The Flattening of the Phillips Curve and the Learning Problem of the Central Bank

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Introduction

- Theme: optimal policy of an uninformed central bank

  Feasibility? Answer depends on:
  - Reasons for price stickiness: exogenous or microfounded

- Framework: L'Huillier (2019)

- Snapshot of model:
  1. Inflation as the guiding star for monetary policy
  2. Microfounded model of stickiness
  3. Short-run and long-run objectives

Implications for Dual Mandate

- Short-run and long-run objectives:

  Short-Run: Minimize size of fluctuations
  Long-Run: Price stability

- Positive results:
  - Phillips curve endogenously flattens

- Normative results:
  - Exogenous stickiness:
    Short-run and long-run objectives are independent
  - Microfounded stickiness:
    Short-run and long-run objectives interact
    Achieving both may not be feasible

Model

- Central bank (CB), firms, consumers
- CB learns from prices and maximizes welfare
- Firms decide to adjust, or not, optimally
  Microfoundation for price stickiness

Model

- Aggregate state: Determines nominal spending
- 3 periods
  - Periods 1+2: Short run
    decentralized market
  - Period 3: Long run
    centralized, competitive market
- For ease of exposition: partial equilibrium

Consumers

- Preferences of consumer i:

$$\max_{c_{1i}, c_{2i}, C_{3i}} E[u(c_{1i}) + u(c_{2i}) + C_{3i}]$$

$$\text{s.t. } p_1 c_{1i} + p_2 c_{2i} + P_3 C_{3i} = Income$$

- Goods:
  - c_{1i} and c_{2i}: decentralized market
  - C_{3i}: centralized market

- Short-run demand function: $\mathscr{D}_t(E[p_t/P_3]),\ t = 1, 2$

Firms

Decentralized Market (Short Run $t = 1, 2$)

- Mass of islands, one firm per island (monopolist)
  - Each island visited by a random mass of consumers
  - Price stickiness due to information friction
    - Details later

- Marginal cost: k
  high- and low-cost firms: $k_h > k_l$
  (this allows for heterogeneity in price adjustment)

Centralized Market (Long Run $t = 3$)

- Representative firm.

Aggregate State

- Aggregate state S_t
  - Matters only for the determination of long-run price:

$$P_3 = S_3$$

  - Generates shifts in short-run nominal spending $\mathscr{D}_t(E[p_t/P_3])$
- Two components:
  - Exogenous shock: D_t
  - Policy: M_t
- D_t and M_t map into state S_t: $S_t = \mathscr{S}(S_{t-1}, D_t, M_t)$

Exogenous Process

- Initial condition at D_0
- Evolves according to a persistent stochastic process
- Distribution $\pi_{t|t-1}$
  - Determines D_1, D_2, D_3

Policy

- Policy chooses M_t
- Timing:
  - $t = 1$: learning
  - $t = 2$: M_2 s.t. maximize welfare
  - $t = 3$: M_3 s.t. long-run regime
    either price stability (PS) or no price stability (no-PS)

    First: no-PS ($M_3 = \emptyset$)
- Later: PS

Information Flows

SHORT-RUN $(t = 1, 2)$: Imperfect info. about shock D_t and M_t

- Firms: informed
- Consumers:
  - Fraction α consumers informed, $1 - \alpha$ uninformed
  - Learn from firms' prices
- CB: Uninformed about D_t, learns from firms' prices
  - Perfect learning: Samples all firms
  - Imperfect learning: Samples only 1 firm

LONG-RUN $(t = 3)$: Perfect information

Game Between Firms and Consumers

- Firm j meets consumers at $t = 1, 2$
- Island j, $t = 1, 2$:
  1. Firm j posts price p_{jt}
  2. Consumers observe p_{jt} and update beliefs
  3. Consumers demand
- Tradeoff between Adjusting or Not Adjusting

Lemma

There is a cutoff $\alpha_k \in (0, 1)$ such that

- *if $\alpha \in [0, \alpha_k)$, optimal not to adjust the price,*
- *if $\alpha \in [\alpha_k, 1]$, optimal to adjust the price.*

Game Between Central Bank and Private Sector

- CB seeks to maximize welfare
- CB policy influences amount of price stickiness
- Informational feedback onto CB information

Long-Run Price Level and Central Bank

- Close the model with: $P_3 = S_3$
- Central bank:
  - $t = 1$: Observes prices (learning)
  - $t = 2$: Stabilization policy M_2 (welfare)
  - $t = 3$: Long-run policy M_3 (regime)

Definition

An equilibrium is given by allocations, prices, and policy such that all agents behave optimally, constraints are satisfied, and agents have consistent beliefs about each other's actions.

Key Questions

- Central bank:
  - $t = 1$: Observes prices (learning)
  - $t = 2$: Stabilization policy M_2 (welfare)
  - $t = 3$: Long-run policy M_3 (regime)

- Key Question #1: Can the CB learn the shock at $t = 1$, so that this information can be used to improve welfare at $t = 2$?

- Key Question #2: How does the regime (PS or no-PS) affect the CB's ability to learn the state at $t = 1$?

Benchmark: Informed Central Bank

Standard set of results:

RESULT 1: Welfare function:
$W(\{c_{1i}, c_{2i}, C_{3i}\}_{i\in[0,1]}) = E\left[\int (u(c_{1i}) + u(c_{2i}) + C_{3i})di\right]$

RESULT 2: When the CB observes the shock D_t directly, the optimal stabilization policy improves welfare by avoiding distortions in allocations generated by price stickiness.

$\longrightarrow$ Define: *Effective* optimal policy.

RESULT 3: A version of the divine coincidence holds.

Uninformed CB

Proposition (Optimal Policy Paradox)

Under perfect learning, there is no equilibrium with effective stabilization policy.

- Reason:
  1. In this eq., the CB learns the shock due to price adjustment
  2. CB stabilizes effectively $\Longrightarrow$ not optimal to adjust
  3. But then, how does CB get the information?
- Potentially effective policy disrupts information
  - Only *partially* effective policy is feasible
  - Or fully effective policy with *imperfect learning*
- Remark: cannot get this result in NK model

Price Stability (PS)

vs.

Not (no-PS)

(Long-Run) Price Stabilization PS

- Define "initial price level": $P_0 \equiv D_0$
- We have that $P_3 = S_3$
- Long-run price stabilization:
  Policy picks M_3 s.t. $P_3 = P_0$

Flattening of the Phillips Curve Under PS

Proposition (Flat PC)

Under PS, prices can become fully sticky. Output fluctuates with S_t.

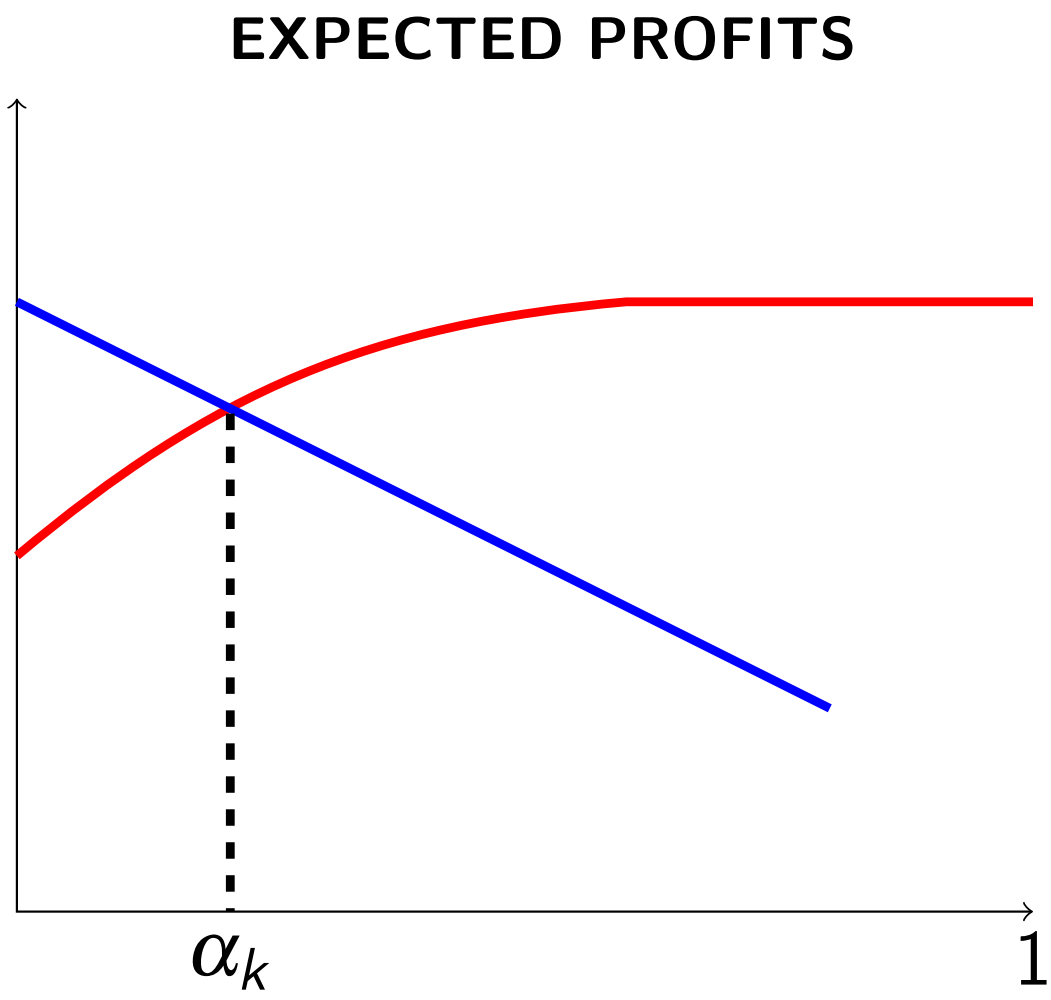
REASON: With microfounded stickiness, firms find it optimal not to adjust prices.

Corollary (Worsening of Learning)

Suppose learning is imperfect. Under PS, the probability that CB learns S_t goes down.

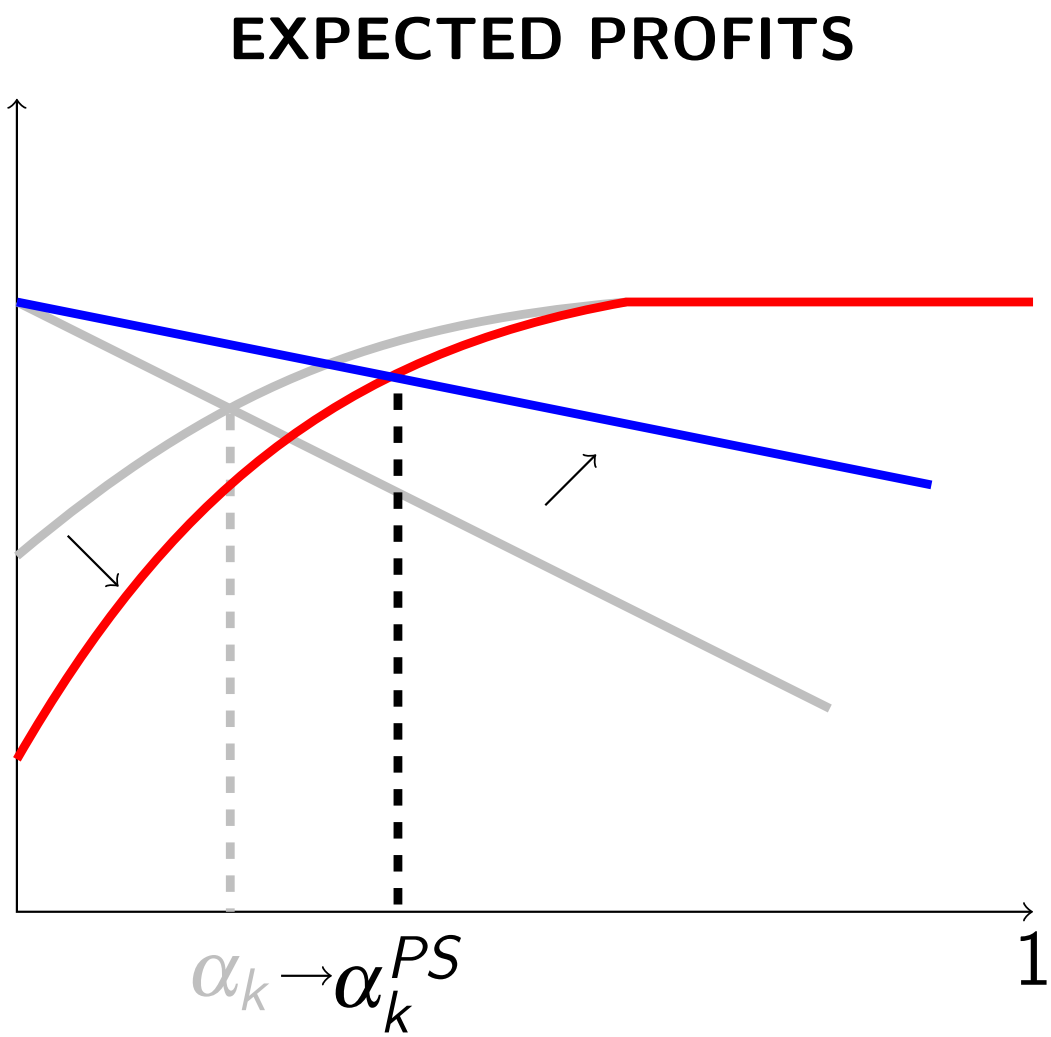
Remark: None of these occur in Calvo economy.
There, PS same allocation as no-PS.

Profit Function, Regime No Price Stability (No-PS)



α_k is the cutoff of price adjustment

Profit Function, Regime Price Stability (PS)



Cutoff of price adjustment shifts to the right, stickier prices

Conclusion and Discussion

- Learning is a serious barrier to policy
- **Two objectives:** stabilization and price stability
- Objectives in this model are coupled
  - Uncoupled if either:
    - CB is informed
    - Stickiness is exogenous