensive margins of trade