Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data

Veronica Rappoport
Columbia Business School

with Daniel Paravisini (Columbia), Philipp Schnabl (NYU), and Daniel Wolfenzon (Columbia)

November 2010
Motivation

- What is the role of banks in amplifying economic fluctuations?
  - Do banks propagate international financial shocks?
  - Do shocks to banks have real economic effects?

- Subprime crisis opened this debate in international trade
Motivation

• When do shocks to banks affect real activity?
  ▶ Banks cannot offset shock with other sources of funding
    → Negative shock to banks’ balance sheet implies drop in lending
  ▶ Firms cannot substitute banks in the short term
    → Drop in overall credit supply to the firm
  ▶ Firms need external finance in the short term
    → Increase cost of working capital and/or investment

• Why focus on trade?
  ▶ International trade is intensive in external finance
    → More working capital, letters of credit, longer period to maturity
  ▶ Data allows to control for changes in demand
    → Detailed information on product and destination
This Paper

• Setting: Peru during the 2008 financial crisis
  ▶ Sharp exports decline
  ▶ Small Open Economy
  ▶ Not directly affected by U.S. real estate market
  ▶ Data: matched customs and credit registry at the firm level

• Margins of Trade
  ▶ Intensive margin: amount of exports for firm-product-destination flows active before and after the credit shock
  ▶ Continuation margin: number of firms that continue exporting a product-destination market
  ▶ Entry margin: number of firms that start exporting a new product-destination market
Peru Monthly Exports (log)

2007m1 2007m7 2008m1 2008m7 2009m1 2009m7 2010m1
Month
Weight FOB
This Paper

• Empirical Challenge:

   How to distinguish the effect of credit supply on exports from changes in credit supply in response to factors also affecting exports?

• Our Approach:

  ▶ Bank A: large share of foreign-currency liabilities
  ▶ Bank B: low share of foreign-currency liabilities
  ▶ One firm borrows from A, another one borrows from B

   Compare exports of men’s cotton overcoats to US by the two firms

   → Changes in demand for overcoats equally affect both firms
   → Changes in U.S. economic conditions equally affect both firms
   → Changes in price of cotton equally affect both firms
Preview of the Results

- Credit supply by banks with above average dollar liabilities drops 17%

- Firms cannot perfectly substitute banks in the short term

- Export elasticity to credit (% change in 1 year export flow for every 1% change in credit stock)
  - Intensive margin: 0.23
    large export flows are more elastic to credit shocks
  - Continuation margin: 0.28
    small export flows are more elastic to credit shocks
  - Entry margin: inconclusive
Outline

- Empirical Strategy
- Data
- Results
  - Transmission of bank balance sheet shocks to firms
  - Effect of credit on export margins
- Conclusion
Empirical Strategy

- **Identification problem**

  \[
  X_{ipdt} = X(H_{ipdt}, C_{it})
  \]

  \[
  C_{it} = C(H_{ipdt}, S_{it})
  \]

  ▶ We are interested in \( \eta = \frac{\partial X}{\partial C} \frac{C}{X} \)

  ▶ Demand (or productivity) factors, \( H_{ipdt} \), affect exports and credit demand

- **Solution**

  ▶ Instrument for \( C_{it} \) with credit supply shifter, \( S_{it} \): shock to the balance sheet of firm \( i \)'s lender

  ▶ Control for demand at product-destination-time level

  \[
  \ln(X_{ipdt}) = \eta \cdot \ln(C_{it}) + \delta_{ipd} + \alpha_{pdt} + \epsilon_{ipdt}
  \]

  i: firm, p: product, d: destination, t: time
Empirical Strategy – Instrumental Variable

- How international financial crisis affects domestic banks’ balance sheet?
  - Capital flow reversal
  - Depreciation of Peruvian currency
  - Negative balance sheet shock to banks with foreign liabilities

(a) Banking Sector Foreign Liabilities
(b) Exchange Rate
Empirical Strategy – Instrumental Variable

- How domestic banks transmit the shock to firms?
  - Heterogeneous dependence on foreign liabilities before the crisis
  - Disproportionately drop in lending by banks with high share of foreign liabilities
    - Affected banks: share of foreign liabilities above mean (10%)

### (c) Outstanding Loans

<table>
<thead>
<tr>
<th>Bank</th>
<th>For.Liabilities/Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSBC</td>
<td>0.177</td>
</tr>
<tr>
<td>Mibanco</td>
<td>0.168</td>
</tr>
<tr>
<td>Continental</td>
<td>0.122</td>
</tr>
<tr>
<td>Citibank</td>
<td>0.103</td>
</tr>
<tr>
<td>Interamericano</td>
<td>0.075</td>
</tr>
<tr>
<td>Financiero</td>
<td>0.073</td>
</tr>
<tr>
<td>Credito</td>
<td>0.062</td>
</tr>
<tr>
<td>Wiese</td>
<td>0.060</td>
</tr>
<tr>
<td>Interbank</td>
<td>0.055</td>
</tr>
<tr>
<td>Santander</td>
<td>0.022</td>
</tr>
</tbody>
</table>

### (d) Foreign Liabilities
Empirical Strategy – Instrumental Variable

\[ \ln(X_{ipdt}) = \eta \cdot \ln(C_{it}) + \delta_{ipd} + \alpha_{pdt} + \epsilon_{ipdt} \]

- Instrument for \( \ln(C_{it}) \) with shifter of firm \( i \)'s credit supply: \( F_{it} = F_i \cdot Post_t \)
  
  \( t\in\{\text{Pre, Post}\} \) : 12 months before and after July 2008
  
  \( F_i \) : 1 if firm \( i \) borrows more than 50% from affected banks
  
  \( Post_t \) : 1 if \( t = Post \)

- Identification assumption 1: \( F_{it} \) correlated with credit supply

- Identification assumption 2: exclusion restriction

\[ E[(F_i \cdot Post_t) \cdot \epsilon_{ipdt}|\delta_{ipd}, \alpha_{pdt}] = 0 \]

- Cross-firm variation in exports of the same product to the same destination is independent of bank affiliation, after accounting for all time invariant heterogeneity
Data

• Bank Balance Sheets

• Credit Registry
  ▶ Firm-bank-month panel
  ▶ Outstanding debt every firm with every domestic bank

• Customs Data (SUNAT)
  ▶ Web crawler: download every export document since 1995
  ▶ Product (11 digits), destination, volume, value, prices

• Unit of information
  ▶ Matched customs-credit registry data at firm level
  ▶ Firm-product-destination export flow (4 and 6 digits HS)
  ▶ Collapsed into two periods of 12 months before and after July 2008 (Pre and Post)
## Data – Descriptive Statistics of Banks

<table>
<thead>
<tr>
<th></th>
<th>High Foreign Exposure (N = 4)</th>
<th>Low Foreign Exposure (N = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>sd</td>
</tr>
<tr>
<td>Assets (M Soles)</td>
<td>7,599</td>
<td>11,451</td>
</tr>
<tr>
<td>Loans (M Soles)</td>
<td>5,127</td>
<td>7,724</td>
</tr>
<tr>
<td>Deposits (M Soles)</td>
<td>5,043</td>
<td>8,045</td>
</tr>
<tr>
<td>Foreign Financing (M Soles)</td>
<td>1,059</td>
<td>1,520</td>
</tr>
<tr>
<td>Loans/Assets</td>
<td>0.659</td>
<td>0.126</td>
</tr>
<tr>
<td>Deposits/Assets</td>
<td>0.573</td>
<td>0.082</td>
</tr>
<tr>
<td>Foreign Financing/Assets</td>
<td>0.196</td>
<td>0.135</td>
</tr>
</tbody>
</table>
### Data – Descriptive Statistics of Firms

<table>
<thead>
<tr>
<th></th>
<th>Borrows &gt; 50% from Affected Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (N = 1,471)</td>
</tr>
<tr>
<td></td>
<td>mean</td>
</tr>
<tr>
<td>Debt (1,000 Soles)</td>
<td>5,917</td>
</tr>
<tr>
<td>Exports (1,000 Soles)</td>
<td>12,789</td>
</tr>
<tr>
<td>Exports (1,000 Kg)</td>
<td>6,004</td>
</tr>
<tr>
<td># destinations</td>
<td>3.6</td>
</tr>
<tr>
<td>Distance (km)</td>
<td>6,000</td>
</tr>
<tr>
<td># products (4-digit)</td>
<td>4.6</td>
</tr>
<tr>
<td># Product-Destinations</td>
<td>8.9</td>
</tr>
<tr>
<td>Frac. debt exposed bank</td>
<td>0.910</td>
</tr>
</tbody>
</table>
Result I – Role of Banks in Spread of Financial Crisis

- Challenge: disentangle drop in credit supply from firm reduction in demand

\[
\ln(C_{ibPost}) - \ln(C_{ibPre}) = \alpha_i + \gamma \cdot FD_b + \epsilon_{ib}
\]

- \( C_{ibt} \): firm \( i \)'s total outstanding credit with bank \( b \) at time \( t \)
- \( FD_b \): 1 if bank \( b \) has more than 10% foreign liabilities (in 2006)

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>( \Delta \ln C_{ib} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All firms</td>
</tr>
<tr>
<td>( FD_b )</td>
<td>-0.168***</td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
</tr>
<tr>
<td>Firm FE</td>
<td>yes</td>
</tr>
<tr>
<td>Observations</td>
<td>10,336</td>
</tr>
<tr>
<td># banks</td>
<td>42</td>
</tr>
<tr>
<td># firms</td>
<td>5157</td>
</tr>
</tbody>
</table>
Result I – Role of Banks in Spread of Financial Crisis

- Banks with high share of foreign liabilities cut lending when Peru capital flows reversed

- Credit supply by exposed banks dropped 17%, relative to other banks
  - More pronounced shock to small firms (19.5%) than large firms (13.5%)

- Important to control for changes in firm credit demand
  - Overall credit of firms linked to exposed banks dropped 66%, relative to other other firms
  - Most drop in credit by firms linked to exposed banks was demand driven
Exports in Peru

Peru Monthly Exports (log)
Exports in Peru

• Margins of Trade

\[ X_t = X_{t}^{Cont} + X_{t}^{Entry} \]

\[ X_{t-1} = X_{t-1}^{Cont} + N_{t-1}^{Out} \]

• Change in Exports

\[ X_t - X_{t-1} = \left( X_{t}^{Cont} - X_{t-1}^{Cont} \right) + \left( X_{t}^{Entry} - X_{t-1}^{Out} \right) \]

<table>
<thead>
<tr>
<th>Value (FOB)</th>
<th>Volume (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t=Pre )</td>
<td>( t=Post )</td>
</tr>
<tr>
<td>Total</td>
<td>10.9%</td>
</tr>
<tr>
<td>Intensive</td>
<td>10.6%</td>
</tr>
<tr>
<td>Extensive</td>
<td>0.3%</td>
</tr>
<tr>
<td>Entry</td>
<td>8.4%</td>
</tr>
<tr>
<td>Exit</td>
<td>-8.1%</td>
</tr>
</tbody>
</table>
Result II – Credit Shocks and the Intensive Margin of Trade

\[
\ln(X_{ipdPost}) - \ln(X_{ipdPre}) = \alpha_{pd} + \eta \cdot [\ln(C_{iPost}) - \ln(C_{iPre})] + \epsilon_{ipd}
\]

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Change in volume for continuing flows (kg)</th>
<th>( \Delta \ln X_{ipd} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>IV</td>
</tr>
<tr>
<td>( \Delta \ln C_i )</td>
<td>0.025(^{\dagger})</td>
<td>0.227(^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.068)</td>
</tr>
<tr>
<td>( \Delta \ln C_i \cdot Large\ firms )</td>
<td>0.078(^{\dagger})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.161)</td>
<td></td>
</tr>
<tr>
<td>( \Delta \ln C_i \cdot Large\ flows )</td>
<td>0.271(^{**})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td></td>
</tr>
</tbody>
</table>

Product-Destination FE | Yes | Yes | Yes | Yes |
\# Product-Destinations | 5,997 | 5,997 | 5,997 | 5,997 |
Observations           | 14,209 | 14,210 | 14,211 | 14,212 |
\( R^2 \)              | 0.438 |      |      |      |
Result II – Credit Shocks and the Intensive Margin of Trade

• Intensive margin of trade is elastic to credit shocks ($\eta = 0.23$)
  ▶ Elasticity is not related to size of the firm
  ▶ Large export flows are very elastic to credit shocks
  ▶ We interpret $\eta$ as elasticity to overall finance (not only bank credit)

• What did we learn about cost structure of the firm?
  ▶ Credit supply affects variable cost of exporting
  ▶ Specific to export activity: letter of credit, insurance
  ▶ General to production: cost of working capital

• Crucial to control for demand
  ▶ Counterfactual exercise aggregating exports by firm leads to bias of 65%
  ▶ Largest bias from not controlling for changes by destination
Result III – Credit Shocks and the Extensive Margin of Trade

- **Entry**: \# new firm-product-destination flows ($N_{Fpdt}^E$)
- **Continuation**: \# firm-product-destination flows that continue ($N_{Fpdt}^C$)
- $F = \{1, 0\}$: Group firms in *affected* and *non-affected*

\[
\ln(N_{FpdPost}) - \ln(N_{FpdPre}) = \alpha_{pd} + \nu \cdot \left[ \ln \left( \sum_{i \in F} C_{iPost} \right) - \ln \left( \sum_{i \in F} C_{iPre} \right) \right] + \epsilon_{Fpd}
\]

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Entry</th>
<th>Continuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln N_{Fpd}^E$</td>
<td>$\Delta \ln N_{Fpd}^C$</td>
<td>$\Delta \ln N_{Fpd}^C$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Small Flows</strong></td>
<td><strong>Large Flows</strong></td>
</tr>
<tr>
<td>$\Delta \ln(\sum_{i \in F} C_i)$</td>
<td>0.232</td>
<td>0.363***</td>
</tr>
<tr>
<td>(0.185)</td>
<td>(0.095)</td>
<td>(0.138)</td>
</tr>
<tr>
<td>Product-Destination FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>3,088</td>
<td>4,658</td>
</tr>
</tbody>
</table>
Result III – Credit Shocks and the Extensive Margin of Trade

• Credit shocks affect the probability of continuing for small export flows
  ▶ Large export flows are less elastic to credit shocks
  ▶ Exports are very skewed: small (below median) export flows account for negligible portion of overall exports

• Entry margin not affected by credit shock

• What did we learn about cost structure of the firm?
  ▶ Consistent with credit supply affecting variable cost of exporting in the presence of fixed costs
  ▶ Increase in variable cost pushes small export flows out of market
  ▶ Not compelling evidence for important entry sunk cost
Conclusions

- Shocks to banks have real outcome consequences
  - Banks transmit shock to related firms
  - Large export flows: negative credit shock affects quantities exported
  - Small export flows: negative credit shock triggers exit from export markets
  - Credit shocks affect variable cost of exporting

- Contribution of Finance to Overall Export Decline in Peru
  - Share of credit by exposed banks: 30.5%
  - Drop in credit supply by exposed banks: 17%
  - Overall drop in volume exports due to finance: –2.1%

<table>
<thead>
<tr>
<th></th>
<th>Annual Export Growth (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t=Pre</td>
</tr>
<tr>
<td>Total</td>
<td>3.2%</td>
</tr>
<tr>
<td>Intensive</td>
<td>2.1%</td>
</tr>
<tr>
<td>Extensive</td>
<td>1.2%</td>
</tr>
<tr>
<td>Entry</td>
<td>8.6%</td>
</tr>
<tr>
<td>Exit</td>
<td>-7.4%</td>
</tr>
</tbody>
</table>