Optimal Monetary Policy in Production Networks
by Jennifer La’O and Alireza Tahbaz-Salehi

Discussed by
Mathieu Taschereau-Dumouchel

Cornell University

Federal Reserve Bank of San Francisco Macro Conference
Introduction

• Outline for this discussion
  1. Brief overview of standard production network model
  2. Overview of findings from the paper
  3. Comments and suggestions
Simplest production network model

• We have $n$ firms $i \in \{1, \ldots, n\}$ each with CRS technology

$$y_i = z_i \zeta_i l_i^{\alpha_i} \prod_{j=1}^{n} x_{ij}^{a_{ij}}$$

where $z_i$ is TFP and $\zeta_i$ is a constant.

• Look at the minimal cost of producing one unit (numeraire = wage)

$$K_i (p_1, \ldots, p_n) = \min_{x, l} l + \sum_{j=1}^{n} p_j x_{ij}$$

subject to $y_i \geq 1$

• With Cobb-Douglas

$$K_i (p_1, \ldots, p_n) = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}}$$
• We have \( n \) firms \( i \in \{1, \ldots, n\} \) each with CRS technology

\[
y_i = z_i \zeta_i l_i^{\alpha_i} \prod_{j=1}^{n} x_{ij}^{a_{ij}}
\]

where \( z_i \) is TFP and \( \zeta_i \) is a constant.

• Look at the minimal cost of producing one unit (numeraire = wage)

\[
K_i (p_1, \ldots, p_n) = \min_{x, l} \left( l + \sum_{j=1}^{n} p_j x_{ij} \right)
\]

subject to \( y_i \geq 1 \)

• With Cobb-Douglas

\[
K_i (p_1, \ldots, p_n) = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}}
\]
Simplest production network model

- We have $n$ firms $i \in \{1, \ldots, n\}$ each with CRS technology

$$y_i = z_i \zeta_i l_i^{\alpha_i} \prod_{j=1}^{n} x_{ij}^{a_{ij}}$$

where $z_i$ is TFP and $\zeta_i$ is a constant.

- Look at the minimal cost of producing one unit (numeraire = wage)

$$K_i (p_1, \ldots, p_n) = \min_{x, l} l + \sum_{j=1}^{n} p_j x_{ij}$$

subject to $y_i \geq 1$

- With Cobb-Douglas

$$K_i (p_1, \ldots, p_n) = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}}$$
• Under perfect competition, it must be that

\[ p_i = K_i (p_1, \ldots, p_n) \]

\[ p_i = \frac{1}{z_i} \prod_{j=1}^{n} p_{ij} \]

(*)

• Things to notice:
  1. Price of a good depends on its TFP and on the price of its inputs.
  2. Prices propagate downstream

• Hulten’s theorem:

\[ \frac{d \log Y}{d \log z_i} = v_i \]

where \( v_i = \frac{p_i y_i}{\sum_{j=1}^{n} p_j c_j} \) is the Domar weight of \( i \) (its sales share)
Simplest production network

• Under perfect competition, it must be that

\[ p_i = K_i (p_1, \ldots, p_n) \]

\[ p_i = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}} \] (⋆)

• Things to notice:
  1. Price of a good depends on its TFP and on the price of its inputs.
  2. Prices propagate **downstream**

• Hulten's theorem:

\[ \frac{d \log Y}{d \log z_i} = v_i \]

where \( v_i = \frac{p_i y_i}{\sum_{j=1}^{n} p_j c_j} \) is the **Domar weight** of \( i \) (its sales share)
Simplest production network

- Under perfect competition, it must be that

\[ p_i = K_i (p_1, \ldots, p_n) \]

\[ p_i = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}} \] (⋆)

- **Things to notice:**
  1. Price of a good depends on its TFP and on the price of its inputs.
  2. Prices propagate **downstream**

- **Hulten’s theorem:**

\[ \frac{d \log Y}{d \log z_i} = v_i \]

where \( v_i = \frac{p_i y_i}{\sum_{j=1}^{n} p_j c_j} \) is the **Domar weight** of \( i \) (its sales share)
Monetary policy in a network

• Network of firms with sticky prices

\[ p_i = \frac{1}{z_i} \prod_{j=1}^{n} p_j^{a_{ij}} \]

If we stabilize one price there are consequences all through supply chains.

• Standard monetary policy in many models: Stabilize the price level to minimize distortions
  ▶ Should we still target a price? Which price? Consumer price index? Producer price index? Some other average of firm prices?
  ▶ All prices are all related
Monetary policy in a network

- Network of firms with sticky prices

\[ p_i = \frac{1}{z_i} \prod_{j=1}^{n} p_{aji} \]

If we stabilize one price there are consequences all through supply chains.

- Standard monetary policy in many models: Stabilize the price level to minimize distortions
  - Should we still target a price? Which price? Consumer price index? Producer price index? Some other average of firm prices?
  - All prices are all related
Production network in the U.S.

Source: Taschereau-Dumouchel (2020), data from Factset 2015
This paper: best way to conduct monetary policy in production network

• Great question without an obvious answer!
• Two key results:
  1. No monetary policy can implement first-best allocation
  2. The optimal monetary policy takes the form

\[ \sum_{s=1}^{n} \psi_s \log p_s = 0 \]
This paper: best way to conduct monetary policy in production network

- Great question without an obvious answer!
- Two key results:
  1. No monetary policy can implement first-best allocation
  2. The optimal monetary policy takes the form

\[
\sum_{s=1}^{n} \psi_s \log p_s = 0
\]
Optimal Monetary Policy

\[ \sum_{s=1}^{n} \psi_s \log p_s = 0 \]

The paper shows that optimal policy puts larger weight \( \psi_s \) on

1. industries with larger Domar weights
   - These have the most influence from Hulten’s theorem

2. stickier industries
   - These are where the inefficiencies are largest

3. more upstream industries
   - Those have the most impact on other firms (recall prices propagate from a supplier to its customer)

4. industries with less sticky upstreams suppliers and stickier downstream customers
   - Less sticky suppliers \( \rightarrow \) own price is volatile
   - Stickier customers \( \rightarrow \) large misallocation from volatility
Comments

• Broad comments:
  ▶ Great paper!
  ▶ Elegant theory:
    • just the right ingredients to capture the main forces
    • characterize things sharply even with all the complexity

• Comments that follow
  ▶ Thoughts about big picture and next steps
  ▶ Suggestions about exposition
Thoughts/Suggestions

• **Static model in a dynamic world**
  ▶ In reality, price setting is a forward looking activity
    ▪ Firms want to minimize future cost of price adjustment
  ▶ This is absent from the paper
  ▶ Not clear what are the implications of introducing dynamics here
    ▪ Best guess: no fundamental change in main mechanism but maybe in magnitude
  ▶ Dynamics in network models can easily become intractable...
Thoughts/Suggestions

- **Only downstream propagation of shocks (I think)**
  - Under different demand structure they could also propagate upstream
    - If a customer changes its price, its sales might change and its demand from a supplier would also change. If supplier has monopoly power they might change their price.
  - This would add an additional channel for monetary policy to operate
  - Not clear how important this channel is in reality
Thoughts/Suggestions

• What if the policy maker does not know the detailed micro-structure?
  ▶ Lots of information is needed to conduct optimal monetary policy
    • Full network, price stickiness parameters, etc...
  ▶ Surprising finding from the paper: stabilizing the output gap is almost as good as the optimal policy

<table>
<thead>
<tr>
<th></th>
<th>optimal policy (1)</th>
<th>output-gap stabilization (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare loss (percent consumption)</td>
<td>2.98</td>
<td>2.99</td>
</tr>
<tr>
<td>within-industry misallocation</td>
<td>2.66</td>
<td>2.67</td>
</tr>
<tr>
<td>across-industry misallocation</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>output gap volatility</td>
<td>(10^{-5})</td>
<td>0</td>
</tr>
<tr>
<td>Cosine similarity to optimal policy</td>
<td>1</td>
<td>0.9957</td>
</tr>
</tbody>
</table>

▶ Is that a general result? Or is it a coincidence?
▶ Would be very interesting if a general (Hulten like) result could be established
Concluding thoughts

• Great paper!
• Opens the door to further work on this topic