Crises and Recoveries: A Disaggregated Approach

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January 2008
Financial Crises in the 1990s (Argentina, Mexico, East Asian countries) have had significant real effects

- Large fall in output and investment
- Current Account reversal
- Real Exchange Rate depreciation
- Slow Recovery: output below trend for several years after the crisis
Growth Accounting Exercises (Bergoeing, Kehoe et.al 2002, Meza and Quintin 2007) show that the output drop is due to fall in TFP, not measured inputs

Questions

- What are the channels through which a crisis is propagated (that looks like a TFP shock)?

- What accounts for the slow recovery of the economy after the crisis?
A look at the disaggregated data provides important insights into the propagation of crises.

Output of traded goods falls less and recovers faster than non traded goods.

(Balance Sheet effects could be important)

Labor is reallocated from the non traded goods sector to the traded goods sector, but by less than the increase in relative output.

(Labor adjustment costs between sectors could be important).
Construct a quantitative general equilibrium two sector model with an endogenous mechanism that looks like a negative TFP shock

Calibrate it to the Mexican economy

Taking as given a sudden stop as in Dec. 1994:

Can we explain what happened in the Mexican crisis and recovery?
MAIN MECHANISMS

Source: unexpected cut in foreign lending (sudden stop)

• Increased demand for domestic savings
  – Makes traded goods more valuable (economy saves in traded goods)
    * Real Exchange Rate Depreciation
    * Reallocation of labor to traded goods sector

• Increase in interest rates makes borrowing more expensive
  – Financial frictions become important
• **Working capital constraint**: Intermediate goods must be bought with (short term) loans
  
  – user cost of intermediate goods increases (distorting tax on intermediate goods)

  – Observationally equivalent to a negative TFP shock which affects current output
• **Investment constraint**: investment must be financed out of current profits and loans subject to a borrowing limit

... firm’s net worth decreases, tightening the constraint

• ... investment falls (financial accelerator)
  ... making the drop in output persistent

• Non-traded firms must borrow in traded goods
  ... the real exchange depreciation affects their balance sheets
  ... investment falls more and output stagnates longer in the non-traded sector
Real Exchange Rate and Interest Rates

![Real Exchange Rates Graph](image1)

![Interbank Rate Graph](image2)
GDP in the Traded and Non Traded Goods Sector

Aggregate GDP

GDP in the traded goods sector  GDP in the non traded goods sector
Labor Reallocation across Sectors
Figure 0.1: Energy Consumption

- Fall in Demand for Intermediate Goods
• Fall in Credit and Investment
• Balance Sheet Effects on Investment

<table>
<thead>
<tr>
<th></th>
<th>Low Exports</th>
<th>High Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Debt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>89-94</td>
<td>17.6</td>
<td>7.14</td>
</tr>
<tr>
<td>95-00</td>
<td>16.2</td>
<td>5.54</td>
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<tr>
<td>High Debt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>89-94</td>
<td>217</td>
<td>226</td>
</tr>
<tr>
<td>95-00</td>
<td>108</td>
<td>201</td>
</tr>
</tbody>
</table>

Firm Level Investment by Debt and Exports

Source: Pratap and Urrutia (2004), Mexican stock market data
A MODEL WITH WORKING CAPITAL CONSTRAINTS

- Four production sectors
  - Traded good: domestic consumption, net exports
  - Non-Traded good: domestic consumption
  - Intermediate good
  - Investment good

- Representative consumer

- Competitive financial intermediaries
Traded good Sector

- Representative Firm

- Production Function

\[ Y = A_T \left[ \left( k^{\alpha_T l^{1-\alpha_T}} \right)^{\varepsilon_T} m^{1-\varepsilon_T} \right]^v \]

- Capital accumulated through investment \( x_t \):

\[ k_{t+1} = (1 - \delta) k_t + x_t \]
- Working capital constraint: A fraction $\psi$ of intermediate goods must be bought in advance with loans

- Static profit function

$$\Pi^T_t (k) = \max_{\{Y, l, m\}} \{Y - w_l l - (1 + \psi \hat{r}_{t+1}) p_t^m m \}$$

s.to

$$Y = A_T \left[ (k^{\alpha_T} l^{1-\alpha_T})^{\epsilon_T} m^{1-\epsilon_T} \right]^v$$

$\hat{r}_{t+1}$: domestic interest rate ($\hat{r}_{t+1} = r^* + \mu$)

- $\mu$ : (small) intermediation cost
• Firms can finance investment by issuing equity (negative dividends)

• Dynamic problem

\[ V_t^T(k) = \max_{\{x,k'\}} \left\{ \prod_t^T(k) - p_t^x x - c_K \left(\frac{x}{k}\right)^2 + \left(\frac{1}{1 + r_{t+1}}\right) V_{t+1}^T(k') \right\} \]

s.to. \[ k' = (1 - \delta) k + x \]

c_K (small) adjustment cost of capital
Similarly for Non-Traded Sector:

- Static profit function

\[
\Pi_t^N (k) = \max_{\{Y,l,m\}} \left\{ p_t^n Y - w_t l - (1 + \psi \hat{r}_{t+1}) p_t^m m \right\}
\]

s.to \quad Y = A_N \left[ \left( k^{\alpha_N} l^{1-\alpha_N} \right)^{\varepsilon_N} m^{1-\varepsilon_N} \right]^{\nu}

- Bellman equation

\[
V_t^N (k) = \max_{\{x,k'\}} \left\{ \Pi_t^N (k) - p_t x - c_K \left( \frac{x}{k} \right)^2 + \left( \frac{1}{1 + r^*} \right) V_{t+1}^N (k') \right\}
\]

s.to. \quad k' = (1 - \delta) k + x
Intermediate good Sector

$$\max \left\{ M_t, M_t^T, M_t^N \right\} \left\{ p_t^m M_t - M_t^T - p_t^n M_t^N \right\}$$

s.to \hspace{1em} M_t = A_m \left( M_t^T \right)^{\phi} \left( M_t^N \right)^{1-\phi}

Investment good Sector

$$\max \left\{ X_t, X_t^T, X_t^N \right\} \left\{ p_t^x X_t - X_t^T - p_t^n X_t^N \right\}$$

s.to \hspace{1em} X_t = A_x \left( X_t^T \right)^{\eta} \left( X_t^N \right)^{1-\eta}$$
Representative consumer

\[
\max_{\{C_t^T, C_t^N, s_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \left[ \lambda \log (C_t^T) + (1 - \lambda) \log (C_t^N) \right]
\]

s.t.
\[
C_t^T + p_t^n C_t^N + s_{t+1} = w_t^T l_t^T + w_t^N (1 - l_t^T) - c_L (l_t^T - l_{t-1}^T)^2 + (1 + r^*) s_t + \pi_t
\]

\(s_{t+1}\): savings

\(\pi_t\): dividends

\(c_L\): cost of adjustment of labor
Calibration: Production function parameters calibrated to input output tables for Mexico, updated in 1993

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Target</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of T to N consumption</td>
<td>0.45</td>
<td>$\lambda$</td>
<td>0.31</td>
</tr>
<tr>
<td>Ratio of T to N investment goods</td>
<td>0.98</td>
<td>$\eta$</td>
<td>0.48</td>
</tr>
<tr>
<td>Returns to Scale Parameter</td>
<td></td>
<td>$\nu$</td>
<td>0.9</td>
</tr>
<tr>
<td>Ratio of intermediate goods to V.A. in T</td>
<td>1.10</td>
<td>$\varepsilon_T$</td>
<td>0.42</td>
</tr>
<tr>
<td>Ratio of wage bill to V.A. in T</td>
<td>0.52</td>
<td>$\alpha_T$</td>
<td>0.34</td>
</tr>
<tr>
<td>Ratio of intermediate goods to V.A. in N</td>
<td>0.44</td>
<td>$\varepsilon_N$</td>
<td>0.66</td>
</tr>
<tr>
<td>Ratio of wage bill to V.A. in N</td>
<td>0.64</td>
<td>$\alpha_T$</td>
<td>0.25</td>
</tr>
<tr>
<td>Ratio of T inputs to total intermediates in T Sector</td>
<td>0.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio of T inputs to total intermediates in N sector</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighted average of ratios</td>
<td></td>
<td>$\phi$</td>
<td>0.55</td>
</tr>
</tbody>
</table>
Parameters calibrated using the steady state of the model

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Target</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>World interest rate</td>
<td>0.05</td>
<td>$r^*$</td>
<td>0.05</td>
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<tr>
<td>Depreciation rate</td>
<td>0.10</td>
<td>$\delta$</td>
<td>0.10</td>
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<tr>
<td>Intermediation cost</td>
<td></td>
<td>$\mu$</td>
<td>0.01</td>
</tr>
<tr>
<td>Trend (long run) growth rate</td>
<td>0.03</td>
<td>$\gamma$</td>
<td>0.03</td>
</tr>
<tr>
<td>Stationary Investment rate in T sector</td>
<td>0.26</td>
<td>$A_T$</td>
<td>1.4</td>
</tr>
<tr>
<td>Stationary Investment rate in N sector</td>
<td>0.14</td>
<td>$A_N$</td>
<td>0.7</td>
</tr>
<tr>
<td>Stationary Fraction of Labor in T sector</td>
<td>0.25</td>
<td>$A_m$</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$A_x$</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Cost of adjustment \((c_K, c_L)\) and initial savings \((s_0)\) calibrated to the first six periods of the transitional path of the economy after a financial liberalization (Mexico, 1988-94)

Starting from steady state with high intermediation cost, at date 0 intermediation costs decline over the transition.
1. 

- **Real GDP in T Sector (1988=100)**
- **Real GDP in the N Sector (1988=100)**
- **Labor Share of T Sector**
- **Current Account to GDP Ratio**
SUDDEN STOP EXPERIMENT

Starting from initial conditions given by the 8th period of the transition after financial liberalization (Mexico, 1994)

... the economy faces an unexpected sudden stop

... for two periods, the economy cannot borrow from abroad

... the domestic interest rate adjusts to clear the credit market
Traded goods become more valuable, so labor reallocates towards T Sector

Reallocation is costly (adjustment cost for capital, labor, intermediates effects)

... the relative price of T/N goods the real exchange rate increases
The model generates large effects in output

... accounts for about 40% of the observed drop in detrended GDP
Main discrepancies with data:

- Traded good sector recovers slower than non traded goods sector since T sector uses intermediates more intensively
Need a mechanism that increases the persistence of the sudden stop effects and amplifies them for the non-traded sector

Borrowing Constraints on Investment based on Collateral Constraints

Devaluation damages collateralizable net worth of N sector more than T sector.

Allows Traded goods sector to invest more and recover faster than non traded goods sector.
CONCLUSIONS

- Simple financial frictions can account for an important part of the immediate real effects of a sudden stop

- Model seems consistent with the Mexican experience in the short run

- Next Step: Does adding borrowing constraints on investment make the model consistent with recovery in the long run?