Lecture 17: Efficiency, RBC, and Money, Inflation, & Interest Rates

ECON 30020: Intermediate Macroeconomics

Prof. Eric Sims

University of Notre Dame

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Readings

GLS Ch. 15, 20, 21, and 22

Economic Efficiency

Economic efficiency refers to allocations

Pareto efficiency: no one can be made better off without making someone else worse off

Efficiency does not necessarily mean an allocation is desirable (e.g., there may be a desire to reallocate resources from the rich to the poor)

How to gauge whether allocations are efficient?

- Solve a social planner's problem
- The planner picks quantities to maximize lifetime utility, subject to scarcity, without prices coordinating allocations
- If the equilibrium allocations are the same as what the planner would choose, the equilibrium is efficient

Planner's Problem in Real, Representative Agent Neoclassical Model

$$\max_{C_t, C_{t+1}, N_t, N_{t+1}, K_{t+1}} \quad U = u(C_t, 1 - N_t) + \beta u(C_{t+1}, 1 - N_{t+1})$$

s.t.

$$C_t + K_{t+1} - (1 - \delta)K_t + G_t \leq A_t F(K_t, N_t)$$

$$C_{t+1} - (1 - \delta)K_{t+1} + G_{t+1} \leq A_{t+1} F(K_{t+1}, N_{t+1})$$

We are taking G_t and G_{t+1} <u>as given</u>

Ignoring nominal allocations (M_t) for right now

First-Order Conditions

$$u_L(C_t, 1 - N_t) = u_C(C_t, 1 - N_t) A_t F_N(K_t, N_t)$$
$$u_C(C_t, 1 - N_t) = \beta u_C(C_{t+1}, 1 - N_{t+1}) \left(A_{t+1} F_K(K_{t+1}, N_{t+1}) + (1 - \delta)\right)$$

Labor supply condition is the same in $t + 1$ as in t

If you take the underling FOC from the decision problems and eliminate prices (w_t and r_t), you get the same conditions (so long as $f_t = 0$)!

This means that a benevolent social planner could not improve upon the equilibrium allocations

So the equilibrium is efficient. There is no role for activist policies to improve over what the competitive equilibrium delivers

Real Business Cycle Theory

Real Business Cycle (RBC) Theory: takes neoclassical model as descriptor of short-run fluctuations

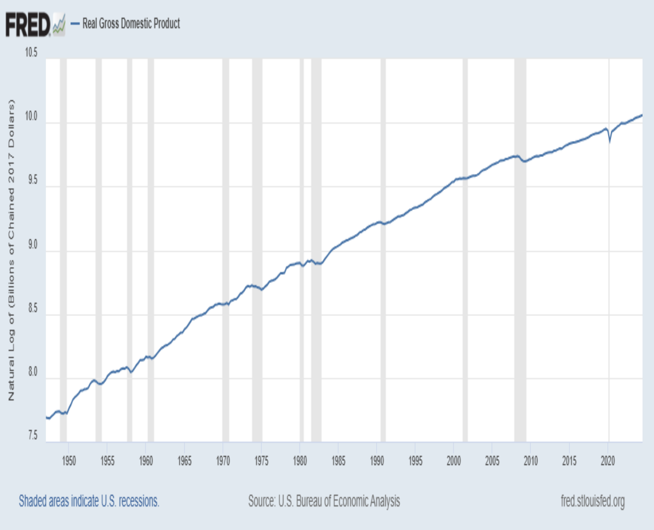
To measure business cycles in the data, need to do some statistical de-trending / filtering:

$$\ln Y_t = \ln {Y_t}^T + \ln Y_t^C$$

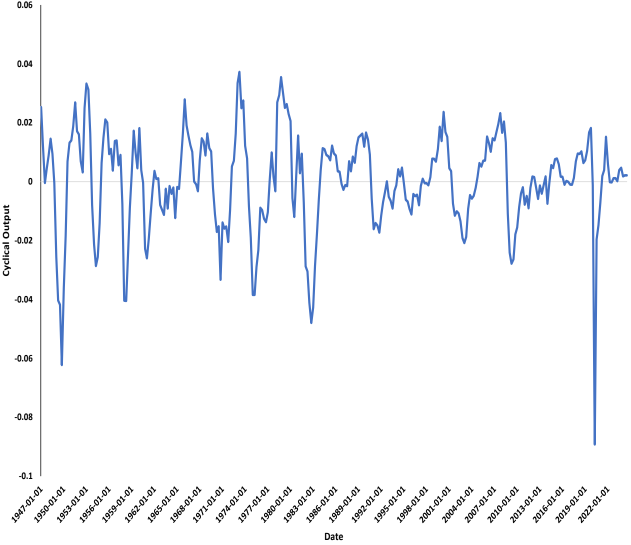
Measure $\ln {Y_t}^T$ (e.g., linear time trend) and isolate deviations about that trend ($\ln Y_t^C$)

The "business cycle" refers to movements in $\ln Y_t^C$ (negative = recession and positive = expansion) and co-movements with cyclical components of other variables

Real GDP: Log Level



Cyclical/Detrended Output



Movements in Variables in the Neoclassical Model

Under our assumptions, output in the neoclassical model is supply-driven

- With vertical Y^s, only way to get Y_t to move is via changes in A_t, θ_t, or K_t
- Even if Y^s were upward-sloping, demand shocks wouldn't move output by much

In model, exogenous changes in A_t can qualitatively match properties of co-movement (i.e., correlations) of cyclical components of aggregate series

- Movements in θ_t produce some counterfactual realizations
- Persistent movements in productivity (i.e., A_t and A_{t+1} go up together) fit even better

Empirical Correlations

Variable	Corr w/ Y_t in Data	Corr conditional on A_t	Corr conditional on θ_t
C_t	0.88	$+$	$+$
I_t	0.91	$+$	$+$
N_t	0.87	$+$	$+$
w_t	0.20	$+$	-
r_t	0.10	- ≈ 0 or > 0 if persistent	-
P_t	-0.46	-	-

Is There Evidence A_t Moves Around in Data in Same Way as Y_t?

Neoclassical model can do decent job matching empirical facts if it is driven by changes in A_t

Is there evidence of large changes in A_t coinciding with observed changes in Y_t in <u>short run</u>?

We already know from our study of the Solow model that differences in measured A_t seem to account for cross-country differences in Y_t

TFP

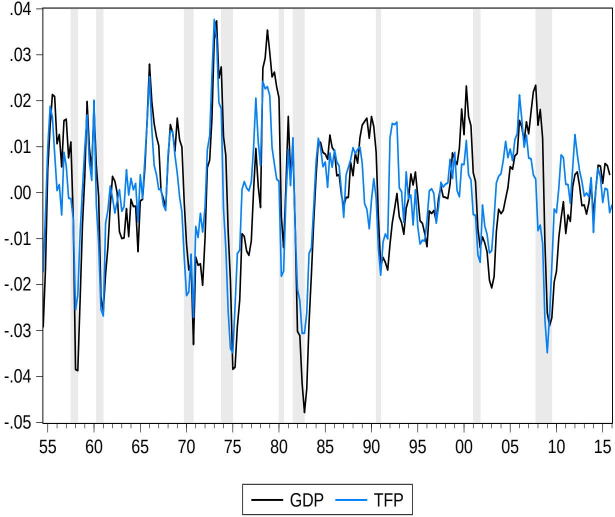
As in Solow model, measure total factor productivity (TFP) by assuming Cobb-Douglas production function:

$$\ln TFP_t = \ln Y_t - \alpha \ln K_t - (1-\alpha) \ln N_t$$

TFP is a the "residual" in output that cannot be explained by observed capital and labor

Correlation of cyclical components of TFP and GDP in data is high – 0.78

Cyclical/Detrended Components of TFP and GDP



Policy Implications

Conditional on movements in A_t, the model can generate movements in endogenous variables that look quite a bit like observed patterns of aggregate series in the data

There is some evidence that A_t actually moves very strongly with output, lending empirical credence to the theory

If it roughly fits the data, then one is tempted to conclude that the theory is good

If the theory is good, one might want to take its policy implications seriously

Policy implication: activist stabilization policies are at best not needed and at worse are undesirable

Do We Really Buy This?

Potential criticisms of RBC theory:

1. What exactly are these productivity shocks? Why don't we read about them in the newspaper?
2. To generate realistic movements in Y_t, model needs to rely on very elastic labor supply (i.e., labor supply curve flat), which seems at odds with micro data
3. Other demand shocks don't matter – money is neutral, and credit spread shocks don't affect output. Does this seem right?
4. Is what we're measuring as TFP really measuring exogenous productivity in the model or something else?

The Nominal Side

In solving the planner's problem above, I did not choose M_t. Given additive separability, this was fine:

$$\max_{C_t, C_{t+1}, N_t, N_{t+1}, K_{t+1}} \quad U = u(C_t, 1 - N_t) + v\left(\frac{M_t}{P_t}\right) + \beta u(C_{t+1}, 1 - N_{t+1})$$

s.t.

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FOC with respect to M_t:

$$v'\left(\frac{M_t}{P_t}\right) = 0$$

The Friedman Rule

Intuition is simple: marginal cost of "producing" money is zero, so want the marginal benefit to be zero

FOC from decentralized equilibrium:

$$v'\left(\frac{M_t}{P_t}\right) = \frac{i_t}{1+i_t} u_C(C_t, 1-N_t)$$

Planner's solution only coincides with equilibrium outcome if $i_t = 0$!

This is the so-called Friedman rule: manage the money supply such that the nominal interest rate is driven to zero

The Money Supply

What constitutes money in real world is fuzzy. It is set jointly by actions of the central bank, commercial banks, and households

Not going to worry about details

- Currency in circulation: bills and coins held outside of the bank sector
- M1: currency in circulation plus deposits
- M2: M1 plus less liquid stuff (savings deposits, small time deposits, and retail money market mutual funds)

Suppose that central bank / government can completely control the money supply

Equation of Exchange and Money Demand

The equation of exchange **defines** velocity as the ratio of nominal spending to a measure of the money supply:

$$M_t V_t = P_t Y_t$$

Sometimes also called the quantity equation. This is just a generic representation of our money demand function, e.g.:

$$\frac{M_t}{P_t} = \psi i_t^{-b} Y_t$$

Here, $V_t = \psi^{-1} i_t^b$

Monetarism

Monetarism is a school of thought that assumes that money demand (i.e., velocity) is stable

Sometimes called the quantity theory

In the short run, this is a poor approximation to reality. But it's better over longer periods of time

Implications of monetarism:

- $\uparrow M_t$: proportional change in $P_t Y_t$ (i.e., nominal GDP). If money is neutral as in neoclassical model, the movement in nominal GDP is all from the price level
- $\uparrow \ln M_t - \ln M_{t-1}$ (increase in growth rate): proportional increase in growth rate of nominal GDP. Assuming super-neutrality (holds in model), changes in money growth load directly onto inflation

Money Growth and Inflation

Take logs and then differences of the quantity equation:

$$\ln M_t - \ln M_{t-1} + \ln V_t - \ln V_{t-1} = \ln P_t - \ln P_{t-1} + \ln Y_t - \ln Y_{t-1}$$

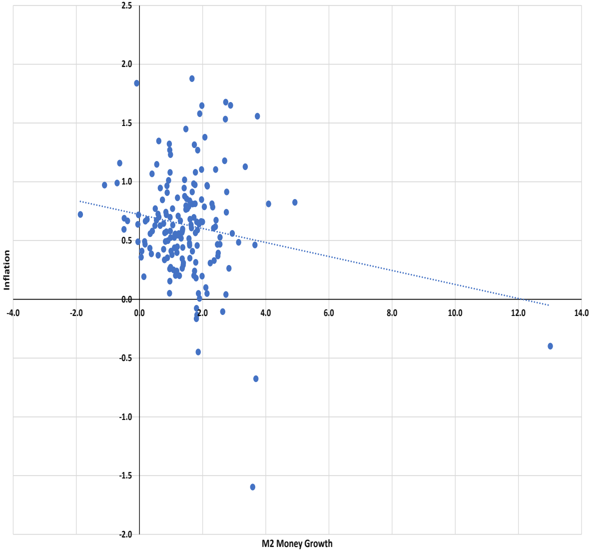
Log first differences: growth rates

Velocity constant: nominal interest rate not changing and no exogenous shifts in money demand:

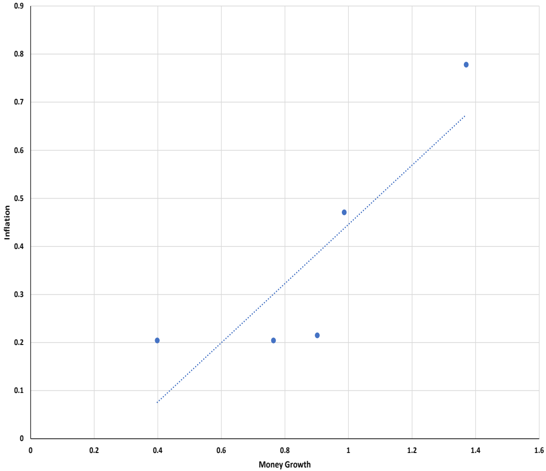
$$\pi_t = g_t^M - g_t^Y$$

Super-neutrality: output growth is independent of money growth. Inflation causes by money growth in excess of output growth

Not So Good at a Quarterly Frequency



Pretty Good Over Decades



Inflation and Interest Rates

Fisher relationship:

$$r_t = i_t - \pi^e_{t+1}$$

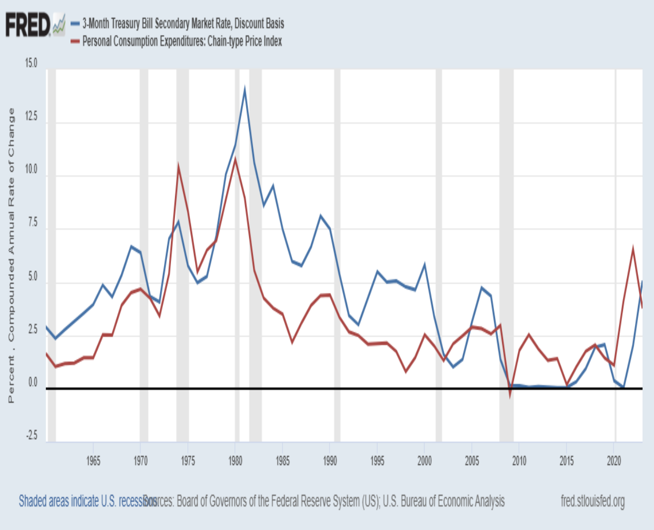
Over long periods of time, think of $\pi^e_{t+1} \approx \pi$ (average inflation), and the real interest rate is independent of anything nominal:

$$i = r + \pi$$

Inflation maps one-to-one into the level of the nominal interest rate

Note: full implementation of the Friedman rule ($i = 0$) would require deflation ($\pi < 0$) assuming $r > 0$

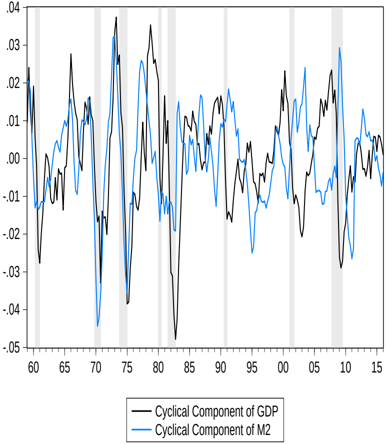
Inflation and Interest Rates



Money and Real Variables

Neoclassical model predicts that money is neutral with respect to output

Is that true? Even in the short run? Correlation between cyclical components of M2 and output is 0.2



Dynamic Correlations

Positive correlations do not imply causality running from money to output

What about dynamic correlations?

Variable	Correlation with $\ln M_t$
$\ln Y_t$	0.22
$\ln Y_{t+1}$	0.32
$\ln Y_{t+2}$	0.37
$\ln Y_{t+3}$	0.37
$\ln Y_{t+4}$	0.33
$\ln Y_{t+5}$	0.26
$\ln Y_{t+6}$	0.19
$\ln Y_{t+7}$	0.10
$\ln Y_{t+8}$	0.03

Money leads output for a couple of years; suggestive that changes in money cause changes in output in the short run. Also emerges in more sophisticated econometric work