ROBERT LUCAS AND NEW CLASSICAL MACROECONOMICS

Exploring rational expectations and the limits of monetary policy effectiveness



STRUCTURE

COURSE OVERVIEW

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INTRODUCTION

Lucas's critique of activist monetary policy

02

EXPECTATIONS

Adaptive versus rational expectations

03

THE NEW CLASSICAL MODEL

Lucas Aggregate Supply equation

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POLICY IMPLICATIONS

Monetary policy ineffectiveness proposition

05

EXCEPTIONS

When systematic policy can work

CHAPTER 1

INTRODUCTION: BEYOND FRIEDMAN

FRIEDMAN'S POSITION

Activist monetary policy affects real variables only transiently

Mechanism: short-term money illusion amongst workers

LUCAS'S ADVANCE

Focused on the role of price level expectations

Questioned the plausibility of systematic money illusion

THE MONEY ILLUSION PROBLEM PROBLEM

Money illusion seems plausible if workers learn gradually from experience about price level increases. Workers respond to observed money wage increases by supplying more labour.

But what if unions hire professional economists who forecast the price level using the best available macroeconomic models?



PROFESSIONAL FORECASTING

1	2	3
BEST AVAILABLE MODEL	**RELEVANT INFORMATION**	**STATISTICAL ACCURACY**
Use professional macroeconomic tools	Plug in all available data	Best forecast given current knowledge

The forecast might not be accurate, but it represents the **best available forecast** given information and knowledge at the time.

ROBERT LUCAS



NOBEL PRIZE 1995
Awarded for developing rational expectations theory

KEY INNOVATION
Introduced rational expectations into monetary policy debate in early 1970s

DEFINITION

RATIONAL EXPECTATIONS

All economic agents can make statistically "best" forecasts of key macroeconomic variables.

CRITERION 1: TRUE MODEL

Forecast based on knowledge of the **true model** describing the economy

CRITERION 2: BEST INFORMATION INFORMATION

Uses best available information on exogenous variables

CRITERION 3: WHITE NOISE

Forecast errors are purely random and unpredictable

UNBIASED FORECASTS

Rational expectations imply statistically unbiased forecasts.

EXPECTED ERROR OF ZERO

Accurate on average over time

NOT SYSTEMATICALLY INACCURATE

No consistent directional bias in predictions

RANDOM DEVIATIONS ONLY

Errors arise from unpredictable shocks alone

ACCESS TO FORECASTS

Lucas's theory doesn't require **all** agents to have rational expectations.

Only requires that all agents have access to such forecasts.



Consequence: unions and workers access statistically unbiased price level forecasts, depriving monetary authorities of ability to influence real variables systematically, even short-run.



EXPECTATIONS: TWO APPROACHES

ADAPTIVE EXPECTATIONS

Forecasting scheme based on **trial and error** learning process.

$$E_{t-1} P_t = f(P_{t-k}, P_{t-k-1}, P_{t-k-2}, \dots)$$

BACKWARD-LOOKING

Expectations formed from past observations

GRADUAL ADJUSTMENT

Agents slowly update beliefs based on experience

SYSTEMATIC ERRORS

Can be systematically wrong during transitions

HOW ADAPTIVE EXPECTATIONS WORK

1

STABLE PRICES

Expect stability to continue

2

TRENDING PRICES

Expect trend to persist

3

AFTER SHOCK

Initially expect pre-shock level

4

CONVERGENCE

Gradually adjust to new reality

Initial expectation following a shock equals the pre-shock price level, making these expectations **backward-looking**.

ORIGINS OF RATIONAL EXPECTATIONS

JOHN MUTH (1930-2005)

Specialist in statistical forecasting who introduced the concept



CORE INSIGHT

"Expectations of future events are essentially the same as predictions of the underlying theory"

No arbitrary distinction between expert economists and economic agents

INTELLECTUAL MODESTY

> "Muth's notion was that the professors, even if correct in their model of man, could do no better in predicting than could the hog farmer or steelmaker or insurance company. The notion is one of intellectual modesty."
>
> *— Deirdre McCloskey, The Rhetoric of Economics (1998)*

RATIONAL EXPECTATIONS: MATHEMATICAL FORM

Expectations depend on model knowledge and information about exogenous variables, not past observations.

$$E_{t-1} P_t = E(P_t \mid I_{t-1})$$

CONDITIONAL OPERATOR

"|" means "conditional on"

INFORMATION SET

I_{t-1} contains all relevant information available at *t-1*

FORWARD-LOOKING

Unlike adaptive expectations, RE are endogenous



ACCURACY VS. SYSTEMATIC BIAS

WHAT RE DOES NOT REQUIRE REQUIRE

- Perfect accuracy
- Complete information
- Knowledge of future shocks

WHAT RE DOES REQUIRE

- No systematic inaccuracy
- Best available information
- Unbiased forecasts on average

STRONG RATIONAL EXPECTATIONS

New Classical models assume strong RE: agents know both the true model and its parameters.

KNOWLEDGE OF TRUE MODEL

Agents understand how the economy actually works

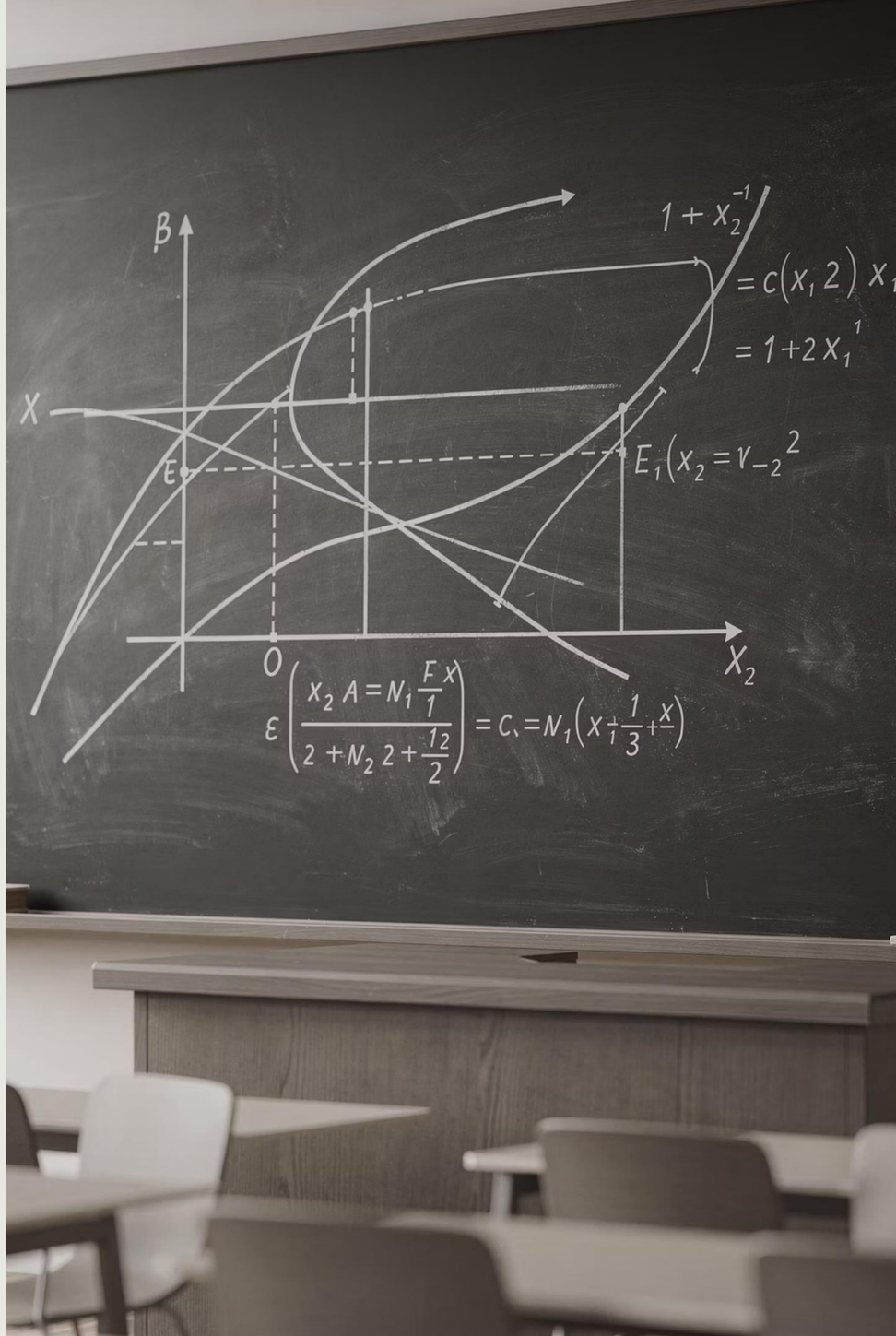
KNOWLEDGE OF PARAMETERS

Agents know behavioural constants of the model

However, agents may not know future values of exogenous variables like money supply.

CHAPTER 3

THE NEW CLASSICAL MODEL



LUCAS AGGREGATE SUPPLY

Lucas incorporated rational expectations into a micro-founded macroeconomic model.

$$Y_t^S - Y = \kappa(P_t - E_{t-1} P_t)$$

Source: Lucas, "Expectations and the Neutrality of Money" (*Journal of Economic Theory*, 1972)

Y^*determined by Classical features: labour market equilibrium and production function.

LAS EQUATION IMPLICATIONS

PRICE SURPRISES POSITIVE

If $P_t > E_{t-1}P_t$ then $Y_t^s > Y^*$

EXPECTATIONS MET

If $P_t = E_{t-1}P_t$ then $Y_t^s = Y^*$

PRICE SURPRISES NEGATIVE NEGATIVE

If $P_t < E_{t-1}P_t$ then $Y_t^s < Y^*$

ADAPTIVE VS. RATIONAL EXPECTATIONS IN LAS

WITH ADAPTIVE EXPECTATIONS

$E_{t-1}P_t$ formed from recent past prices

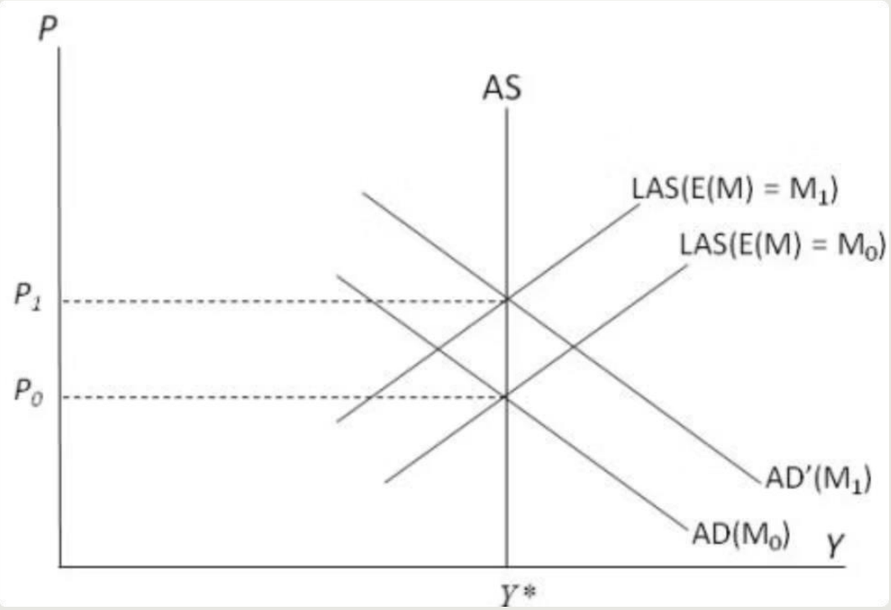
Consistent with Friedman's short-run/long-run distinction

WITH RATIONAL EXPECTATIONS

$E_{t-1}P_t$ is **endogenous**

Notation: $E(P_t|I_{t-1})$

Information set includes knowledge of complete macroeconomic model: supply, demand, and money market.



AGGREGATE DEMAND EQUATION

Derived from Quantity Theory of Money in logarithmic form:

$$Y_t^d = \gamma + M_t - P_t$$

Strong RE assumption: agents know behavioural parameters γ and κ, plus Y^*.

COMPLETE MODEL STRUCTURE

1

LUCAS AGGREGATE SUPPLY

$$Y_t^s - Y^* = \kappa(P_t - E_{t-1}P_t)$$

2

AGGREGATE DEMAND

$$Y_t^d = \gamma + M_t - P_t$$

Balance between equations and unknowns. Purpose: demonstrate implications of RE for monetary policy, extending Friedman's monetarist arguments.

SOLUTION PROCEDURE: KEY INSIGHTS

EQUILIBRIUM CONDITION

Agents predict $Y_t^s = Y_t^d = Y_t$

EXPECTED OUTPUT

With RE, agents always expect *E_{t-1}*$Y_t = Y^*$

CONSISTENCY REQUIREMENT

$$E_{t-1}P_t - E_{t-1}(E_{t-1}P_t) = 0$$

WHY EXPECTED OUTPUT EQUALS NATURAL RATE

Agents use LAS curve in forming expectations:

$$E_{t-1}\,Y_t = \quad Y \quad + \quad \kappa E_{t-1}\,[P_t - \quad E_{t-1}\,P_t]$$

$$E_{t-1}\,Y_t = \quad Y \quad + \quad \kappa[E_{t-1}\,P_t - \quad E_{t-1}\,(E_{t-1}\,P_t)]$$

But $E_{t-1}P_t - E_{t-1}(E_{t-1}P_t) = 0$, otherwise expectations would be inconsistent with rational forecasting.

Therefore: $E_{t-1}Y_t = Y^*$

SOLVING THE MODEL: STEPS 1-2

STEP 1: TAKE EXPECTATIONS OF AD

$$Y^* = \gamma + E_{t-1}M_t - E_{t-1}P_t$$

STEP 2: SUBTRACT FROM ACTUAL AD

$$Y_t - Y^* = [M_t - E_{t-1}M_t] - [P_t - E_{t-1}P_t]$$

SOLVING THE MODEL: STEPS 3-4

STEP 3: SOLVE FOR PRICE SURPRISES

$$[P_t - E_{t-1}P_t] = [M_t - E_{t-1}M_t] - [Y_t - Y^*]$$

STEP 4: SUBSTITUTE INTO LAS

$$Y_t - Y^* = \kappa\big[[M_t - E_{t-1}M_t] - [Y_t - Y^*]\big]$$

REDUCED FORM SOLUTIONS

Rearranging yields the output equation:

$$Y_t - Y = \frac{\kappa}{1+\kappa}[M_t - E_{t-1} M_t]$$

Substituting back gives the price surprise equation:

$$[P_t - E_{t-1} P_t] = \frac{1}{1+\kappa}[M_t - E_{t-1} M_t]$$

This closed-form solution excludes endogenous variable Y_t.



CHAPTER 4

IMPLICATIONS FOR MONETARY MONETARY POLICY

DIRECT EFFECTS ON OUTPUT

The reduced form equation reveals:

EXPANSIONARY SURPRISE

If $M_t > E_{t-1}M_t then Y_t > Y^*$

EXPECTED POLICY

If $M_t = E_{t-1}M_t\ then\ Y_t = Y^*$

CONTRACTIONARY SURPRISE SURPRISE

If $M_t < E_{t-1}M_t$ then $Y_t < Y^*$

PREDICTABLE MONETARY POLICY

Suppose monetary authority follows perfectly predictable policy:

$$M_t = (1 + g_M)M_{t-1}$$

Agents know each period's money supply by period end, so:

$$E_{t-1} M_t = (1 + g_M)M_{t-1}$$

Therefore $[M_t - E_{t-1}M_t] = 0$and $Y_t = Y^*$

Conclusion: predictable money supply changes affect prices, not output.

UNPREDICTABLE COMPONENT

Now suppose money supply has random variation:

$$M_t = (1 + g_M)M_{t-1} + u_t$$

where *u_t* is white noise with mean zero and variance *sigma_M*.

Rational agents predict: $E_{t-1}M_t = (1 + g_M)M_{t-1}$

Difference: $[M_t - E_{t-1}M_t] = u_t$

RANDOM SHOCKS AFFECT OUTPUT

Plugging into reduced form:

$$Y_t - Y = [\frac{K}{1+K}]u_t$$

Output affected by random and unpredictable component of money supply, but not by systematic and predictable component.

If $u_t > 0$:unpredictable increase in money supply causes positive output response.

PRICE EFFECTS OF RANDOM SHOCKS

Direct effect on price surprises:

$$P_t - E_{t-1} P_t = \frac{1}{1+\kappa}[M_t - E_{t-1} M_t] = \frac{1}{1+\kappa} u_t$$

HIGHER K

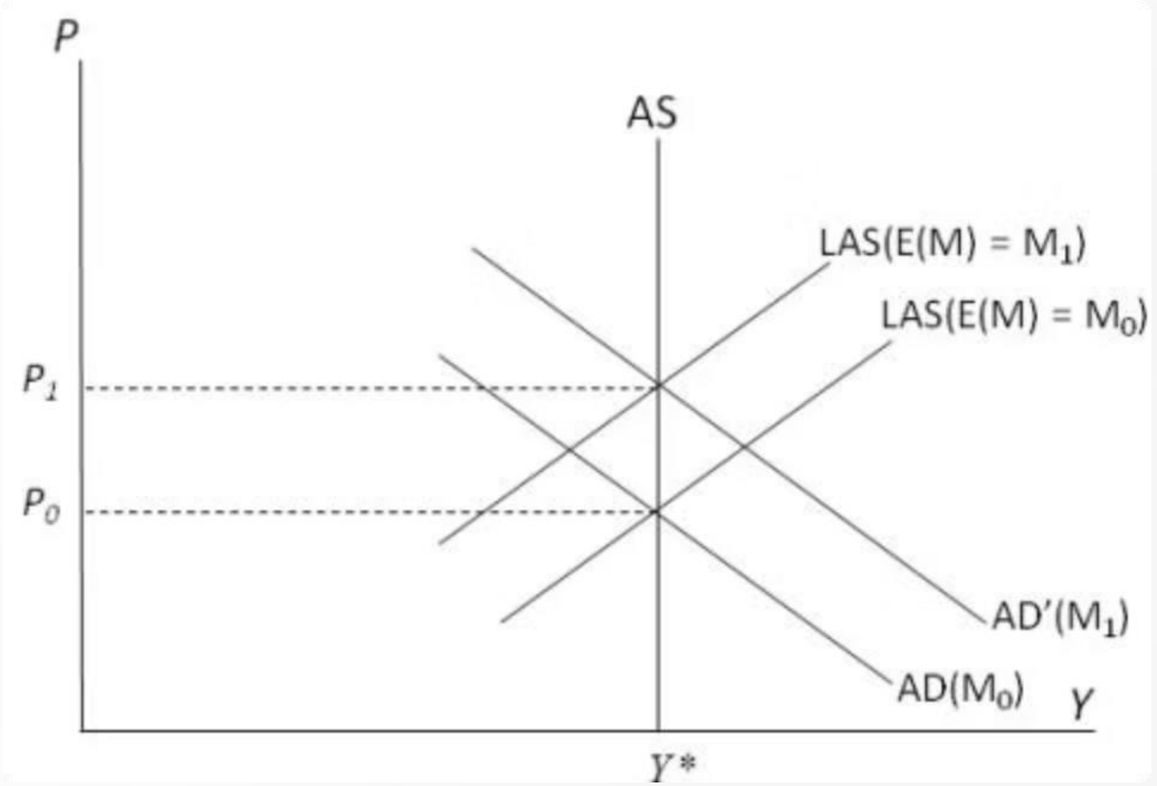
Stronger effect on real output, weaker effect on prices

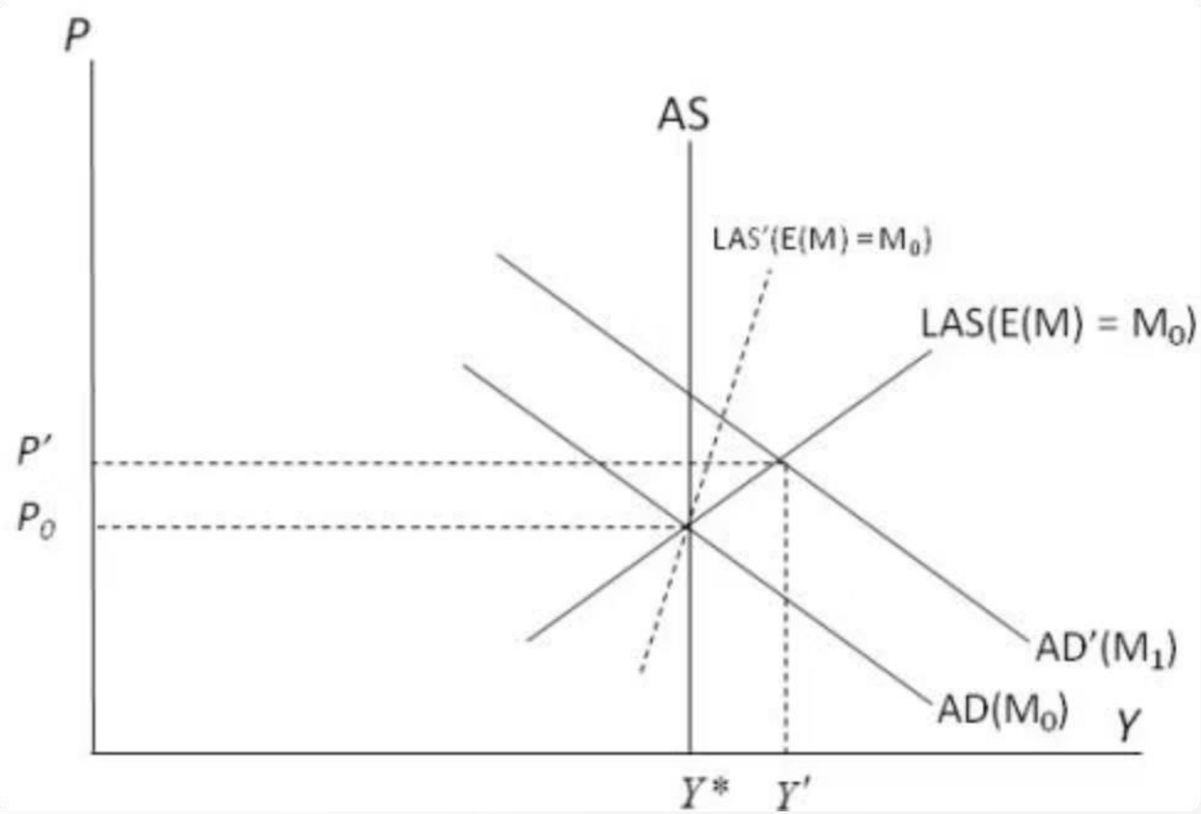
LOWER K

Weaker effect on real output, stronger effect on prices

SYSTEMATIC CHANGE IN CHANGE IN M

When the money supply change is systematic and predictable, expected prices adjust in advance. The economy stays at the benchmark point on LAS where Y = Y*. The price level changes from P_0 to P_1, but output does not change.





UNEXPECTED CHANGE IN M

Unexpected increase shifts AD whilst LAS remains fixed at $E(M) = M_0$. Both output and price level rise. Steeper LAS means smaller output effect, larger price effect.

THE ROLE OF K

Recall: *kappa* reflects strength of unpredictable price changes on output.

$$\frac{\partial Y_t}{\partial (P_t - E_{t-1} P_t)} = \kappa$$

LAS slope in diagrams is $1/\kappa$. Steep LAS indicates low κ.

In Lucas's model, κinversely related to money supply volatility. More erratic monetary policy $\rightarrow$ lower $\kappa\rightarrow$ lower output effect.



THE BOY WHO CRIED WOLF

HIGH VOLATILITY

Agents make large prediction errors about money supply and prices

Rational agents discount price shocks

Low κ value

LOW VOLATILITY

Agents make small prediction errors

Price surprises taken seriously

High κvalue

POLICY LESSONS SUMMARY

INEFFECTIVENESS PROPOSITION

With RE, systematic monetary policies affect prices, not output, even in the short run

RANDOM DISTURBANCES

Can affect real variables but equally likely to cause recessions as booms

VOLATILE POLICY BACKFIRES

High volatility makes LAS steeper, reducing real effects

CHAPTER 5

EXCEPTIONS TO INEFFECTIVENESS

Two situations where systematic monetary policy can influence real outcomes:

1

ASYMMETRIC INFORMATION

Central bank predicts productivity shocks before public

2

WAGE CONTRACTS

Nominal wages fixed by contract for several years

Neither justifies **activist** policy, but both support counter-cyclical stabilisation.