CREDIT SHOCKS IN AN ECONOMY WITH HETEROGENEOUS FIRMS AND DEFAULT

by Aubhik Khan, Tatsuro Senga and Julia K. Thomas

Discussed by Urban Jermann
Contribution

- Present GE model with heterogenous firms and default

Similar objectives as Gomes and Schmid (2010), Arellano, Bai and Kehoe (2012)

Solve & calibrate the model, and study TFP and credit shocks

Credit shocks have persistent effects on N, I and GDP

Slow recovery

Fluctuations in entry and exit are important
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Model

- Firms’ production function

\[ y_i = z \epsilon_i k_i^a n_i^\nu, \quad \alpha + \nu < 1 \]

- $z$ aggregate TFP
- $\epsilon_i$ firm specific TFP
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- \( k_i' = (1 - \delta) k_i + i_i \)
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- Fixed cost

\[ \zeta_0 \]
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- Fixed cost

\[ \zeta_0 \]

- Labor choice

\[ \pi (k, \varepsilon; s, \mu) = \max_n z \varepsilon k^\alpha n^\nu - \omega (s, \mu) n \]
\[ = (1 - \nu) y (k, \varepsilon; s, \mu) \]
Financing

- One-period defaultable debt

  due : \( b_i \)
  
  sold : \( q (k'_i, b'_i, \epsilon_i; s, \mu) b'_i \)
Financing

- One-period defaultable debt

  due : \( b_i \)

  sold : \( q \left( k'_i, b'_i, \varepsilon_i; s, \mu \right) b'_i \)

- Financial fixed cost

  \( \chi_\theta (s) \bar{\zeta}_1 (\varepsilon) \), with

  \( \chi_\theta (s) = 1, \) if \( \theta \in \) crisis

  \( \chi_\theta (s) = 0, \) if \( \theta \notin \) crisis
Financing

- One-period defaultable debt

  due: \( b_i \)

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- Financial fixed cost

  \[ \chi_\theta \left( s \right) \zeta_1 \left( \varepsilon \right), \quad \text{with} \quad \chi_\theta \left( s \right) = 1, \text{if } \theta \in \text{crisis} \]
  \[ \chi_\theta \left( s \right) = 0, \text{if } \theta \notin \text{crisis} \]

- Cash on hand

  \[ x \left( . \right) = \left( 1 - \nu \right) y \left( . \right) + \left( 1 - \delta \right) k - b - \zeta_0 - \chi_\theta \left( s \right) \zeta_1 \left( \varepsilon \right) \]
Financing

- One-period defaultable debt
  
  \[ \text{due : } b_i \]

  \[ \text{sold : } q (k'_i, b'_i, \varepsilon_i; s, \mu) b'_i \]

- Financial fixed cost
  
  \[ \chi_{\theta}(s) \xi_1(\varepsilon), \text{ with } \begin{align*} 
  \chi_{\theta}(s) &= 1, \text{ if } \theta \in \text{ crisis} \\
  \chi_{\theta}(s) &= 0, \text{ if } \theta \notin \text{ crisis} 
  \end{align*} \]

- Cash on hand
  
  \[ x(.) = (1 - \nu) y(.) + (1 - \delta) k - b - \bar{\xi}_0 - \chi_{\theta}(s) \xi_1(\varepsilon) \]

- Dividends
  
  \[ D = x - k' + q(.) b' \]
Financing

- One-period defaultable debt
  
  due : $b_i$
  
  sold : $q(k'_i, b'_i, \varepsilon_i; s, \mu) b'_i$

- Financial fixed cost
  
  $\chi_\theta(s) \xi_1(\varepsilon)$, with
  
  $\chi_\theta(s) = 1$, if $\theta \in \text{crisis}$
  
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- Cash on hand
  
  $x(.) = (1 - \nu) y(.) + (1 - \delta) k - b - \xi_0 - \chi_\theta(s) \xi_1(\varepsilon)$

- Dividends
  
  $D = x - k' + q(.) b'$

- Nonnegative dividends, no external equity
  
  $D \geq 0$
Firms with negative equity default

\[ V^1(x, \varepsilon; s_l, \mu) = \pi_d x + (1 - \pi_d) V^2(x, \varepsilon; s_l, \mu) < 0 \]
Firms with negative equity default

\[ V^1(x, \varepsilon; s_l, \mu) = \pi_d x + (1 - \pi_d) V^2(x, \varepsilon; s_l, \mu) < 0 \]

with

\[ V^2(.) = \max_{k', b'} \left[ x - k' + q(.) b' + \sum_{m=1}^{N_s} \pi_{lm}^s d_m(s_l, \mu) \sum i j \pi_{ij}^e V^0(.) \right] \]

subject to

\[ x - k' + q(.) b' \geq 0 \]
Debt pricing

\[ q(k', b', \varepsilon_i; s_l, \mu) b' = \]

\[ \sum_{m=1}^{N_s} \pi_{lm}^s d_m (.) \sum \pi_{ij}^\varepsilon \left[ \chi \left( x'_{jm}, \varepsilon_j; s_m, \mu' \right) b' + \left( 1 - \chi(.) \right) \min \{ b', \rho(\theta)(1 - \delta) k \} \right] \]
Frictions in the model

- Default cost
Frictions in the model

- Default cost
- Nonnegative dividends / no equity injection
Frictions in the model

- Default cost
- Nonnegative dividends / no equity injection
- Financial (crisis) fixed cost $\chi_\theta (s) \xi_1 (\varepsilon)$
Frictions in the model

- Default cost
- Nonnegative dividends / no equity injection
- Financial (crisis) fixed cost $\chi_{\theta} (s) \xi_1 (\varepsilon)$
- Exit & entry
Credit Shock
Many moving parts

- Credit shock = Recovery shock + Fixed cost shock
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- Default vs Entry&Exit
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  - Pareto distribution with lower bound $k_0$ and curvature parameter $\kappa_0$
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- Firm specific "Disaster Shocks"
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- Credit shock = Recovery shock + Fixed cost shock
- Default vs Entry&Exit
- Capital distribution at entry
  - Pareto distribution with lower bound $k_0$ and curvature parameter $\kappa_0$
- Firm specific "Disaster Shocks"
  - 10% probability of $\varepsilon = 0$
Simplified partial equilibrium model

\[ V(x) = \]

\[ = \max_{k', b'} \left[ x - k' + q(k', b')b' + \beta E \max \left\{ \left( A\epsilon' k' \frac{a}{1 - \nu} + (1 - \delta) k' \right), 0 \right\} \right] \]
Simplified partial equilibrium model

\[ V(x) = \]

\[ = \max_{k', b'} \left[ x - k' + q(k', b')b' + \beta E \max \left\{ \left( A\epsilon' k' \frac{a}{1-v} + (1 - \delta) k' \right), 0 \right\} \right] \]

Assume

\[ k' = q(b')b' + x \]
Simplified partial equilibrium model II

\[
\max_{B'} \beta E \int_{\epsilon'^* (B')}^{\bar{\epsilon}'} \left\{ \epsilon' \left[ A (B' + x)^{\frac{a}{1-v}} + (1 - \delta) (B' + x) \right] \right. \\
- B' R^c (B') - \tilde{\xi}_0 - \chi_\theta (\theta') \tilde{\xi} \epsilon' \left. \right\} d\Phi (\epsilon')
\]
Simplified partial equilibrium model II

\[
\max_{B'} \beta E \int_{\varepsilon^*'(B')}^{\varepsilon'} \left\{ \varepsilon' \left[ A (B' + x)^{\frac{a}{1-\nu}} \right. \right.
\left. + (1 - \delta) (B' + x) \right] \\
- B' R^c (B') - \zeta_0 - \chi_\theta (\theta') \zeta \varepsilon' \right\} d\Phi (\varepsilon')
\]

\[
\frac{B'}{\beta} = E \{ \Phi (\varepsilon^*') BR^c \}
\]

\[
+ E \left\{ \int_{\bar{\varepsilon}} \min \left[ \rho (\theta) (1 - \delta) \varepsilon' (B' + x), BR^c \right] d\Phi (\varepsilon') \right\}
\]
Optimal policies
Recovery rate shock

Reduction in recovery parameter from 0.37 to 0

Change in expected default
Change in firm value

Change in $k'$

Cash on hand, $x$
Recovery rate shock with lower interest rate

Change in expected default

Change in firm value

Change in $k^*$

Reduction in recovery parameter from 0.37 to 0, with decline of interest rate 0.05%
Fixed cost shock (balance sheet shock)
Conclusion

- Progress: GE with default and heterogeneous firms

I would like tighter calibration and more clarity in the empirical evaluation.
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  - tighter calibration and more clarity
  - more explicit empirical evaluation