Middlemen and Private Information

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Introduction

Why are many trades executed through middlemen? Middlemen mitigate trading frictions:
- Middlemen reduce the search cost.
- Middlemen reduce consumers’ uncertainty about the quality of goods.

Some aspects about middlemen:
- Middlemen emerge endogenously.
- Middlemen have an informational advantage over other agents.
- Middlemen are trade agencies only.
- Middlemen may or may not be trustworthy.
Model: Production, preferences, and trade

• A continuum of infinitely lived agents.

• Production and consumption

  one good \( \begin{cases} 
  H: \text{production cost } \gamma, \text{utility } u. \\
  L: \text{production cost } 0, \text{utility } 0. 
\end{cases} \)

• Storage:
  Commodities are freely disposable, divisible and storable at no cost but only one unit of one good at a time. Goods are not storable if divided.
Model: Information

- In a meeting, an agent can recognize quality of the goods in trade with prob. $\theta < 1$.
- To be a middleman, an agent has to give up the production technology and pay investment cost $\delta$ to acquire the quality-testing technology, and cost $\gamma$ to get one unit of high quality goods. In every period of time, middlemen have to pay cost $\delta$ to maintain their technology.
- The identity of middlemen and the fact that they always recognize quality of goods are public information.
- Trading histories are private information.
Model: Meeting technology and trade

- Agents meet pairwise and at random.
- When two producers meet...
- When a producer meets a middleman:

  $$\text{producer} \quad \xrightarrow{1 \text{ unit of good}} \quad \text{middleman} \quad \xleftarrow{1 - q \text{ unit of good}}$$

- $q$ is determined by the take-it-or-leave-it offer proposed by the middlemen.
Strategy

• Entry strategy: agents choose to be an expert middleman or a producer.

• For a producer:
  1. Production strategy: producing $H$ or $L$.
  2. Trading strategy:
     $\Sigma = \text{prob (a random agent accepts unrecognized goods)}$ 
     $\sigma = \text{the best response}.$

• For a middleman:
  Trading strategy: whether to trade for $L$.
  $\Omega = \text{prob (a random middleman accepts } L)\,$
  $\omega = \text{the best response}.$
Equilibrium

- Agents choose entry, production, and trading strategies to maximize the expected discounted utility, taking as given the strategies of others and meeting probabilities.
- We look for nondegenerate stationary Nash equilibrium.
- $V_{Pj}$ and $V_{Ij}$: the value functions for a producer and a middleman, holding a commodity of quality $j$, where $j = H$ and $L$. 
Equilibrium

- S-S eqm where people do not change career decisions: Best response condition:

\[
\begin{align*}
V_{PH} > -\delta + V_{IH} & \Rightarrow P_I = 1 \\
V_{PH} < -\delta + V_{IH} & \Rightarrow P_I = 0 \\
P_I \in (0, 1) & \Rightarrow V_{PH} = -\delta + V_{IH}.
\end{align*}
\] (1)

- Participation condition for middlemen with L:

\[ V_{IL} \geq 0. \] (2)

- Best response condition for production:

\[
\begin{align*}
V_{PH} - \gamma > V_{PL} & \Rightarrow P_{PH} = 1 \\
V_{PH} - \gamma < V_{PL} & \Rightarrow P_{PH} = 0 \\
P_{PH} \in (0, 1) & \Rightarrow V_{PH} - \gamma = V_{PL}.
\end{align*}
\] (3)
Equilibrium

\[
\begin{align*}
rv_{PH} & = (1 - P_I)[\theta P_{PH}\alpha(u + Z - V_{PH}) \\
& + (1 - \theta) \max_\sigma \sigma A_P \\
& + P_I\{\theta P_{IH}[(1 - Q_H)u + Z - V_{PH}] \\
& + (1 - \theta) \max(A_I, 0)\} 
\end{align*}
\]

(4)

where

\[
\begin{align*}
\alpha & = \theta + (1 - \theta)\Sigma \\
A_P & = P_{PH} \alpha(u + Z - V_{PH}) + (1 - P_{PH})(Z - V_{PH}) \\
A_I & = P_{IH}[(1 - Q_H)u + Z - V_{PH}] + (1 - P_{IH})(Z - V_{PH}).
\end{align*}
\]
Equilibrium

$V_{PL}$, $V_{IH}$ and $V_{IL}$ satisfy similar Bellman’s equations:

\begin{align*}
    rV_{PL} &= (1 - P_i)P_{PH}(1 - \theta)\sum (u + Z - V_{PL}) \\
            &\quad + P_i P_{IH} \Omega (1 - Q_L)(u + Z - V_{PL}) \\
    rV_{IH} &= (1 - P_i)[P_{PH} Q_H u \\
            &\quad + (1 - P_{PH}) \max_{\omega} \omega(Q_L u + V_{IL} - V_{IH})] - \delta \\
    rV_{IL} &= (1 - P_i)P_{PH} (1 - \theta)(V_{IH} - V_{IL}) - \delta.
\end{align*}

(5) \quad (6) \quad (7)
Definition

A stationary equilibrium is a vector of value functions $V$, trading strategies $\tau$, and distribution of types and inventory holdings $P$, such that

1. given $Q$, $\tau$, and $P$, the value functions $V$ satisfy equations (4) – (7);
2. given $V$, $Q$, $P$ and $\Omega$, $\sigma = \Sigma$ solves the maximization problem in (4), and given $V$, $Q$, $P$ and $\Sigma$, $\omega = \Omega$ solves the maximization problem in (6);
3. given $V$, prices $Q$ are consistent with take-it-or-leave-it offers;
4. given $P_{IH} < 1$, the participation condition (2) is satisfied;
5. given $V$ and $\tau$, $P_I$ satisfies (1), $P_{PH}$ satisfies (3) and $P_{IH}$ satisfies S-S condition.
Equilibrium

• We can rule out some cases: (1) $P_I = 1$, (2) $P_{PH} = 0$, (3) $\Sigma = 0$.

• ALGORITHM:
  — Put the candidate strategic parameters for each type of equilibrium into the Bellman’s equations.
  — Solve for restrictions on the parameter values such that the best response conditions are satisfied.
Equilibrium

• When $\theta = 1$, only $H$ is produced and there is no role for middlemen.

• $\theta < 1$:
  • Eqm without middlemen ($P_I = 0$)
  • Eqm with middlemen who trade high quality goods only ($\Omega = 0$)
  • Eqm with middlemen who trade high and low quality goods ($\Omega \neq 0$).
Results

- Whenever there exist an eqm with middlemen always trading \( H \), there also exists the first best eqm.
- When the information problem is sufficiently severe but not too severe, and \( \delta \) is big enough – eqm without middlemen.
- As \( \delta \) decreases, there arise eqm with middlemen who always trade \( H \).
- When the information problem is relatively severe – eqm with middlemen who trade \( H \) and \( L \).
- When the information problem is very severe, no high quality goods would be produced without middlemen. – middlemen certainly improve welfare.
Welfare

• We discuss welfare for the eqm with trustworthy middlemen.

• Welfare criterion:

\[ W = P_I V_{IH} + (1 - P_I)[P_{PH} V_{PH} + (1 - P_{PH}) V_{PL}] . \]

• Equilibrium with \( P_{PH} = \Sigma = 1 \) entails the highest welfare.

• Intermediary equilibrium with \( \Sigma = 1 \) yields higher welfare than the equilibrium with \( \Sigma \in (0, 1) \).
Welfare

• What is the optimal number of middlemen?
  • The optimal number of middlemen for equilibrium with \( \Sigma = 1 \) is zero.
  • There is a strictly positive optimal number of middlemen for some parameter values in equilibrium with \( \Sigma \in (0, 1) \).

• Do we get the “right” number of middlemen?
  “Too many middlemen” – Policy intervention in regulating intermediation
Conclusion

- The feasibility and properties of intermediation depend on the extent of private information and the cost of middlemen’s quality verification technology.
- The welfare-improving role of middlemen depends on the relative efficiency and cost of intermediation to the economy.
- The too many middlemen result raises the issue of policy intervention in obtaining efficient intermediation.