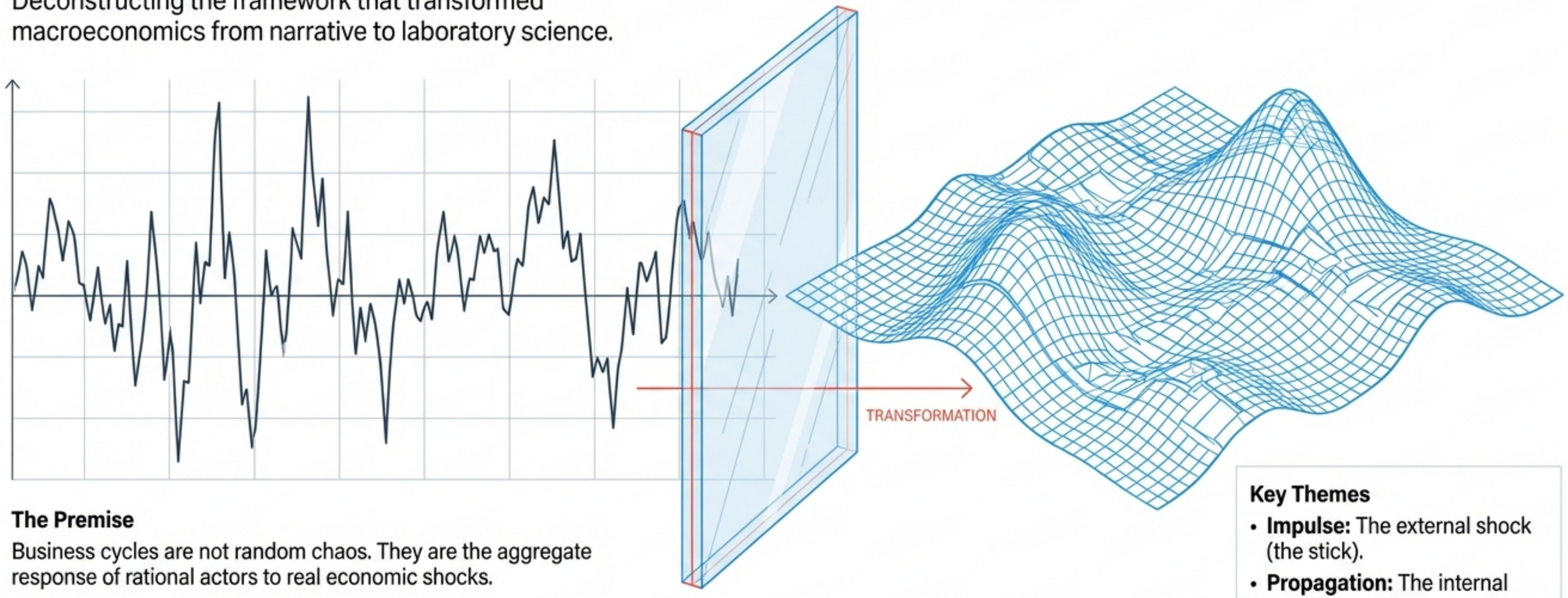
Real Business Cycles: Impulse, Propagation, and the Quantitative Revolution

Deconstructing the framework that transformed macroeconomics from narrative to laboratory science.



The Premise

Business cycles are not random chaos. They are the aggregate response of rational actors to real economic shocks.

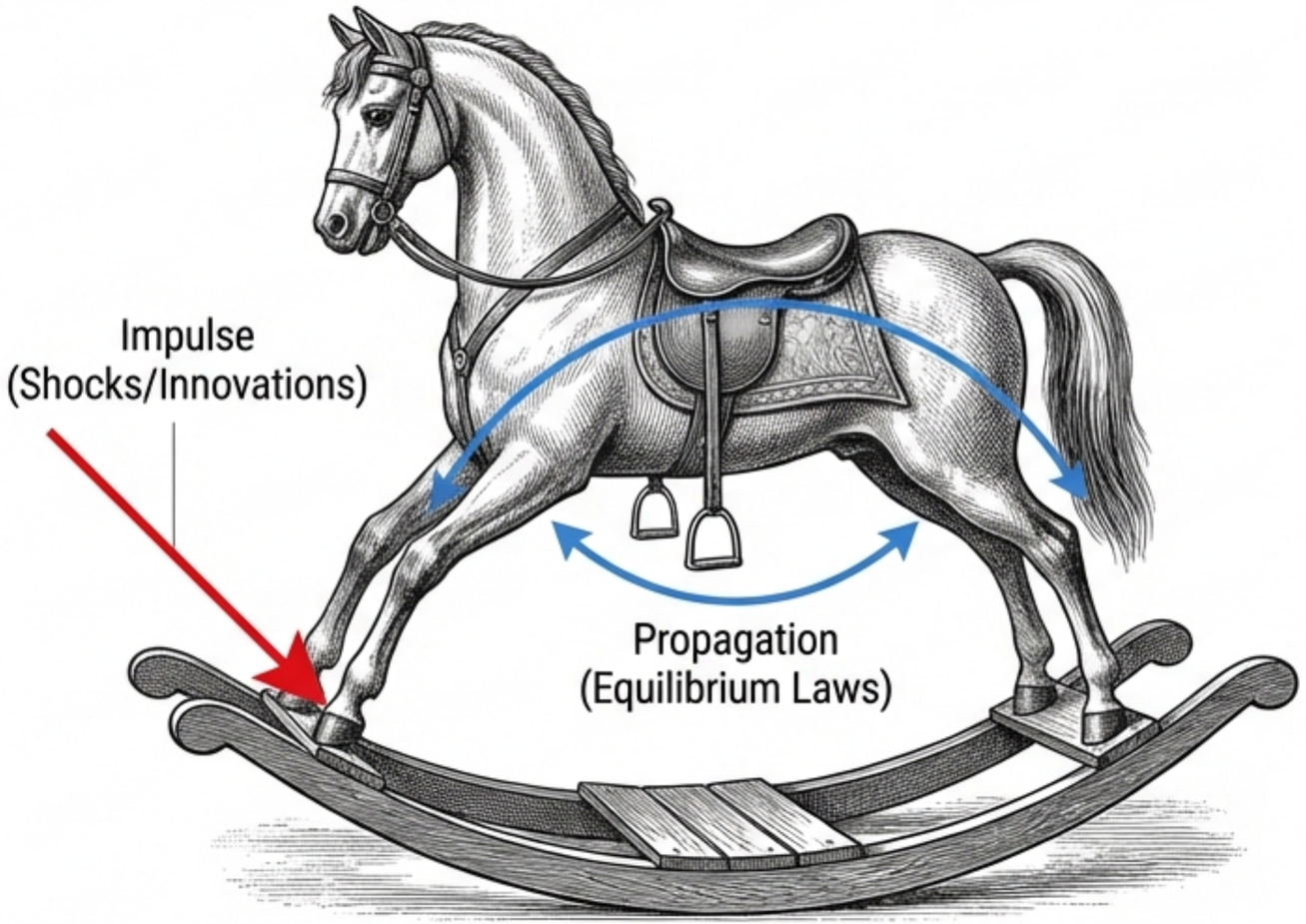
The Framework

This deck explores the Real Business Cycle (RBC) model—the stochastic version of the neoclassical growth model. It traces the journey from the 'Kydland-Prescott Blueprint' to modern heterogeneous agent models.

Key Themes

- **Impulse:** The external shock (the stick).
- **Propagation:** The internal mechanism (the rocking horse).
- **Calibration:** The measurement of theory against reality.

The Anatomy of a Fluctuation



"If you hit a rocking horse with a stick, the movement of the horse will be very different from the stick." — Knut Wicksell

The Definition

Business cycles are not perfect sine waves. They are recurrent fluctuations of output around a slow-moving trend.

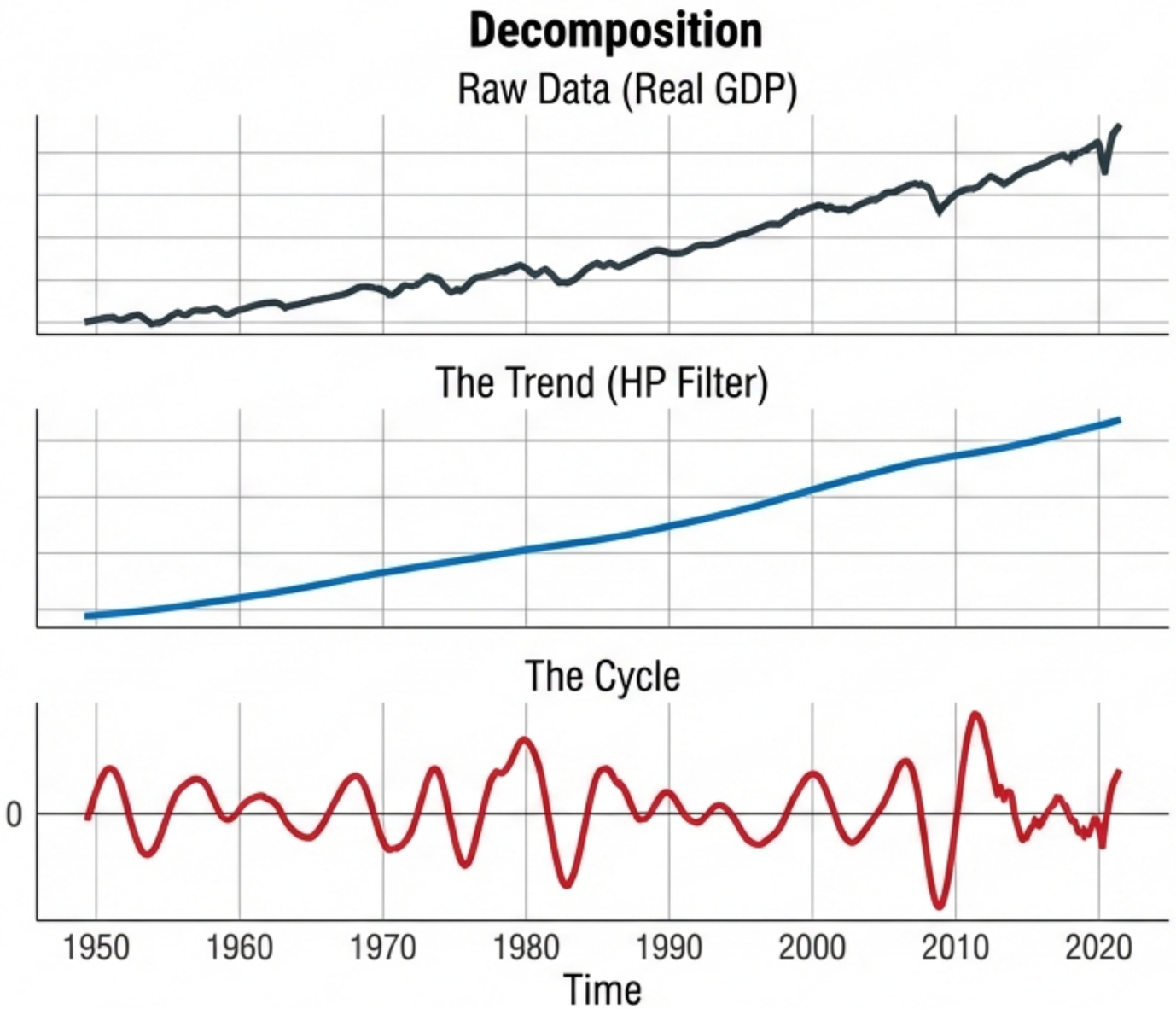
The Insight

Modern analysis distinguishes between the *origin* of the shock (technology, preferences) and the *structure* of the economy that transmits it. The shock might be random, but the response is structured.

Historical Context

- **19th Century:** Descriptive cycles (Kitchin, Juglar).
- **Schumpeter (1939):** Innovations occur in clusters.
- **Keynes (1936):** Demand-driven cycles requiring intervention.

Separating Signal from Noise: The Filtering Problem



Technical Note:

The Hodrick-Prescott (HP) Filter

The goal is to decompose time series Y_t into trend τ_t and cycle $Y_{c,t}$.

The Minimization Problem:

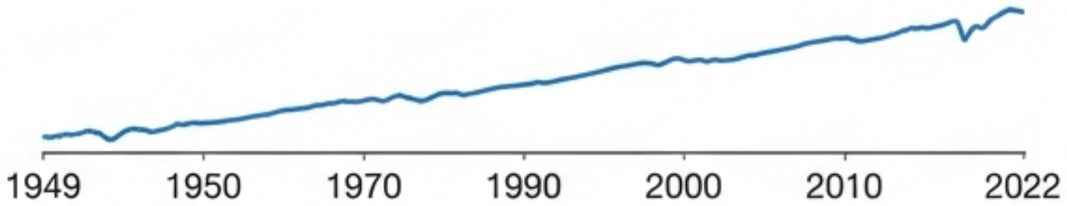
$$\min_{\{\tau_t\}} \sum (Y_t - \tau_t)^2 + \lambda \sum [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

Parameter λ:

Controls smoothness. For quarterly data, standard practice is $\lambda = 1600$. This balances tracking the raw data against maintaining a linear trend.

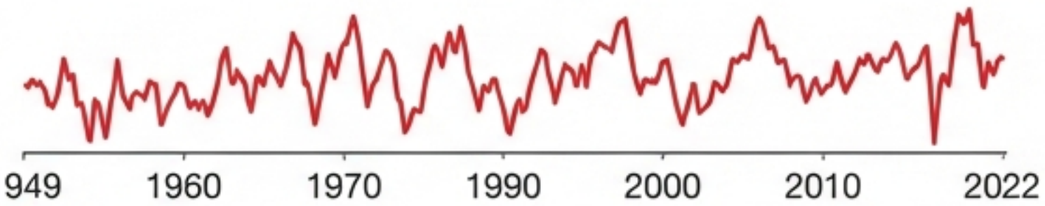
The Target: Stylized Facts of the U.S. Economy (1949-2022)

Consumption



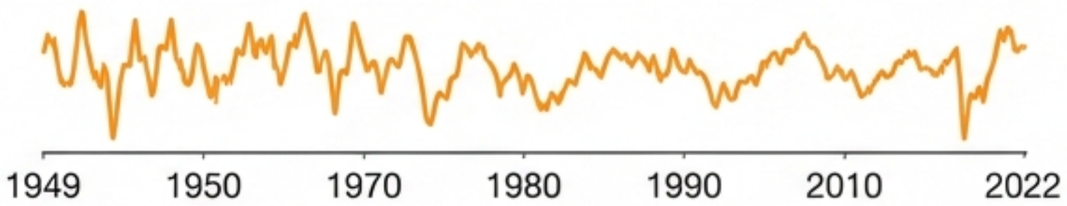
Status: **Smooth**
Relative Std Dev: **0.65**
Note: Households smooth consumption over time.

Investment



Status: **Volatile**
Relative Std Dev: **2.68**
Note: The most volatile component of GDP.

Hours Worked



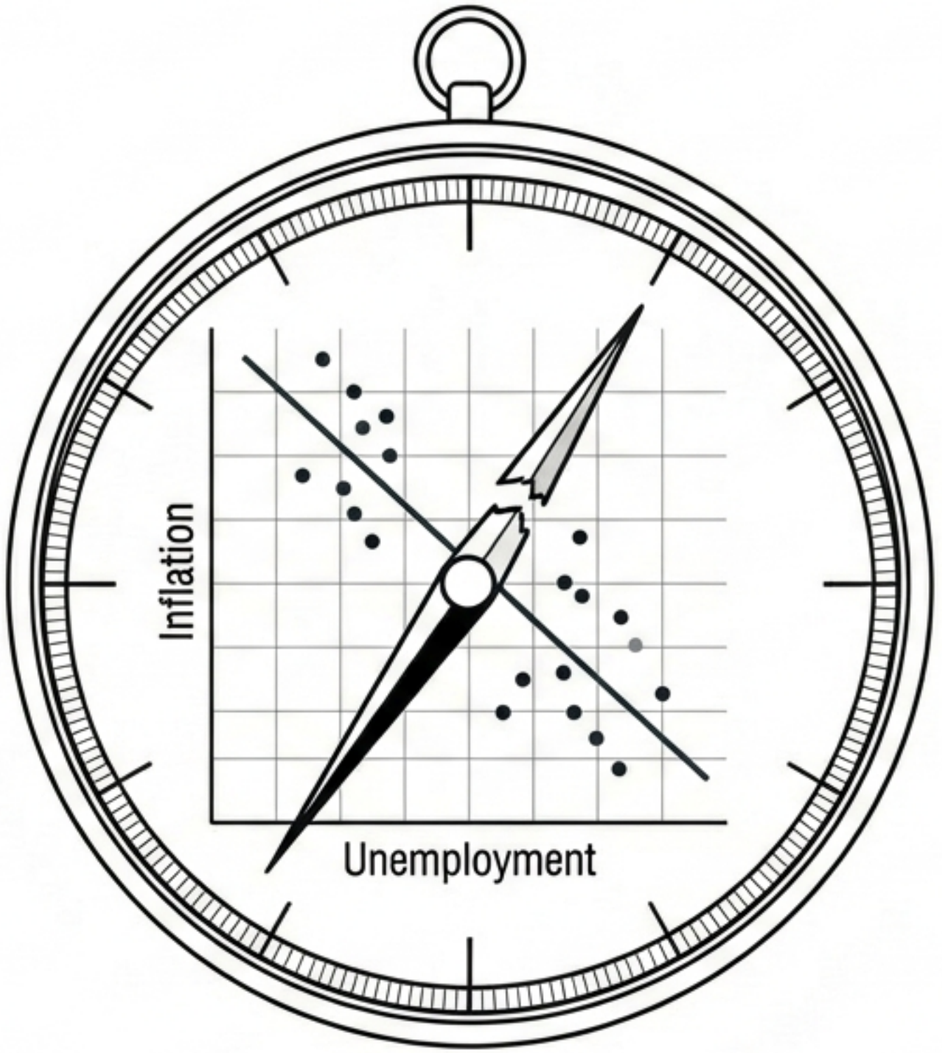
Status: **Volatile**
Relative Std Dev: **1.29**
Note: Nearly as volatile as output itself.

Correlations

- Pro-cyclical: Consumption, Investment, Hours
- Counter-cyclical: Unemployment
- Persistent: Productivity & TFP

These are the unconditional moments (HP Filtered) that any successful business cycle theory must replicate.

The Paradigm Shift: From Correlations to Microfoundations



The Lucas Critique (1976)

The Failure of the 70s

Stagflation (high inflation + high unemployment) defied Keynesian trade-offs. Policy tools based on historical correlations stopped working.

The Intellectual Pivot

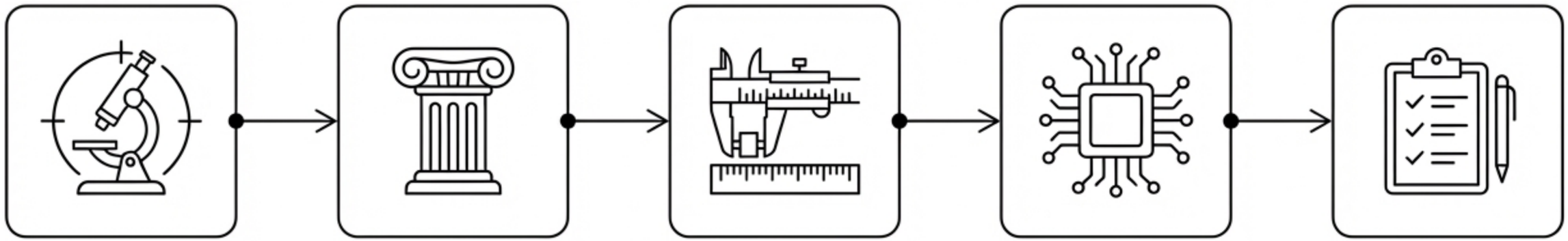
Robert Lucas argued that relying on past correlations fails because expectations change when policy changes.

The Solution: Microfoundations

Models must be built on **'Deep Parameters'**—preferences (utility) and technology (production)—that remain invariant to policy intervention. Agents must be modeled as having **Rational Expectations**.

The Kydland-Prescott Blueprint

A methodology for quantitative macroeconomics.



Question

Pose a precise quantitative question.

Model

Build on well-tested micro-theories (Neoclassical growth).

Calibrate

Select parameters based on long-run growth data. Do not estimate.

Experiment

Run numerical simulations.

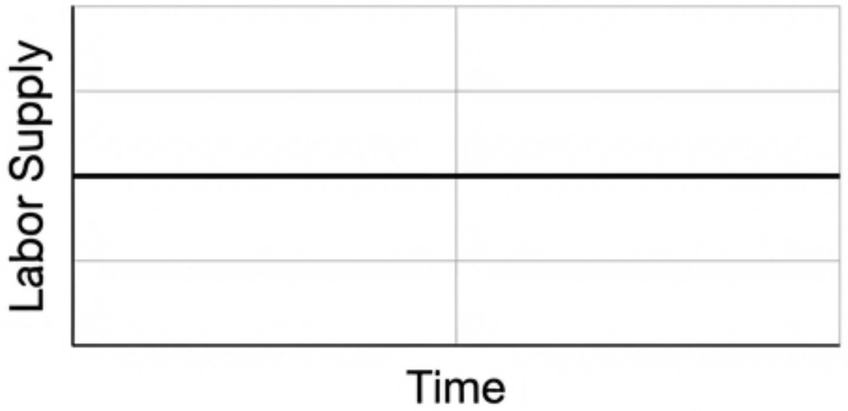
Evaluate

Compare model moments to data facts.

"The model is a measurement device." — Kydland & Prescott (1982)

Inside the Machine: Why Labor Alone Fails

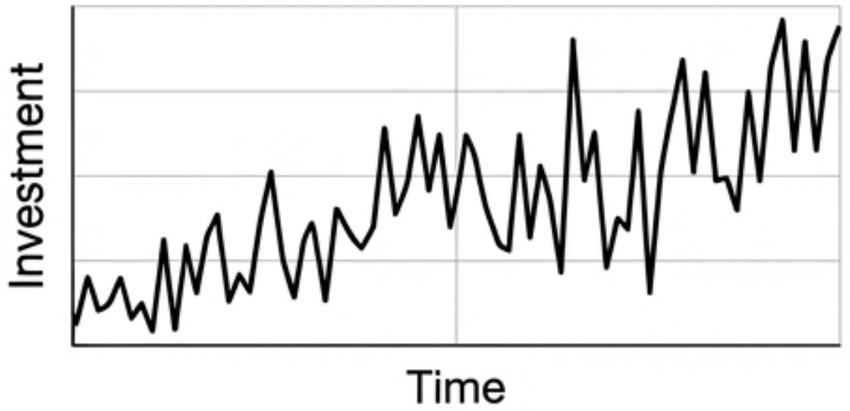
The Simple Model (Labor Only)



Production is linear in labor ($Y = zL$).
Households consume all income immediately ($C = wL$).
Income and substitution effects cancel out.

FAILURE: Constant optimal labor supply.
No propagation.

The Core Model (With Capital)



Households can save. When productivity is high, they work hard to build capital.

Intertemporal Substitution: Agents smooth consumption by adjusting investment.

SUCCESS: Volatile investment and fluctuating labor.

The Engine of Fluctuation: TFP Shocks

Solow Residual Equation

$$\log(z_t) = \log(y_t) - \alpha \log(k_t) - (1-\alpha) \log(\ell_t)$$

The Solow Residual
(Total Factor Productivity).
The "Measure of Our Ignorance".

Output

Weighted Inputs
(Capital & Labor)

The Concept: Fluctuations in output not explained by changes in capital or labor are attributed to real "Technology Shocks."

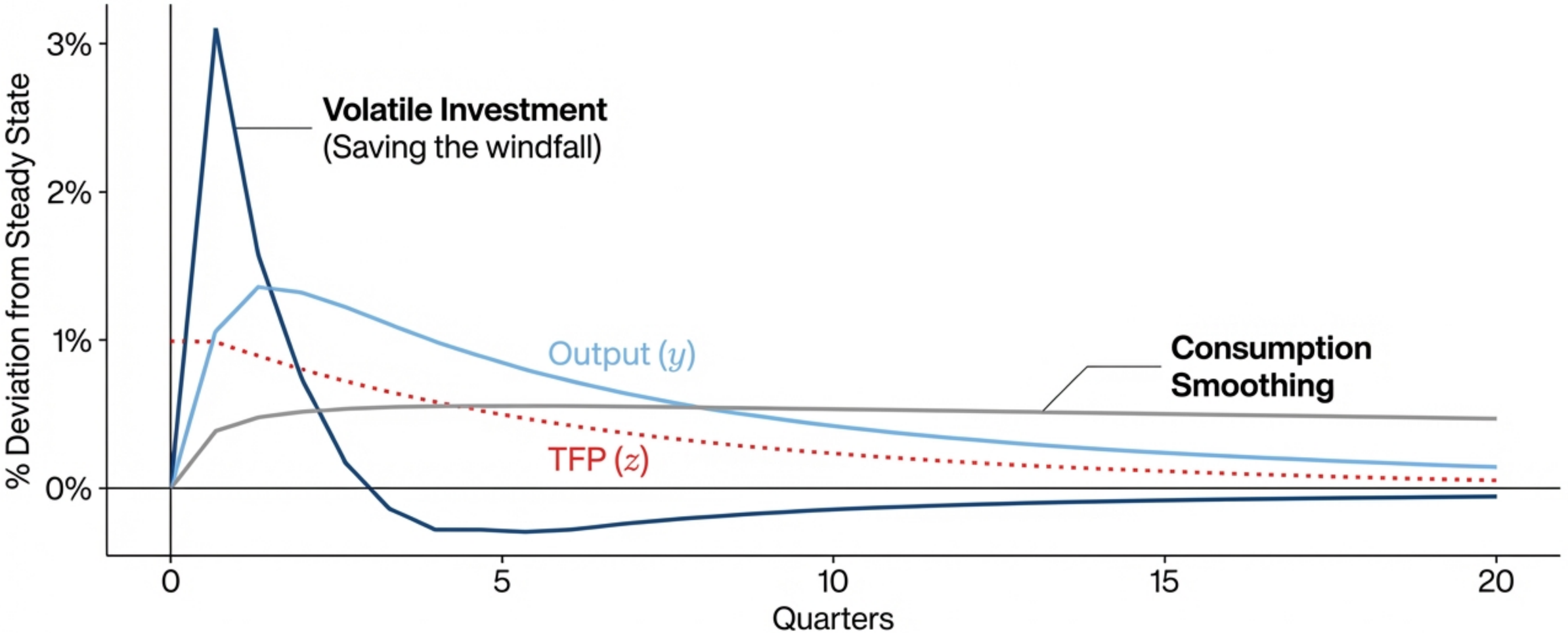
The Process: Modeled as an AR(1) process with high persistence ($\rho \approx 0.95$) and standard deviation ($\sigma_z \approx 0.007$).

Calibration: Tuning the Instrument

Parameter	Value	Source / Logic
Capital Share (α)	**0.36**	National Income Accounts (Labor share ≈ 0.64)
Depreciation (δ)	**0.025**	Quarterly rate (10% annually), from investment data
Discount Factor (β)	**0.99**	Matches 4% annual real interest rate ($r = 1/\beta - 1$)
Preferences (σ)	**1.0**	Log utility, consistent with balanced growth
Leisure Weight (ϕ)	**0.63**	Calibrated so households work 1/3 of time

Side Note: Parameters are chosen to match **long-run growth facts**, leaving business cycle frequencies as the test.

The Mechanism: Impulse Response Functions



The model converts a persistent productivity shock into a volatile investment cycle while smoothing consumption—mimicking the Wicksellian rocking horse.

The Scorecard: Successes vs. Failures

Successes

- **Volatility Ranking:** Correctly predicts Investment > Output > Consumption.
- **Co-movement:** Captures pro-cyclical nature of C, I, and Labor.
- **The Headline:** Explains ≈ 70% of output fluctuations using *only* technology shocks.

Failures

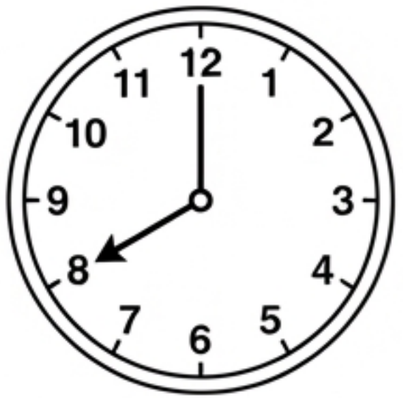
- **The Labor Puzzle:** Modeled hours are less volatile than real data.
- **The Frisch Elasticity:** Model requires high elasticity (willingness to work), but micro-studies show low elasticity.
- **Propagation:** Output dynamics rely too heavily on the persistence of the shock itself.

Extension 1: The Indivisible Labor Fix

Rogerson & Hansen (1985)

Intensive Margin

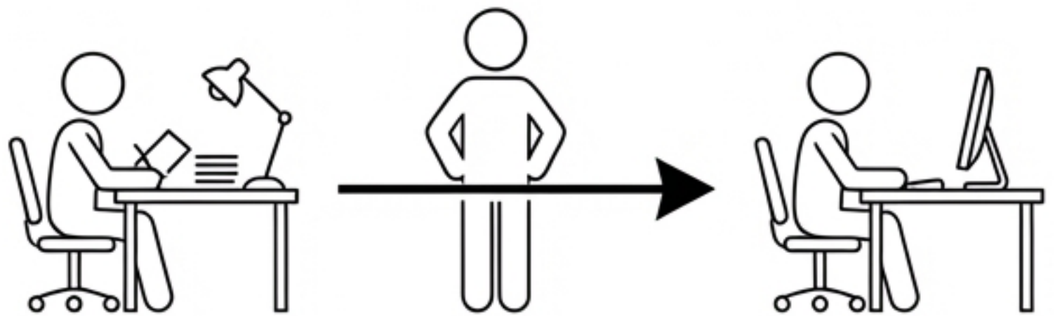
(Everyone works a bit more)



8 hours → 8.1 hours

Extensive Margin

(Employment vs. Unemployment)



The Solution:

Assume workers face a binary choice: Work full-time or not at all. Households “insure” against unemployment via lotteries.

The Result:

The aggregate economy behaves as if it has **infinite elasticity**, reconciling macro-volatility with micro-evidence.

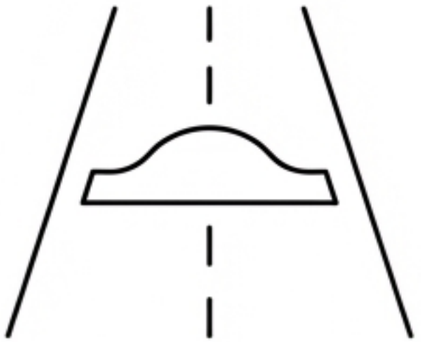
Extension 2: Frictions and Capacity

Variable Capacity Utilization

Firms run machines harder
Firms run machines harder during booms. Cost = Higher depreciation.

Effect: Increases amplification of shocks.

Capital Adjustment Costs



It is costly to install new capital quickly (Tobin's q).

Effect: Spreads investment over time, increasing internal propagation (persistence).

Business Cycle Accounting: Diagnosing the Wedges

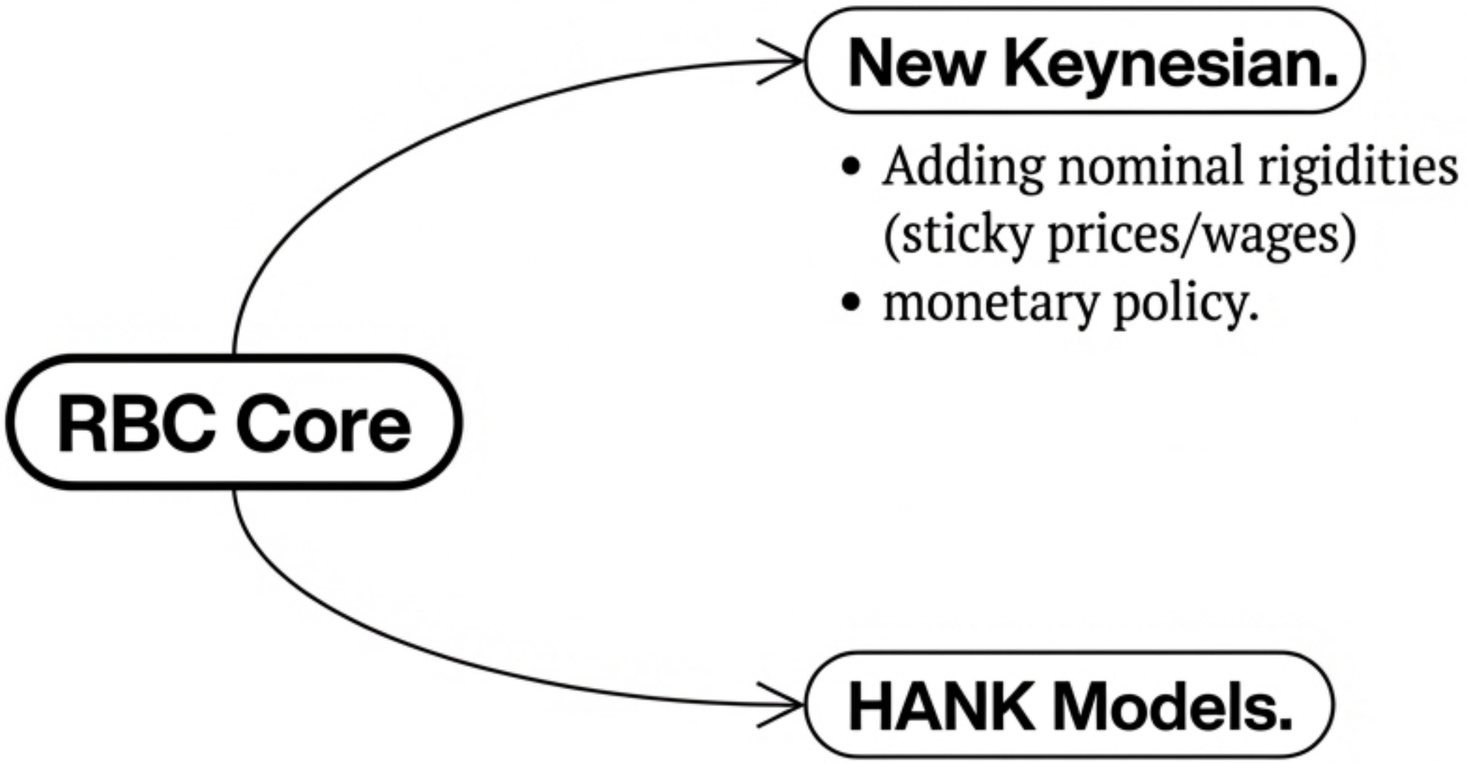
Chari, Kehoe, and McGrattan

The Four Wedges (Distortions)

Efficiency Wedge Looks like TFP. Accounts for 70% of output variance.	**Labor Wedge** Looks like a tax on labor income. Explains the Great Depression and "Jobless Recoveries".
Investment Wedge Looks like a tax on capital (Financial frictions).	**Government Wedge** Public consumption effects.

Instead of generating data, we use the model in reverse to identify *where* the economy is breaking.

The Frontier: Beyond the Representative Agent



The Legacy

The "Great Moderation" is over. New challenges (pandemics, inflation) require new extensions, but the RBC model remains the engine block of modern macroeconomics.

Final Thought

“The model is a measurement device.”