Discussion of
Illut & Saijo: Learning, Confidence and Business Cycles

Venky Venkateswaran
FRB Minneapolis

October 2018

Disclaimer: The views expressed here do not necessarily reflect the views of the Federal Reserve Bank of Minneapolis.
Beliefs and Business Cycles

*Exogenous* belief changes as drivers of aggregate fluctuations

- Lorenzoni (2009), Angeletos and LaO (2013)…..

*Endogenous* belief changes as a propagation mechanism

- van Niewerburgh and Veldkamp (2006), Senga (2018), *this paper*…..
Beliefs and Business Cycles

Exogenous belief changes as drivers of aggregate fluctuations

▶ Lorenzoni (2009), Angeletos and LaO (2013).....

Endogenous belief changes as a propagation mechanism

▶ van Niewerburgh and Veldkamp (2006), Senga (2018), this paper....

Common theme: in the data, \((Y_t, H_t, I_t..)\) only loosely linked to \((A_t, r_t, ...)\)

▶ Big role for ‘wedges’

Here: The complete package !

▶ Microfounded, quantitative comparison to other rigidities, survey data
Main Ingredients

Each firm $\ell$ sees a noisy signal of its idiosyncratic productivity

$$s_{\ell,t} = z_{\ell,t} + \nu_{\ell,t}$$

$$\nu_{\ell,t} \sim \mathcal{N}\left(0, \frac{\sigma^2_{\nu}}{K_{\ell,t}^\alpha H_{\ell,t}^{1-\alpha}}\right)$$

Noise is decreasing in $K_{\ell,t}^\alpha H_{\ell,t}^{1-\alpha}$

- A larger scale generates more information about the firm’s demand/productivity
Main Ingredients

Each firm $\ell$ sees a noisy signal of its idiosyncratic productivity

$$s_{\ell,t} = z_{\ell,t} + \nu_{\ell,t} \quad \nu_{\ell,t} \sim \mathcal{N}(0, \frac{\sigma_{\nu}^2}{K_{\ell,t}^{\alpha} H_{\ell,t}^{1-\alpha}})$$

Noise is decreasing in $K_{\ell,t}^{\alpha} H_{\ell,t}^{1-\alpha}$

- A larger scale generates more information about the firm’s demand/productivity

Ambiguity-averse agents act as if their 1-period ahead forecasts were

$$\mathbb{E}_{\ell,t}^{\mu}(z_{\ell,t+1}) = \mathbb{E}_{\ell,t}(z_{\ell,t+1}) - \eta \rho_z \sqrt{\Sigma_t|_t}$$

- Uncertainty has a first-order effect \(\rightarrow\) allows the use of linearized models
Main Ingredients

Each firm $\ell$ sees a noisy signal of its idiosyncratic productivity

$$s_{\ell,t} = z_{\ell,t} + \nu_{\ell,t} \quad \nu_{\ell,t} \sim \mathcal{N}\left(0, \frac{\sigma_{\nu}^2}{K_{\ell,t}^{\alpha} H_{\ell,t}^{1-\alpha}}\right)$$

Noise is decreasing in $K_{\ell,t}^{\alpha} H_{\ell,t}^{1-\alpha}$

- A larger scale generates more information about the firm’s demand/productivity

Ambiguity-averse agents act as if their 1-period ahead forecasts were

$$\mathbb{E}_{\ell,t}^{\mu}(z_{\ell,t+1}) = \mathbb{E}_{\ell,t}(z_{\ell,t+1}) - \eta \rho_z \sqrt{\Sigma_{t|t}}$$

- Uncertainty has a first-order effect $\rightarrow$ allows the use of linearized models

$\Rightarrow$ Propagation mechanism

- $$(K_{\ell,t}^{\alpha} H_{\ell,t}^{1-\alpha}) \downarrow \Rightarrow \Sigma_{t|t} \uparrow \Rightarrow \mathbb{E}_{\ell,t}^{\mu}(z_{\ell,t+1}) \Rightarrow K_{\ell,t+1}, H_{\ell,t+1} \downarrow$$
Wedges

The labor wedge

\[ \tau^H_t = 1 - \frac{\mathbb{E}^\mu(\lambda_tMPL_t)}{\lambda_tMPL_t} \]

- Substitution effect \( > \) wealth effects \( \Rightarrow \) countercyclical wedge labor ‘tax’
Wedges

The labor wedge

\[ \tau_t^H = 1 - \frac{\mathbb{E}^\mu(\lambda_t MPL_t)}{\lambda_t MPL_t} \]

▶ Substitution effect > wealth effects ⇒ **countercyclical** wedge labor ‘tax’

The consumption wedge

\[ 1 + \tau_t^B = \frac{\mathbb{E}^\mu(\lambda_{t+1})}{\mathbb{E}\lambda_{t+1}} \]

▶ Pessimism → high \( \mathbb{E}^\mu(\lambda_{t+1}) \) → **countercyclical** consumption ‘tax’
Wedges

The labor wedge

\[
\tau^H_t = 1 - \frac{\mathbb{E}^\mu(\lambda_t MPL_t)}{\lambda_t MPL_t}
\]

- Substitution effect > wealth effects \(\Rightarrow\) countercyclical wedge labor ‘tax’

The consumption wedge

\[
1 + \tau^B_t = \frac{\mathbb{E}^\mu(\lambda_{t+1})}{\mathbb{E}\lambda_{t+1}}
\]

- Pessimism \(\rightarrow\) high \(\mathbb{E}^\mu(\lambda_{t+1})\) \(\rightarrow\) countercyclical consumption ‘tax’

The risk premium wedge

\[
1 + \tau^K_t = (1 + \tau^B_t) \frac{\mathbb{E}(\lambda_{t+1} R^K_{t+1})}{\mathbb{E}^\mu(\lambda_{t+1} R^K_{t+1})}
\]

- Pessimism \(\rightarrow\) capital less attractive \(\rightarrow\) countercyclical ‘tax’ on risky assets
Quantitative Analysis

Strategy: embed mechanism in a standard DSGE model
  ▶ Bayesian estimation matching IRF of TFP, monetary and financial shocks

Survey evidence for external validation
  ▶ Both aggregate (from SPF) as well as firm-level (from I/B/E/S) forecasts
Quantitative Results

Learning improves fit of responses to financial shocks.

Figure 4: Responses to a financial shock (three shock estimation)
Quantitative Results

...less so for monetary policy shocks

Figure 5: Responses to a monetary policy shock
Quantitative Results

...and TFP shocks

Figure 10: Responses to a technology shock
What is special about financial shocks?
What is special about financial shocks?

Financial Shocks

MoPo shocks

TFP shocks
Financial shocks are more than just changes in lending spreads

- Likely to be associated with changes in risk aversion and/or beliefs
Discussion

Financial shocks are more than just changes in lending spreads
  ▶ Likely to be associated with changes in risk aversion and/or beliefs

More broadly, this battle is unlikely to be decided by aggregate data alone
  ▶ Need *quantitative* validation from micro data

Our best bet: Survey data
  ▶ But, what kind of surveys – moments – should we use?
The paper’s approach

Use Survey of Professional Forecasters: Dispersion in aggregate GDP forecasts
More sophisticated information processes?

- E.g. substitution between endogenous and exogenous signals?
Comments

More sophisticated information processes?
  ▶ E.g. substitution between endogenous and exogenous signals?

How should we think of analyst forecasts?
  ▶ More than one reasonable interpretation here
Comments

More sophisticated information processes?
  ▶ E.g. substitution between endogenous and exogenous signals?

How should we think of analyst forecasts?
  ▶ More than one reasonable interpretation here

Dispersion = uncertainty?
  ▶ Theory usually predicts a non-monotonic relationship
Comments

More sophisticated information processes?
  - E.g. substitution between endogenous and exogenous signals?

How should we think of analyst forecasts?
  - More than one reasonable interpretation here

Dispersion = uncertainty?
  - Theory usually predicts a non-monotonic relationship

Aggregate vs idiosyncratic uncertainty?
  - Maybe do more with firm-level forecast errors
Firm-level Evidence

Broadly support the predictions of the theory

<table>
<thead>
<tr>
<th></th>
<th>Corr(range, rgdp)</th>
<th>Std. range</th>
<th>(Std. range)/(Std. rgdp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>-0.49</td>
<td>15.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Model</td>
<td>-0.98</td>
<td>11.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Firm-level Evidence

Broadly support the predictions of the theory

<table>
<thead>
<tr>
<th></th>
<th>Corr(range, rgdp)</th>
<th>Std. range</th>
<th>(Std. range)/(Std. rgdp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>-0.49</td>
<td>15.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Model</td>
<td>-0.98</td>
<td>11.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Source: Table 4 of the paper. Range is dispersion in analyst forecasts for a given firm

Source: Bachmann et. al. (2018).
Firm-level Evidence

Source: Blue - David et. al. (2016), Green dashed - Jurado et. al. (2017)
Final Comments

Interesting, important paper

- Part of a nice research agenda

Intuitive, tractable way to embed beliefs into DSGE models

- Makes it easy for others to build on

Use of micro data is a very nice addition

- Lot more papers to be written!
How does variance affect the worst-case belief?

The worst possible distribution within a neighborhood of the Bayesian one

Blue: Bayesian, Orange: The one chosen under ambiguity