Monetary Macroeconomics

Chapter 10:
Money Stock Fluctuations

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May 7, 2021

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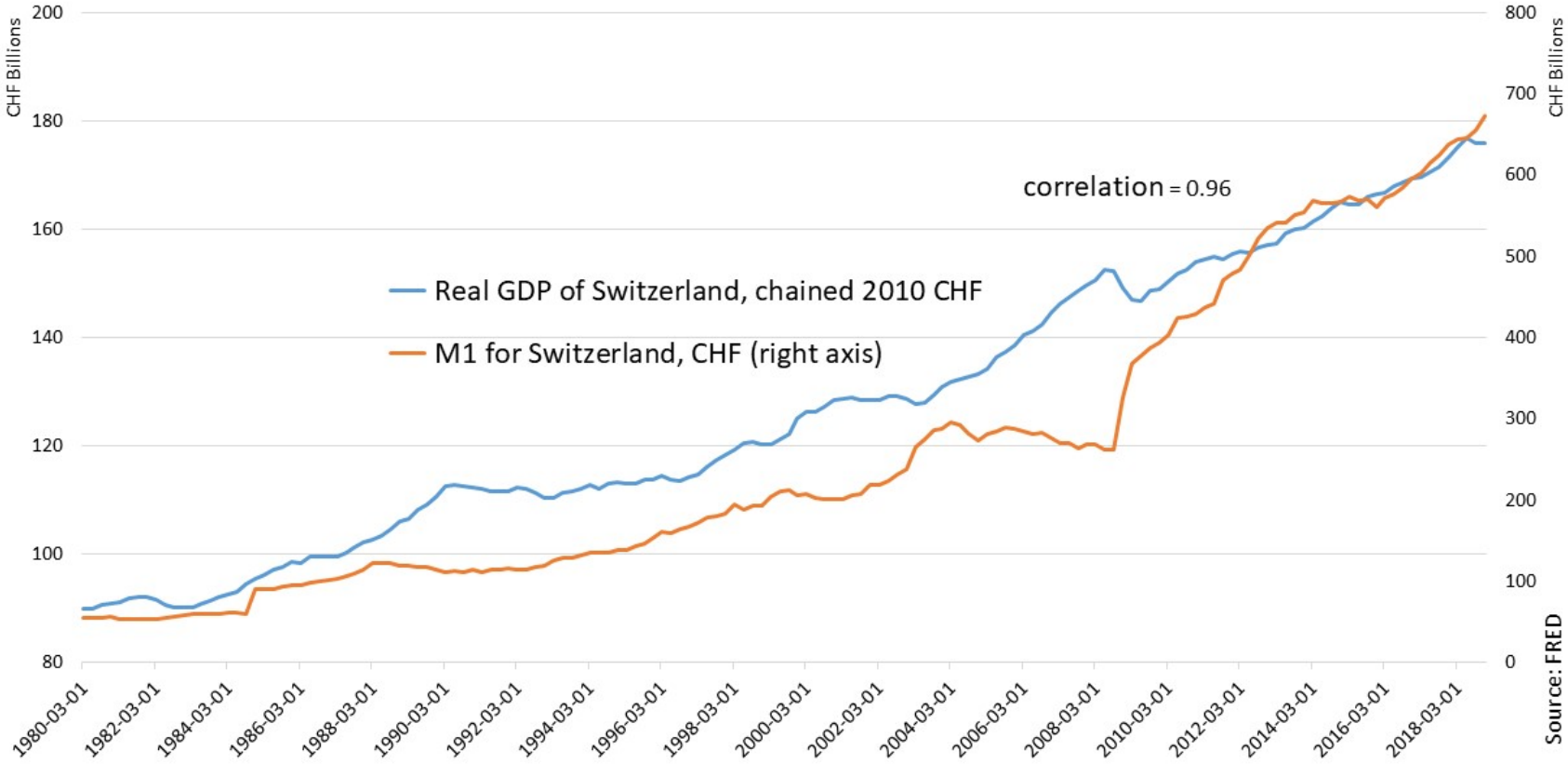
Why Do We Observe a Positive Correlation Between Nominal Money Stock and Real Output?

We observe in the data that nominal money stock and real output are positively correlated with each other. How can nominal money have something to do with real production?

This is the question we will try to answer now.

Positive correlation between **nominal** money stock and **real** output



The big question: is it possible to stimulate real output by increasing money supply?

- Positive correlation between the nominal stock and real output.

- The monetary authority has the power to change the money stock at will.

- So it seems that the monetary authority can stimulate real output at will.

Correlation versus Causality

- An observed correlation between two variables does **not** mean that one of the variables causes the other to change. Funny examples:

  Spurious Correlations by Tyler Vigen, published in 2015

- Changes in some third variable may be behind the changes in both variables.

- **The main message of this chapter: Correlation does not imply causality.**

Definition:

Innovation in some variable can be defined as the difference between a variable's actual value and the value predicted by the variable's recent behavior.

So it is the unpredicted change in a variable.

Some Facts

1. Innovations in real output are *positively correlated* with innovations in the total nominal money stock.

2. Innovations in the total money stock occur *before* the innovations in the real output.

3. Innovations in the real interest rate help to predict innovations in money and output.

4. The money innovations linked to output innovations primarily take the form of changes in the deposit-to-currency ratio and the money multiplier.

How Can We Explain These Facts Using a Model?

We cannot use our former model as it is because the deposit-to currency ratio and the money multiplier were constant given the reserve requirement ratio.

We need to modify our OLG model to allow variations in the deposit-to-currency ratio and the money multiplier.

The Model

OLG model with 2-period lived people.

The population is constant and the total stock of fiat money is constant.

Thus the return on fiat money is 1.

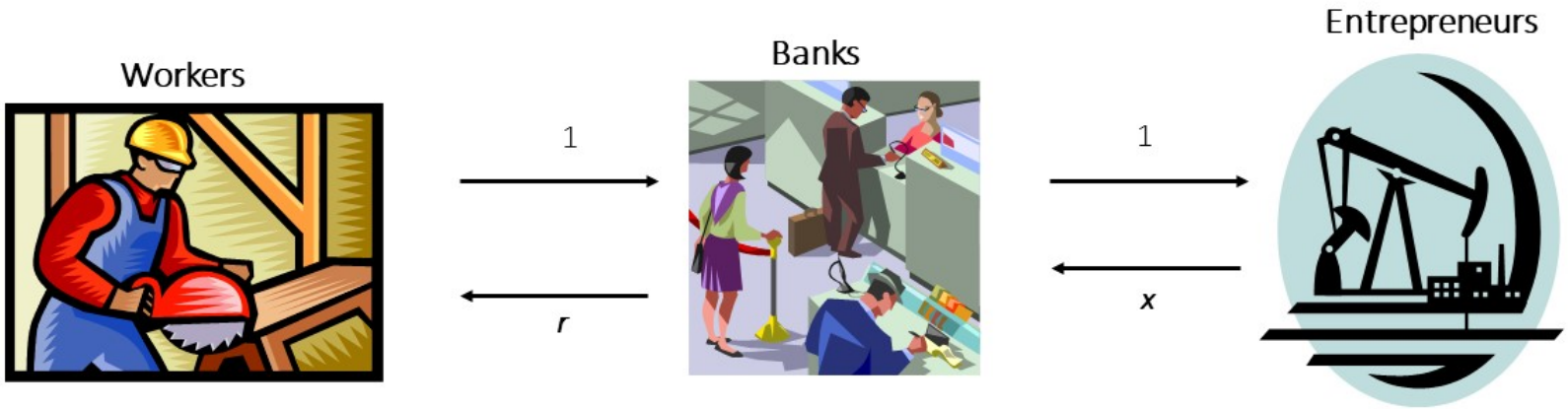
There are three types of people: workers, entrepreneurs, bankers.

Workers: When young, they can produce according to their productivity. When old, they have no endowment. Worker i wants to have fiat money balances worth s_i goods for his old age.

Entrepreneurs: They can produce $x > 1$ goods in the next period for each good invested in the current period. They have some endowment, but can also use other people's goods for production. However, they do not know how to reach those workers who want to save as well.

Bankers: They have no endowment, but they can locate both the workers and the
entrepreneurs. They can borrow from the workers and give loans to entrepreneurs. The banking system is competitive: Interest rate they pay to workers and interest rate on the loans is x. Bankers make zero profits. There are no reserve requirements.

Economic relationships between agents



Competitive banking results in $r = x$

Transaction Cost

There is a transaction cost ϕ for the worker when he withdraws his money next period.

If he deposits s_i when young, he gets $xs_i - \phi$ back next period.

Thus the rate of return on the savings account will be

$$\frac{xs_i - \phi}{s_i} = x - \frac{\phi}{s_i}$$

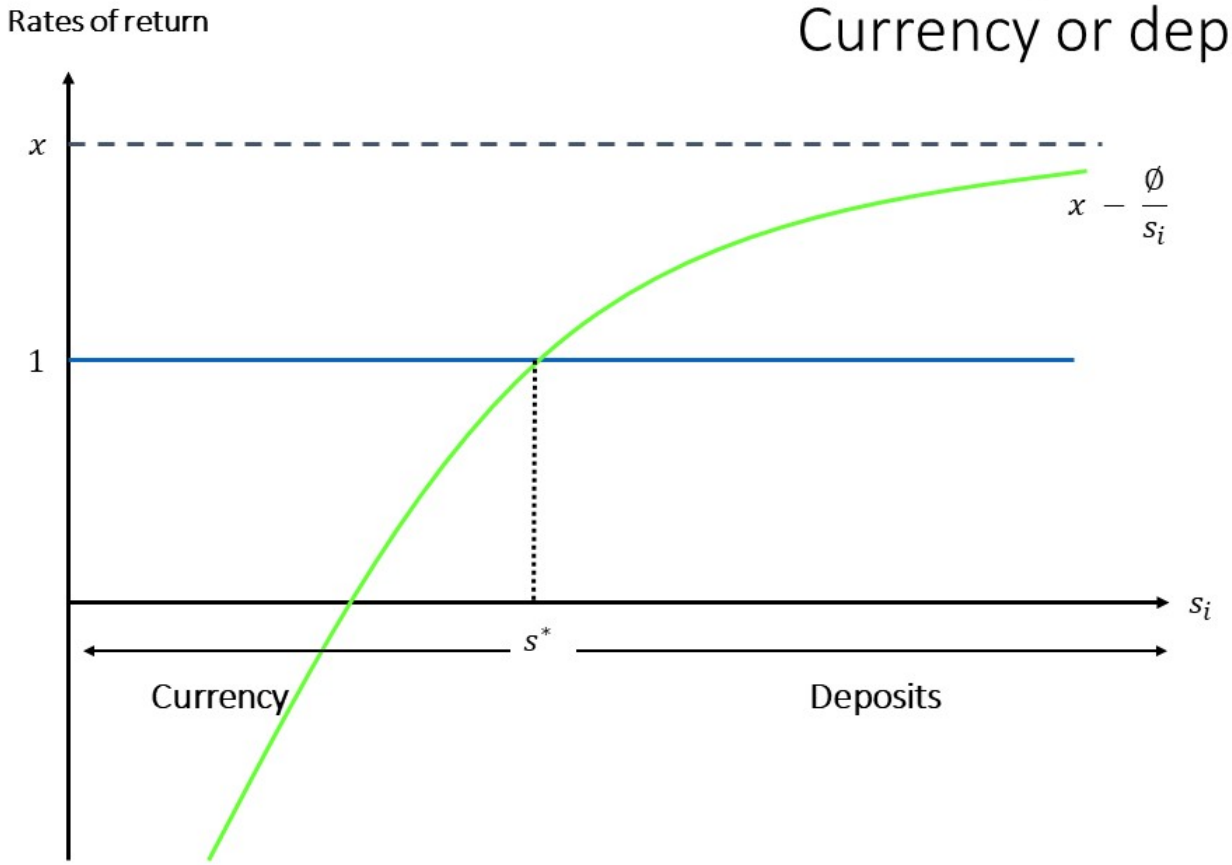
This is increasing in s_i.

Problem

Graph the rate of return on the savings account and the rate of return on fiat money.

Find when the worker would want to use currency and when "checks".

Worker's optimal choice: Currency or deposits

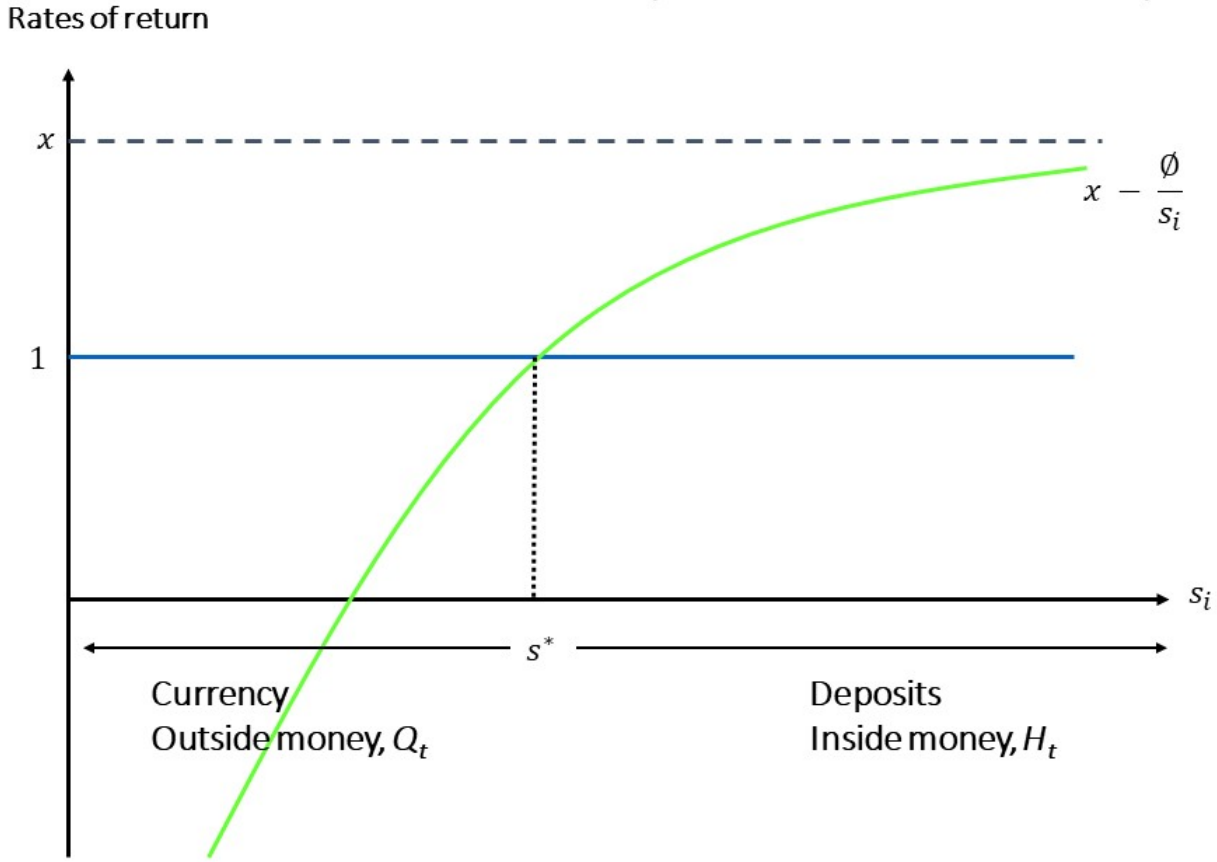


Inside and Outside Money

Denote the real value of total inside money balances in period t as H_t.

Denote the real value of total money balances in period t as Q_t.

Outside money and inside money



Since there is no reserve requirement in this model, fiat money is demanded by the consumers only.

$$p_t Q_t = M_t$$

So $p_t = \frac{M_t}{Q_t}$.

Total nominal money supply $(M1)_t$ is the sum of currency held and bank deposits.

$$\begin{aligned}(M1)_t &= M_t + p_t H_t \\ &= M_t + \left(\frac{M_t}{Q_t}\right) H_t \\ &= \underbrace{\left(1 + \frac{H_t}{Q_t}\right)}_{\text{money multiplier}} M_t\end{aligned}$$

Note that the money multiplier is not constant anymore!

If people want to hold less currency (i.e. s^* goes down), then Q_t decreases and H_t increases.

Thus the money multiplier increases. For a fixed M_t, $(M1)_t$ increases.

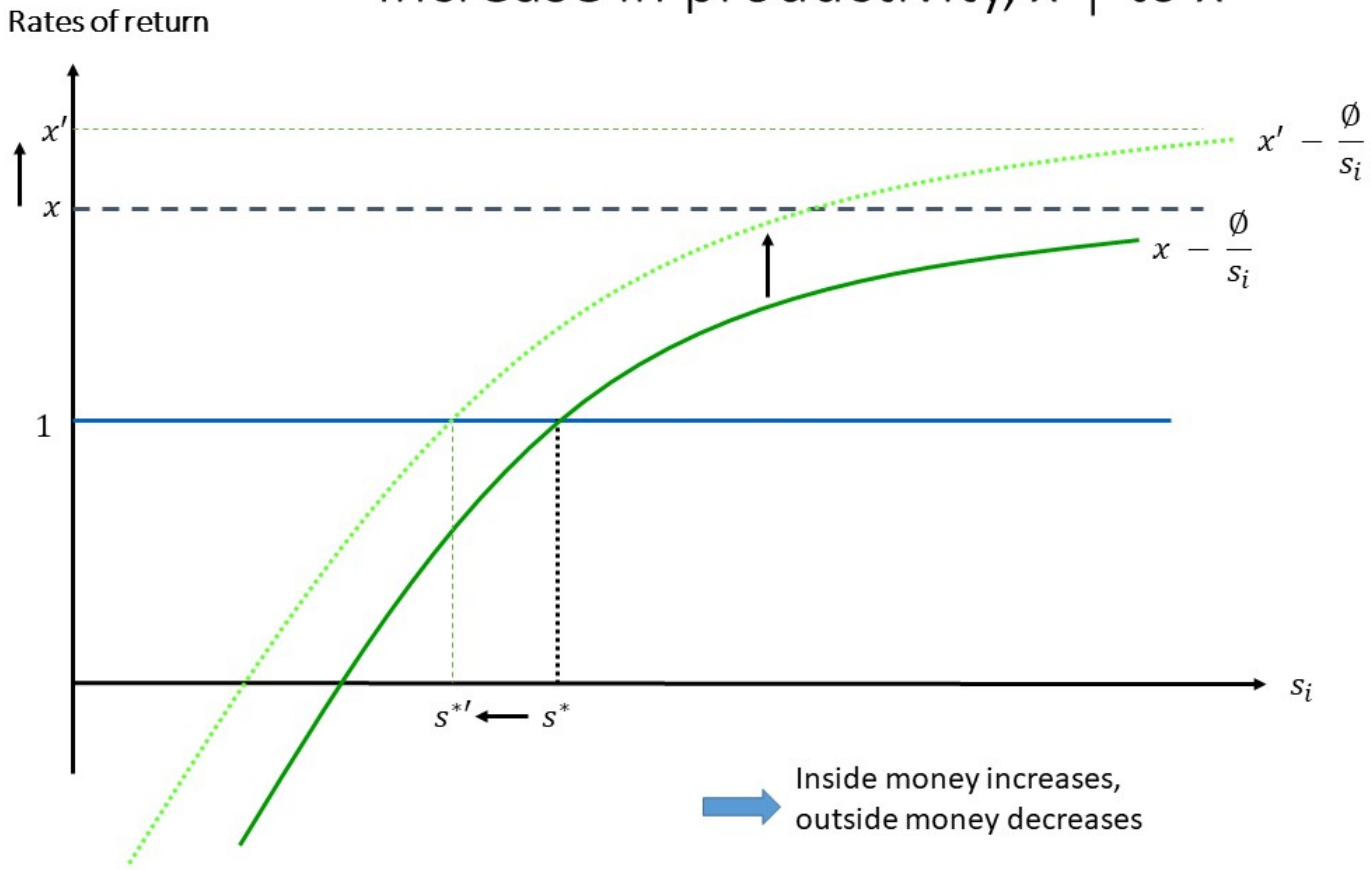
So the money supply can fluctuate depending on the deposit-to-currency ratio.

What is the Effect of an Increase in the Productivity x?

When x increases to x', then the rate of return on the savings account increases to $x' - \frac{\phi}{s_i}$.

Thus the intersection of the rate of return on fiat money and the savings account moves to the left. People are less willing to hold fiat money, their real fiat money balances go down, and their deposits in the bank go up.

Increase in productivity, $x \uparrow$ *to* x'



Effect on the Money Market

Thus H_t goes up and Q_t goes down.

The money multiplier, $1+\frac{H_t}{Q_t}$, goes up and so do the total nominal money supply $(M1)_t$ and the price level p_t.

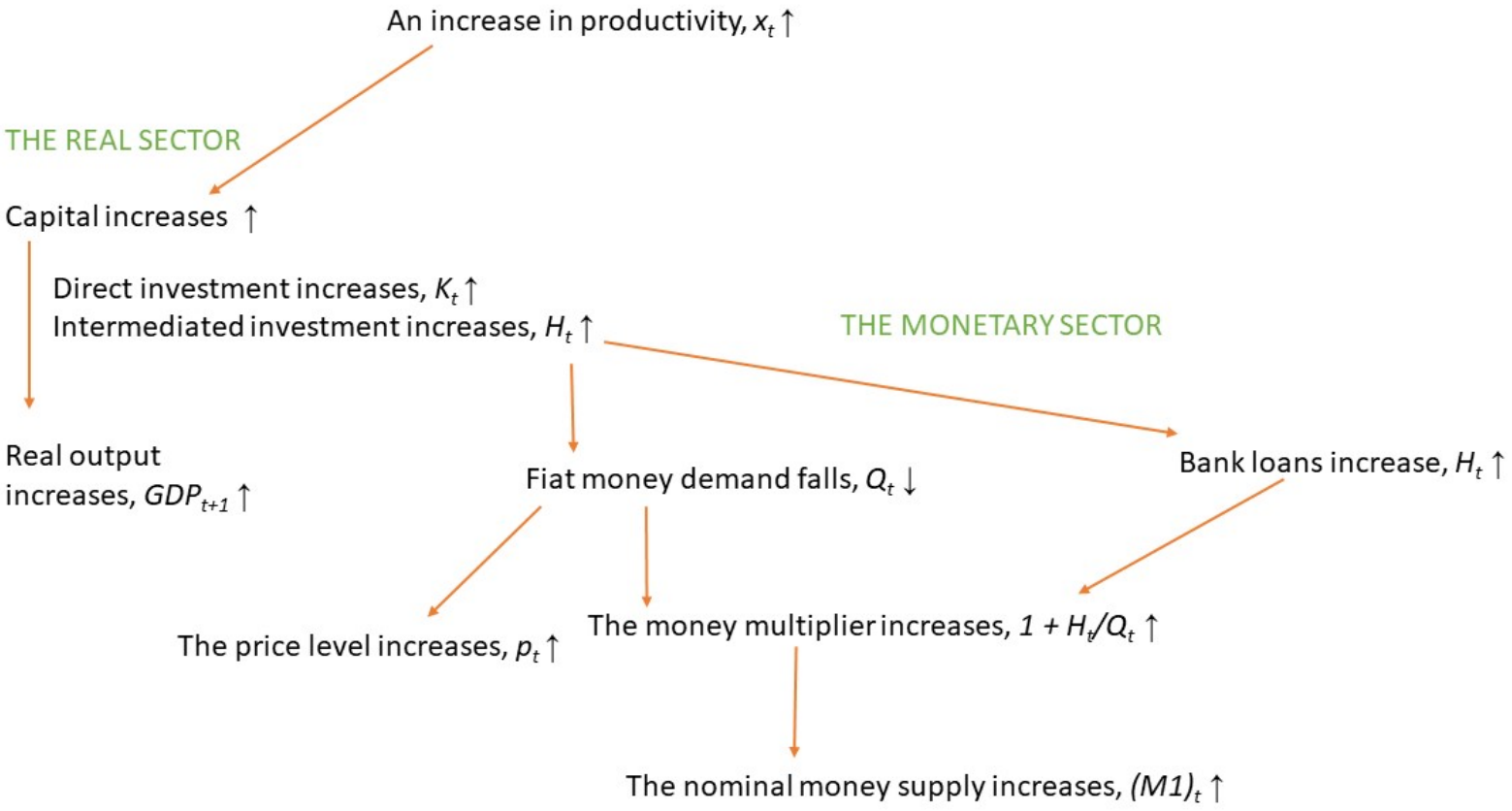
Effect on the Real Sector

Capital increases, since intermediated investment rises, i.e. H_t increases and bank loans increase. Direct investment would also rise, i.e. K_t increases.

Hence output will increase:

$$GDP_{t+1} = Y_{t+1} + x'H_t + x'K_t$$

The Model's Chain of Causes and Effects



Thus we get a positive correlation between the nominal money supply and the real output as observed in the data!

But as you can see, there is no causality here. The change in the money supply did not cause a change in the real output.

A third variable, namely the productivity of capital (and here also the real interest rate), was the source of both of these changes actually.

Correlation does not imply causality.

What is the Effect of an Unexpected Increase in the Fiat Money Stock?

This will be a once-for-all change in the fiat money stock. Thus the rate of return on fiat money will stay constant at 1.

So the graph will not change, s^* will remain the same.

Thus H_t and Q_t remain unchanged.

But the price level, $p_t = \frac{M_t}{Q_t}$, will increase.

So does the nominal money supply, $(M1)_t = \left(1 + \frac{H_t}{Q_t}\right) M_t$.

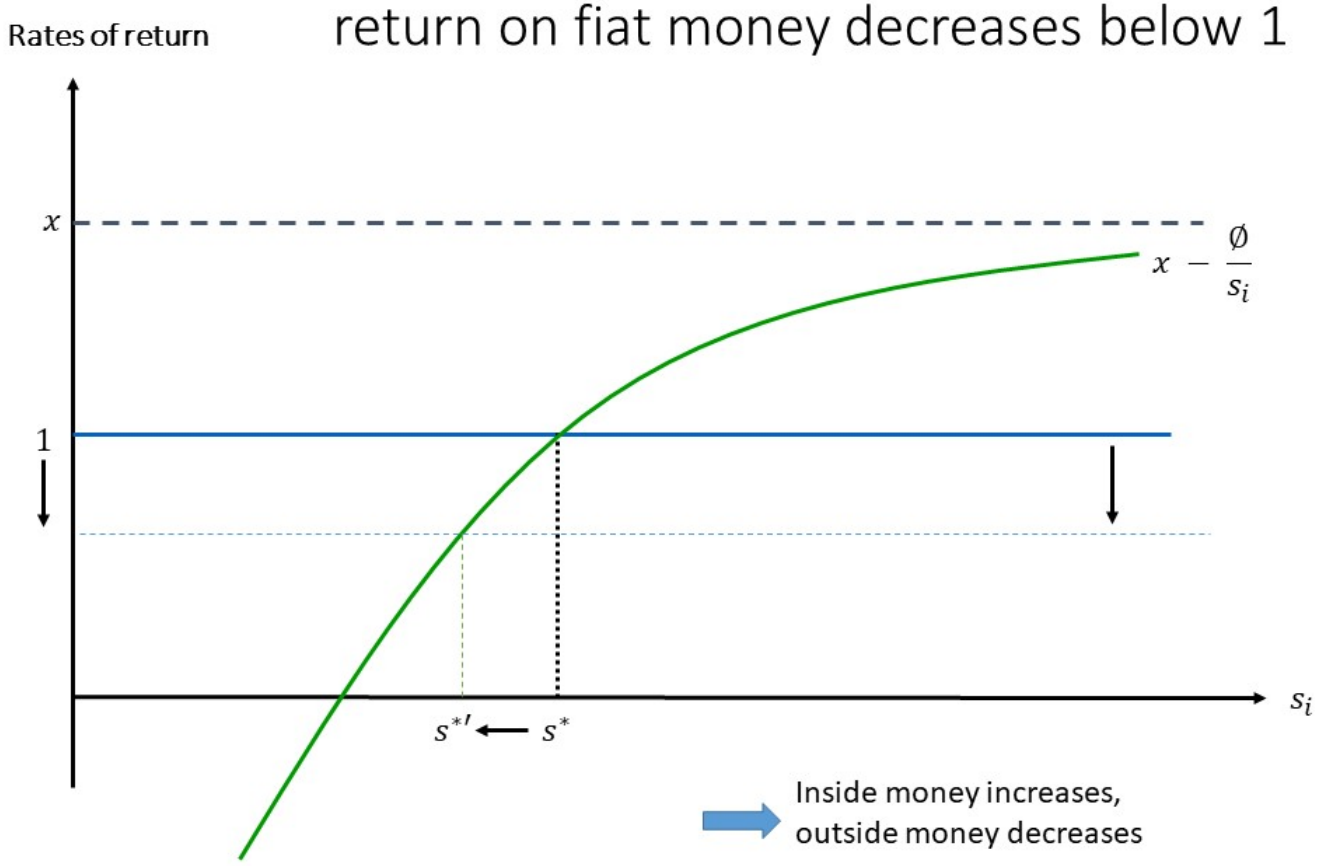
And the output, $GDP_{t+1} = Y_{t+1} + xH_t + xK_t$, will remain unchanged.

What Happens if the Change in the Fiat Money Stock Was Anticipated?

Then the rate of return on fiat money would decrease!

From the graph, we would see that s^* would decrease. Hence people would substitute toward bank deposits. There would be an increase in the intermediated capital and subsequent output. *This is the Tobin Effect!*

Anticipated increase in inflation return on fiat money decreases below 1



Anticipated inflation is not a good policy to stimulate output

- Shifting away from currency increases transaction costs.

- Total stock of currency is a small fraction of the size of the nation's capital stock. The effect on output would be rather small.

A Monetary Stabilization Policy

Suppose productivity of capital fluctuates through time. We know that this will cause fluctuations in the total money supply and real output.

Can and/or *should* one eliminate the fluctuations in the real output by stabilizing the total money supply?

Suppose x decreases, so s^* increases, people hold more currency and Q_t increases, H_t decreases.

Thus the money multiplier $1 + \frac{H_t}{Q_t}$ decreases.

Recall $(M1)_t = M_t \left[1 + \frac{H_t}{Q_t}\right]$. So to keep $(M1)_t$ stable, one must increase M_t to offset the decline in the money multiplier!

Assume that this policy is implemented. Will the real output remain unchanged?

NO! Because $(M1)_t$ does not affect output.

The real output $GDP_{t+1} = Y_{t+1} + x'H_t + x'K_t$ will still decrease because $x' < x$ and both capital investments H_t and K_t decreased.

Keeping $(M1)_t$ fixed does not eliminate real output fluctuations that arise due to fluctuations in productivity (i.e. real interest rate).

Introduce Reserve Requirements to the Model

Let γ be the reserve requirement ratio.

Then the fiat money stock should equal to the nominal currency held by the workers plus the nominal reserves at the banks.

$$
\begin{aligned}
(M1)_t =& \text{nominal currency} + \text{nominal bank deposits} \\
=& (M_t - \text{nominal reserves}) \\
& + \text{nominal bank deposits} \\
=& M_t - \gamma p_t H_t + p_t H_t \\
=& M_t + \underbrace{p_t(1-\gamma)H_t}_{\text{nominal intermediated capital}}
\end{aligned}
$$

$$(M1)_t = M_t + p_t(1-\gamma)H_t$$

Here $(1-\gamma)H_t$ is the real inside money which is part of deposits backed by capital.

If γ increases, then $(M1)_t$ decreases – consistent with chapter 8!

Now M_t includes demand for currency by the workers and a fraction of the demand for deposits held as reserves by the banks.

So

$$M_t = p_t Q_t + \gamma p_t H_t$$

and

$$p_t = \frac{M_t}{Q_t + \gamma H_t}$$

$$
\begin{aligned}
(M1)_t =& M_t + p_t(1-\gamma)H_t \\
=& M_t + \left[\frac{M_t}{Q_t + \gamma H_t}\right](1-\gamma)H_t \\
=& \underbrace{\left[1 + \frac{H_t(1-\gamma)}{Q_t + \gamma H_t}\right]}_{\text{money multiplier}} M_t
\end{aligned}
$$

Consistency check with previous models:

Note that when the young do not demand money then $Q_t = 0$, and thus the money multiplier reduces to $\frac{1}{\gamma}$.

And when there is no reserve requirement, i.e. $\gamma = 0$, then the money multiplier reduces to $1 + \frac{H_t}{Q_t}$.

Conclusion

The total money supply is not a useful measure when looking at changes in real output.

Inside money is deposits invested through banks in productive capital.

Outside money is merely unbacked pieces of paper with no direct link to production.

A correlation of inside money with real output can appear to be a correlation of total money with real output.

Be careful when observing correlations.

Correlation does not imply causality!