Financial Frictions, Asset Prices, and the Great Recession

Zhen Huo and José-Víctor Ríos-Rull

University of Minnesota, Federal Reserve Bank of Minneapolis, CAERP, CEPR, NBER

University of Mannheim
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Very Preliminary
Facts on the last recession: I

Real output

Unemployment

Consumption

Investment

Note: Except for unemployment, figures show percentage deviation from a linear trend.

Huo & Ríos-Rull (UMN, Mpls Fed, CAERP)
Facts on the last recession: II

Wealth to output

Debt to output

Housing value to output

Housing price index
Facts on the last recession: III

TFP with total hours

Labor productivity

Labor quality

TFP with total labor inputs

Note: Figures show percentage deviation from a linear trend.

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Summary of the facts

- Large decline in main aggregate variables.

- Households deleveraging process: private debt and housing price plunged.

- Total factor productivity dropped, but labor productivity and labor quality increased.
Objective of this project

- To explore the quantitative properties of environments where recessions are caused by worse financial conditions faced by households.

- These environments have

  1. Real frictions that make difficult to switch from production of consumption goods to exports or investment.

  2. Households differing in wealth and job market prospects.

  3. A financial system used widely by households to buy houses which are inferior goods and not wanted by the super-rich.

  4. Asset prices respond to market conditions.

  5. Frictions in the goods market generate movements in measured TFP.
Ingredients of this project

- It is a small open Aiyagari/Krusell-Smith economy with a housing market and a stock market.

- Borrowing has to be collateralized by the value of housing. The financial terms available are the financial conditions and are subject to shocks.

- Like in Huo & Rios-Rull (13) there are goods market frictions that generate TFP losses, job market frictions, and adjustment costs to move into tradable production.
Findings

- A recession can be triggered by financial shocks to households.

- It shares most of the features of the Great Recession.

- Insufficient reductions in assets (housing and stocks) prices.

- For now!!
The Model
Households: Preferences

- Continuum of households that live forever ($\beta$), are subject to uninsurable idiosyncratic and aggregate shocks.

- Hholds care about quantities and number of varieties of nontradables.

\[ c_N = \left( \int_0^{I_N} c_{Ni}^{\frac{1}{\rho}} \, di \right)^{\rho} \]

- Under equal consumption of each variety: \[ c_N I_N^\rho = \left[ \int_0^{I_N} c_{Ni}^{\frac{1}{\rho}} \, di \right]^\rho \]

- Households have to search for varieties, its number is a choice.

\[ I_N = d \psi^d(Q^g) \]

$\psi^d(Q^g)$: Probability (per search unit) of finding a variety.

- Households also like tradables and housing and dislike goods searching

\[ u [c_A(c_N I_N^\rho, c_T), h, d] \]
Households: Endowments and Wealth

- Household skill type is $\epsilon$, follows a Markov chain $\Gamma_{\epsilon,\epsilon'}$. Moves slowly and accommodates opportunities to get rich.

- Households either have a job $e = 1$ or not $e = 0$.
  - Type-dependent exogenous job destruction rate $\delta^e_n$.
  - Job finding rate is type independent and depends on job creation by firms (workers are rationed, it is like no matching function in labor market but hiring costs) (Fang and Nie (2013)).

- Households have assets $a$. These assets can be allocated to (frictionless) houses and/or to financial assets with a collateral constraint. The poor will have some housing wealth and a mortgage, the rich houses and shares of the economy’s mutual fund.
Production: two sectors tradables and nontradables.

- **Tradables.**
  - Measure one of competitive firms.
  - (Large) Adjustment costs to both capital and labor.
  - Its output is used for exports, investment, and (part of) consumption.
  - $F^T(k, \ell)$ may have decreasing returns.

- **Nontradables**
  - Measure one of monopolistic firms each one producing a different variety.
  - Each firm/variety has a measure one of locations, each location has its own production function $F^N(k, \ell_1, \ell_2)$.
    - $\ell_1$ Committed to the location. (Sales staff)
    - $\ell_2$ Can be reallocated within the period. (Production Staff)
  - Locations may or may not be filled (get a customer). They produce only for consumption.
  - Firms post prices before the location is filled.
Goods markets

- Perfect competition and frictionless markets for tradables.

- Search frictions in the markets for nontradables:
  - Households look for varieties.
  - CRS matching function \( M(D, 1) \). Market tightness is \( Q^g = \frac{1}{D} \).

- Random search. There is no possibility of attracting more customers with lower prices (we are working on a paper where there is shopping and searching simultaneously).
  - The probability that a shopper finds a firm-variety: \( \Psi^d(Q^g) = \frac{M}{D} \)
  - The probability that a firm finds a shopper is the measure of filled locations or of consumers buying the good: \( \Psi^f(Q^g) = \frac{M}{1} = M(D, 1) \).
Labor market

- Workers are rationed.

- Firms hire as many workers as they wish paying hiring costs. (like a vacancy filling probability of 1, with hiring costs).

- Employment: \( N = N_N + N_T \).

- Same job finding probability across types: \( \Phi^e = \frac{V}{1-N} \).

- Wages are determined via the following formula

\[
\log w - \log \bar{w} = \varepsilon_w (\log Y - \log \bar{Y})
\]

It simplifies things.

Gornemann, Kuester, and Nakajima (2012).
Assets markets: Financial assets and houses

- Total housing $\bar{H}$ is in fixed supply.

- Negative financial assets ($b' < 0$) are (undefaultable) mortgages.
  - Its interest rate $\frac{1}{q}$ is predetermined at borrowing time,
    \[ q(\theta, b') = \begin{cases} 
    1, & \text{if } b \geq 0 \\
    \frac{1}{1+r^*} - s(\theta), & \text{if } b < 0 
    \end{cases} \]
  - Mortgages have to be collateralized by housing
    \[ q(\theta, b) \geq -\lambda(\theta) \ p_h(S) \ h \]

- Positive financial assets ($b > 0$) are shares of a mutual fund.
  - Its return is stochastic. Possible Capital gains and loses.
  - The return is
    \[ R(S, S', b) = \begin{cases} 
    1 + r(S, S'), & \text{if } b \geq 0 \\
    1, & \text{if } b < 0 
    \end{cases} \]
State variables

- A household is characterized by \( \{\epsilon, e, a\} \).

- Let \( X \) denote the measure over types \( x = \{\epsilon, e, a\} \).

- The vector of aggregate state variables is

\[
S = \{\theta, B, K_N, K_T, N_N, N_T, X\}
\]

Here \( B \) is the net foreign asset position. \( K \) and \( N \) are predetermined factor inputs.

- Hence either we do Krusell-Smith or the transition after an unforeseen shock. Today, we do the latter.
Households’ problem

\[
V(S, \epsilon, e, a) = \max_{c_{N,i}, c_T, I_N, h, d} u(c_A, h, d) + \\
\beta \sum_{\epsilon', e', \theta'} \Pi^\theta_{\epsilon', \theta'} \Pi^w_{e', e} (S') \Pi^\epsilon_{\epsilon', \epsilon'} V[S', \epsilon', e', a'(S', b, h)]
\]

subject to

\[
\int_0^{I_N} p_i(S) c_{N,i} + c_T + p_h(S) h + q(\theta, b) b = a + 1_{e=1} w(S) \epsilon + 1_{e=0} w \quad \text{BC}
\]

\[
a'(S', b, h) = p_h(S') h + R(S, S', b) b \quad \text{AA}
\]

\[
q(\theta, b) b \geq -\lambda(\theta) p_h(S) h \quad \text{FC}
\]

\[
I_N = d \Psi^d [Q^g(S)] \quad \text{SC}
\]

\[
S' = G(S, \theta') \quad \text{RE}
\]
Nontradable firms’ problem

- At each location, the production function is

\[ F^N(k, \ell_1, \ell_2) = z_N k^{\alpha_0} \ell_1^{\alpha_1} \ell_2^{\alpha_2} \]

  - \( k \) and \( \ell_1 \) are pre-installed. \( \ell_2 \) is variable to meet different demands.

- The demand function is given by

\[ c(p_i, S, x) = \left[ \frac{p_i}{p(S)} \right]^{1-\rho} c_N(S, x) \]

- When a shopper wants to buy \( c \) units of goods at a location, the amount of variable labor \( \ell_2 \) needed to produce \( c \) is

\[ f^\ell(c, k, \ell_1) = \left( c^{-1} z_N k^{\alpha_0} \ell_1^{\alpha_1} \right)^{-\frac{1}{\alpha_2}} \]

- At the posted price \( p_i \), the total variable labor needed is

\[ \ell_2 \geq \psi^f[Q^g(S)] \int f^\ell[c(p_i, S, x), k, \ell_1] \frac{d(x, S)}{D(S)} \]
Nontradable firms’ problem

\[
\Omega^N(S, k, n) = \max_{i, v, p_i} \psi^f [Q^g(S)] p_i \int c(p_i, S, x) dx - w(S) \ell - i - \kappa v \\
+ \sum_{\theta'} \prod_{\theta_\theta'}^\theta \frac{\Omega^N(S', k', n')} {1 + r^*}
\]

subject to

\[
\ell_2 \geq \psi^f [Q^g(S)] \int f^\ell [c(p_i, S, x), k, \ell_1] \frac{d(x, S)} {D(S)} \quad \text{DC}
\]

\[
\ell_1 + \ell_2 = n \bar{\epsilon}(S) \quad \text{SL}
\]

\[
k' = (1 - \delta_k) k + i - \phi^N(k, i) \quad \text{LMK}
\]

\[
n' = [1 - \bar{\delta}_n(S)] n + v \quad \text{LML}
\]

\[
S' = G(S, \theta') \quad \text{RE}
\]
Tradable firms’ problem

\[ \Omega^T(S, k, n) = \max_{i, \nu} F^T(k, \ell) - w(S)\ell - i - \kappa \nu - \phi^{T,n}(n', n) \]

subject to

\[ k' = (1 - \delta_k)k + i - \phi^{T,k}(k, i) \]
\[ \ell = n\bar{\epsilon}(S) \]
\[ n' = [1 - \bar{\delta}_n(S)]n + \nu \]
\[ S' = G(S). \]
Mutual fund

- Financial wealth in the economy is

\[
L_+ = \int_{b>0} b(S, \epsilon, e, a) \, dx
\]

- Mortgages in the economy are

\[
L_- = \int_{b<0} -b(S, \epsilon, e, a) \, dx
\]

- Net foreign asset position of the country (the mutual fund owns all firms)

\[
B = L_+ - \left( \Omega^N(S) - \pi^N(S) + \Omega^T(S) - \pi^T(S) + \frac{1}{1 + r^*L_-} \right)
\]

- The realized rate of return is

\[
1 + r(S, S') = \frac{\Omega^N(S') + \Omega^T(S') + (1 + r^*)B + L_-}{L_+}
\]
Equilibrium

An equilibrium is a set of decision rules and values for households, firms’ values and decision rules, and a set aggregate variables of aggregate states, such that:

- Households’ and firms’ policy functions and value functions solve the corresponding program problems.

- Aggregate searching consistence

\[ D(S) = \int d(S, x) \, dx, \]

- Nontradable prices satisfies

\[ p(S) = p_i(S, K_N, N_N) \, dx, \]

- Housing market clears

\[ \int h(S, x) \, dx = H. \]
Equilibrium

- Average separation probability and labor force quality
  \[
  \bar{\delta}_n(S) = \frac{\sum_{\epsilon} \delta_n(\epsilon) n(\epsilon)}{N}, \quad \bar{\epsilon}(S) = \frac{\sum_{\epsilon} \epsilon n(\epsilon)}{N}
  \]

- Rate of return to the mutual fund satisfies
  \[
  1 + r(S, S') = \frac{\Omega^N(S') + \Omega^T(S') + (1 + r^*) B + \int_{b<0} b(S, x) \int_{b>0} b(S, x)}{B}
  \]

- Wage satisfies
  \[
  \log w(S) - \log \bar{w} = \epsilon_w \left( \log Y(S) - \log \bar{Y} \right)
  \]

- The law of motion \( G(S) \) is consistent with households' decisions and employment dynamics.
Mapping the Model to Data
Functional forms

- Preferences

\[
u(c_A, h, d) = \frac{1}{1 - \sigma_c} \left( c_A - \xi_d \frac{d^{1+\gamma}}{1 + \gamma} \right)^{1-\sigma_c} + v(h)
\]

where there is an Armington aggregator for consumption

\[
c_A = \left[ \omega \left( c_N I_N^\rho \right)^{\frac{\eta-1}{\eta}} + (1 - \omega) c_T^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}
\]

- and houses are inferior goods.

\[
v(h) = \begin{cases} 
\frac{\xi_h}{1-\sigma_h} \left( h + h_1 \right)^{1-\sigma_h^1}, & \text{if } h < \hat{h} \\
\frac{\xi_h}{1-\sigma_h^2} \left( h + h_2 \right)^{1-\sigma_h^2}, & \text{if } h \geq \hat{h}.
\end{cases}
\]
Housing utility function

Policy function: consumption vs housing

Housing function with less curvature

Housing function with more curvature
Functional forms

- Production function

\[ F^N(k, l_1, l_2) = z_N k^{\alpha_0} l_1^{\alpha_1} l_2^{\alpha_2}, \quad F^T(k, l) = z_T k^{\theta_0} l^{\theta_1} \]

- Capital adjustment cost in the nontradable goods sector

\[ \phi^N(i, k) = \frac{\varepsilon^N}{2} \left( \frac{i}{k} - \delta_k \right)^2 k \]

- Capital and employment adjustment cost in the tradable goods sector

\[ \phi^{T,k}(i, k) = \frac{\varepsilon^{T,k}}{2} \left( \frac{i}{k} - \delta_k \right)^2 k, \quad \phi^{T,n}(n', n) = \frac{\varepsilon^{T,n}}{2} \left( \frac{n'}{n} - 1 \right)^2 n \]

- Matching technology

\[ M(D, T) = \nu D^\mu T^{1-\mu} \]
Exogenously determined parameters

- A period is half a quarter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk aversion for consumption, $\sigma_c$</td>
<td>2.0</td>
</tr>
<tr>
<td>Risk aversion for housing, $\sigma_c^1$</td>
<td>2.0</td>
</tr>
<tr>
<td>Risk aversion for housing, $\sigma_c^2$</td>
<td>10.0</td>
</tr>
<tr>
<td>Curvature of shopping, $\gamma$</td>
<td>2.0</td>
</tr>
<tr>
<td>Elasticity of substitution bw tradables and nontradables, $\eta$</td>
<td>0.80</td>
</tr>
<tr>
<td>Cutoff value for housing utility, $\tilde{h}$</td>
<td>2.0</td>
</tr>
<tr>
<td>Price markup, $\rho$</td>
<td>1.1</td>
</tr>
<tr>
<td>Loan to value ratio, $\lambda$</td>
<td>0.85</td>
</tr>
<tr>
<td>Interest rate for international bonds, $r^*$</td>
<td>4%</td>
</tr>
</tbody>
</table>
Endogenously determined parameters: aggregate

<table>
<thead>
<tr>
<th>Target</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wealth to output ratio</td>
<td>4.70</td>
<td>$\beta$</td>
<td>0.985</td>
</tr>
<tr>
<td>Housing value to output ratio</td>
<td>1.67</td>
<td>$\xi_h$</td>
<td>0.61</td>
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<tr>
<td>Debt to output ratio</td>
<td>0.75</td>
<td>$\epsilon_4$</td>
<td>12.51</td>
</tr>
<tr>
<td>Share of tradables</td>
<td>0.30</td>
<td>$\omega$</td>
<td>0.95</td>
</tr>
<tr>
<td>Occupancy Rate</td>
<td>0.81</td>
<td>$\nu$</td>
<td>0.81</td>
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<tr>
<td>Capital to output ratio</td>
<td>2.75</td>
<td>$\delta_k$</td>
<td>0.006</td>
</tr>
<tr>
<td>Labor Share in nontradables</td>
<td>0.64</td>
<td>$\alpha_0$</td>
<td>0.27</td>
</tr>
<tr>
<td>$\alpha_1 = \alpha_2$</td>
<td></td>
<td>$\alpha_1$</td>
<td>0.36</td>
</tr>
<tr>
<td>Labor Share in tradables</td>
<td>0.66</td>
<td>$\theta_1$</td>
<td>0.66</td>
</tr>
<tr>
<td>$1.4\theta_0 + \theta_1 = 1$</td>
<td></td>
<td>$\theta_0$</td>
<td>0.23</td>
</tr>
<tr>
<td>Vacancy cost to output ratio</td>
<td>0.02</td>
<td>$\kappa$</td>
<td>0.42</td>
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<tr>
<td>Home production to lowest earning ratio</td>
<td>0.50</td>
<td>$\bar{w}$</td>
<td>0.07</td>
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<table>
<thead>
<tr>
<th>Units Parameters</th>
<th>Value</th>
<th>$z_N$</th>
<th>0.85</th>
</tr>
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<tbody>
<tr>
<td>Output</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Relative price of nontradables</td>
<td>1</td>
<td>$z_T$</td>
<td>0.44</td>
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<tr>
<td>Market tightness in goods markets</td>
<td>1</td>
<td>$\xi_d$</td>
<td>0.03</td>
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Endogenously determined parameters: cross-section

<table>
<thead>
<tr>
<th>Target</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Job duration for type 1</td>
<td>1.5 year</td>
<td>$\delta^1_n$</td>
<td>0.083</td>
</tr>
<tr>
<td>Job duration for type 3</td>
<td>5 year</td>
<td>$\delta^3_n$</td>
<td>0.025</td>
</tr>
<tr>
<td>Job duration for type 4</td>
<td>5 year</td>
<td>$\delta^4_n$</td>
<td>0.025</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>6%</td>
<td>$\delta^2_n$</td>
<td>0.047</td>
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<tr>
<td>Wealth Gini index</td>
<td>0.82</td>
<td>$\Pi_{1,4}^\epsilon$</td>
<td>0.0003</td>
</tr>
<tr>
<td>Earning Gini index</td>
<td>0.64</td>
<td>$\Pi_{4,1}^\epsilon$</td>
<td>0.0031</td>
</tr>
<tr>
<td>Earning autocorrelation</td>
<td>0.95</td>
<td>$\Pi_{1,1}^\epsilon$</td>
<td>0.9894</td>
</tr>
<tr>
<td>Earning stdev</td>
<td>0.12</td>
<td>$\Pi_{2,2}^\epsilon$</td>
<td>0.9860</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transition matrix</th>
<th>$\epsilon_1$</th>
<th>$\epsilon_2$</th>
<th>$\epsilon_3$</th>
<th>$\epsilon_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\epsilon_1$</td>
<td>0.9894</td>
<td>0.0101</td>
<td>0.0000</td>
<td>0.0003</td>
</tr>
<tr>
<td>$\epsilon_2$</td>
<td>0.0067</td>
<td>0.9860</td>
<td>0.0067</td>
<td>0.0003</td>
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<tr>
<td>$\epsilon_3$</td>
<td>0.0000</td>
<td>0.0101</td>
<td>0.9894</td>
<td>0.0003</td>
</tr>
<tr>
<td>$\epsilon_4$</td>
<td>0.0031</td>
<td>0.0031</td>
<td>0.0031</td>
<td>0.9904</td>
</tr>
</tbody>
</table>

| Skill Value                         | 0.2259        | 0.4496        | 0.8948        | 12.50         |
### Dynamic parameters

<table>
<thead>
<tr>
<th>Target</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Decrease of investment</td>
<td>35%</td>
<td>$\varepsilon^N$</td>
<td>1.25</td>
</tr>
<tr>
<td>Increase of tradable output</td>
<td>1.5%</td>
<td>$\varepsilon^{T,n}$</td>
<td>2.80</td>
</tr>
<tr>
<td>Symmetry of tradable adjustment costs</td>
<td>$\varepsilon^{T,k} = \varepsilon^{T,n}$</td>
<td>$\varepsilon^{T,k}$</td>
<td>2.80</td>
</tr>
<tr>
<td>Decrease of TFP</td>
<td>1%</td>
<td>$\mu$</td>
<td>0.50</td>
</tr>
<tr>
<td>Wage elasticity w.r.t. output</td>
<td>0.45</td>
<td>$\varepsilon_w$</td>
<td>0.45</td>
</tr>
</tbody>
</table>
Experiments: Financial Shocks
Experiments

1. Decrease the loan to value ratio from 0.85 to 0.75 in period 1, with flexible and fixed wage.

2. Decrease the loan to value ratio from 0.85 to 0.75 gradually in 4 years, with flexible and fixed wage.

3. Increase the interest rate for borrowing from 4% to 4.3% in period 1, with flexible and fixed wage.

4. Increase the interest rate for borrowing from 4% to 4.3% gradually in 4 years, with flexible and fixed wage.

5. Increase both the loan to value ratio from 0.85 to 0.75, and the interest rate for borrowing from 4% to 4.3% gradually in 4 years, with flexible wage.
1: Sudden change of $\lambda$. **Flex. $w$**  **Fixed $w$**

- **Real output**
- **Unemployment**
- **Consumption**
- **Investment**
1 Sudden change of $\lambda$, Flex. $w$ vs Fixed $w$

Wealth

Debt

Housing price

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1. Sudden change of $\lambda$, \textcolor{blue}{Flex. $w$} \textcolor{red}{Fixed $w$}

- **TFP with total hours**
- **Labor Productivity**
- **Labor quality**
- **TFP with total labor inputs**
1. Sudden change of $\lambda$, **Flex. $w$**  **Fixed $w$**

- **Nontradable sector**

- ** Tradable sector**

- **Net export/output ratio**

- **Aggregate search**
1. Fate of the different types, flexible wage

- **Housing**

- **Debt**

- **Consumption**

- **Unemployment rate**
2, slow change of $\lambda$

- **Real output**
- **Unemployment**
- **Consumption**
- **Investment**

Huo & Rios-Rull (UMN, Mpls Fed, CAERP)

Financial Frictions & Great Recessions
2, slow change of $\lambda$  

- Flex. $w$ 
- Fixed $w$

Wealth

Debt

Housing price

Huo & Ríos-Rull (UMN, Mpls Fed, CAERP)

Financial Frictions & Great Recessions

University of Mannheim
2, slow change of $\lambda$  

- **Flex. $w$**
- **Fixed $w$**

**TFP with total hours**

**Labor Productivity**

**Labor quality**

**TFP with total labor inputs**

---

**Graphs:**

- TFP with total hours
- Labor Productivity
- Labor quality
- TFP with total labor inputs

---

**Graph Details:**

- The graphs show the impact of slow change of $\lambda$ on TFP, labor productivity, labor quality, and TFP with total labor inputs.
- The graphs compare the effects of flexible and fixed labor market characteristics.

---

**Legend:**

- **Flex. $w$**
- **Fixed $w$**

---

**Source:**

- Huo & Rios-Rull (UMN, Mpls Fed, CAERP)
- Financial Frictions & Great Recessions

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** Citation:**

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3. Sudden $\Delta \zeta$, Flex. $w$ – Fixed $w$

![Graphs showing real output, unemployment, consumption, and investment](image)
3. Sudden $\Delta \zeta$, \textcolor{blue}{Flex.} $w$ \textcolor{red}{Fixed} $w$

![Graphs showing Wealth, Debt, and Housing price changes with sudden change in $\Delta \zeta$.]
3. Sudden $\Delta \zeta$, \hspace{1cm} Flex. $w$ \hspace{1cm} Fixed $w$

- TFP with total hours
- Labor Productivity
- Labor quality
- TFP with total labor inputs
4. Slow $\Delta \zeta$, Flex. $w$ vs Fixed $w$
4, slow $\Delta \zeta$, \hspace{1cm} \textcolor{blue}{\textbf{Flex. } w} \hspace{1.5cm} \textcolor{red}{\textbf{Fixed } w}$

Wealth

Debt

Housing price
4, slow $\Delta \zeta$, \textcolor{blue}{Flex. $w$} \quad \textcolor{red}{Fixed \ w}$

TFP with total hours

Labor Productivity

Labor quality

TFP with total labor inputs

Huo & Ríos-Rull (UMN, Mpls Fed, CAERP)
5, slow change of \( \lambda \) and \( \Delta \zeta \), \textcolor{red}{\text{Flex. } w} \quad \textcolor{blue}{\text{Fixed } w}

\[\begin{align*}
\text{Real output} & \quad \text{Unemployment} \\
\text{Investment} & \\
\text{Consumption} & \\
\text{Unemployment} & \\
\text{Real output} & \\
\end{align*}\]
5, slow change of $\lambda$ and $\Delta_\varsigma$,  

Fixed $w$

![Graph showing wealth and debt over time with different scenarios.](attachment:graph.png)
5, slow change of $\lambda$ and $\Delta \zeta$, Flex. $w$  
Fixed $w$

TFP with total hours  
Labor Productivity

TFP with total labor inputs  
Labor quality
Results: larger TFP drop? Sudden change of $\lambda$ with $\mu = 0.8$

TFP with total hours

Labor Productivity

TFP with total labor inputs

Labor quality
Model properties

- All the experiments generate
  - Drop of output, employment, investment and consumption.
  - Drop of wealth, housing price and debt.
  - Drop of total productivity, increase of labor quality and labor productivity.

- With fixed wage, the recovery of employment is much slower.

- With slow change of the financial condition, the initial drop of debt is smaller, which is the case in the data.

- A decrease of the loan to value ratio $\lambda$ and an increase of borrowing cost have similar effects.
Results: an expansion? Change $\lambda$ from 0.75 to 0.85
Results: an expansion? Change $\lambda$ from 0.75 to 0.85

Housing price

Sudden change of

Slow change of

Wealth

Debt

Huo & Rios-Rull (UMN, Mpls Fed, CAERP)

Financial Frictions & Great Recessions

University of Mannheim
Results: an expansion? Change $\lambda$ from 0.75 to 0.85

- TFP with total hours
- Labor Productivity
- Labor quality
- TFP with total labor inputs

Sudden change of $\lambda$ ——— Slow change of $\lambda$
Results: a boom and bust cycle

![Graph showing loan to value ratio over time with sudden and slow change of λ]

- Sudden change of λ
- Slow change of λ
Results: a boom and bust cycle

- Real output
- Unemployment
- Consumption
- Investment

Sudden change of $\lambda$  Slow change of $\lambda$

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Financial Frictions & Great Recessions
University of Mannheim
Results: a boom and bust cycle
Results: a boom and bust cycle

TFP with total hours

Labor Productivity

Labor quality

TFP with total labor inputs

Sudden change of $\lambda$  Slow change of $\lambda$
Model properties

- All the experiments generate
  - Drop of output, employment, investment and consumption.
  - Drop of wealth, housing price and debt.
  - Drop of total productivity, increase of labor quality and labor productivity.

- With fixed wage, the initial drop of employment is larger and the recovery is much slower.

- With slow change of the financial condition, the initial drop of debt is smaller, which is the case in the data.

- A decrease of the loan to value ratio $\lambda$ and an increase of borrowing cost have similar effects.
Insufficient drop of housing price

- In the data: housing price $\downarrow$ 20%, housing value $\downarrow$ 36%.

- In the model: housing price $\downarrow$ 6% to 14%.

**Problem:**

- Rich households with deep pockets pick up the slack. Not so much in the real world.

- Large decline of housing price may force poor households default their debt. Not allowed in the model.

**Solution:**

- Housing utility function with more curvature.

- Smaller initial load to value ratio $\lambda$ gives larger room for drop of housing price without default.
Housing utility function

A three-piece housing utility function.

- A: greater curvature to prevent rich households from expanding houses.
- B: greater curvature to prevent super rich households from expanding houses.
- C: upper bound for housing holding.
Housing as a function of consumption.

- Rich households will not increase their housing by much due to decreasing marginal utility.

- Housing price has to drop more to induce poor households not to sell their houses.
Conclusions

- We have a recession generated purely by increased difficulties to borrow on the part of households.
- The recession comes together with:
  - TFP loses
  - Drop in Housing prices (movements too sharp because of lack of house frictions)
  - Drop in Stock Market
- Still insufficient drop in asset prices.
- The literature is trying hard to get this (Midrigan and Philippon (2011), Guerrieri and Lorenzoni (2009)) with limited success.
- Still ways to go.
References


