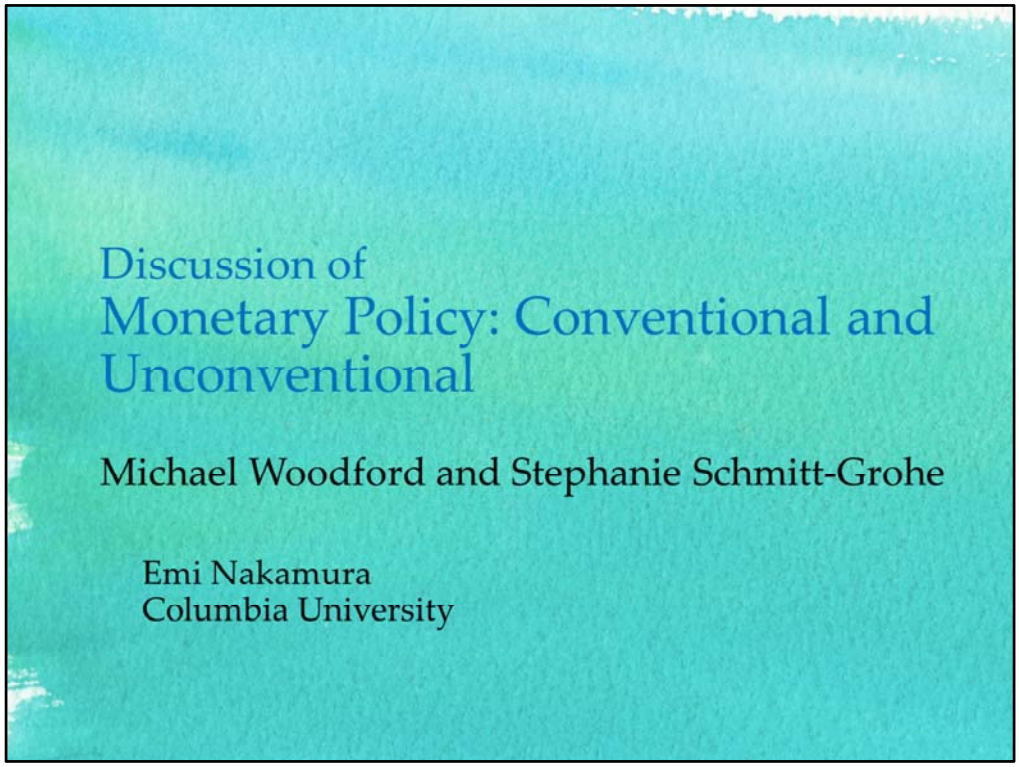
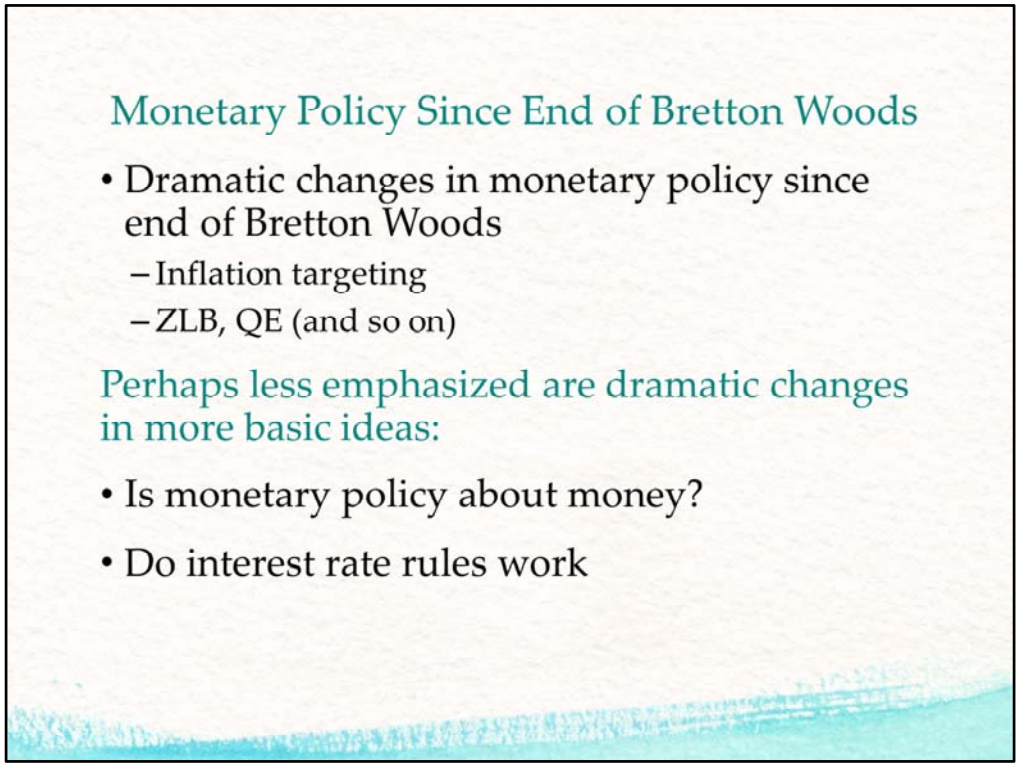


Let me start by thanking Jon Steinsson, who helped me in developing these ideas.



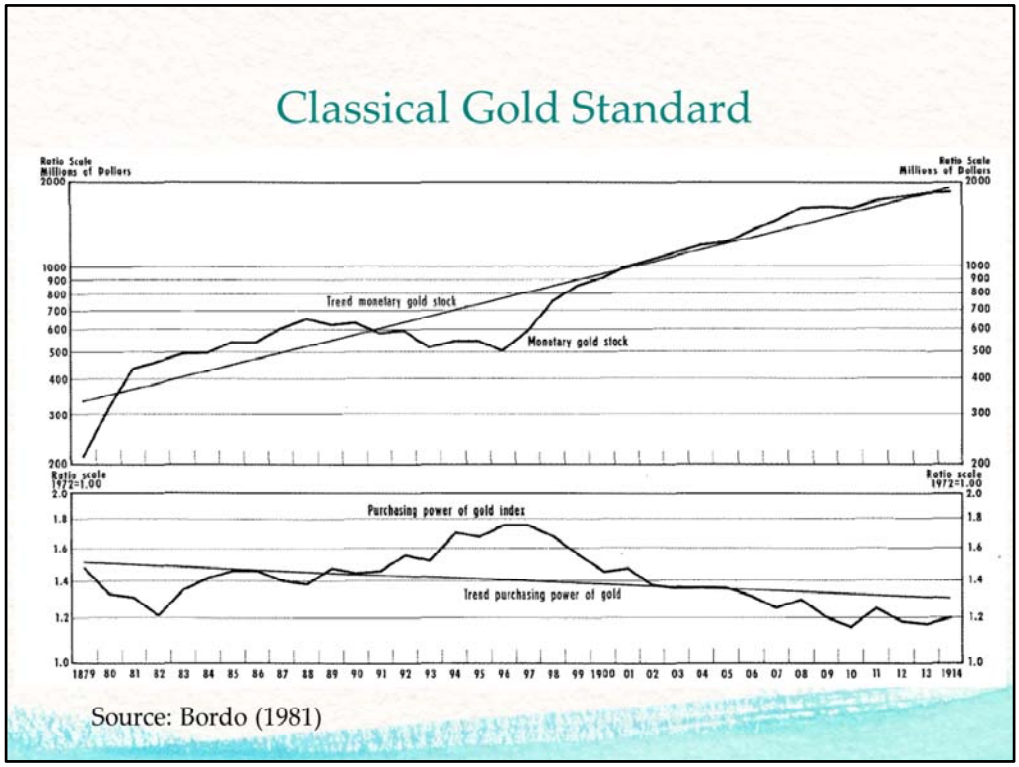
There have been many dramatic changes in monetary policy since the end of Bretton woods

Some of the more complicated ones are that things like the consequences of the zero lower bound, quantitative easing and so on have gone from the realm of somewhat abstract theoretical ideas to part of common parlance, even in newspapers. The presenters so far have focused on these more complicated ideas.

But there have also been basic, but important questions to which the answers have changed over time:

- Is monetary policy about money?
- Does targeting interest rate work as a monetary policy?

The authors in this session have also contributed greatly to our understanding of these questions, so I want to focus my discussion on this.

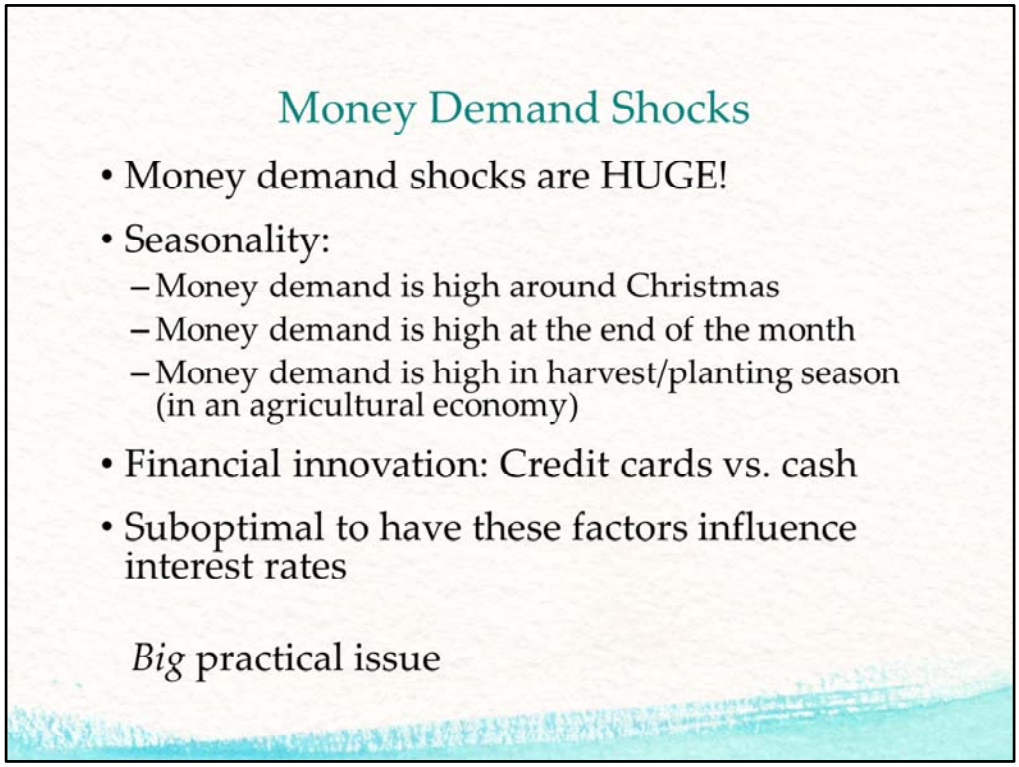


Let me start with some (deep) background. Going back to the classical gold standard of the late 1800's and early 1900's monetary policy seemed like a very "tangible" object: Paper money was backed by an object with intrinsic value – gold

And higher growth in the gold stock led to more rapid declines in the purchasing power of gold– i.e. inflation. Also, when the growth in the stock of gold failed to keep up with growth in the world economy, there was deflation.

Of course, one problem with this system was that monetary policy was subject to the vagaries of the gold market: So, e.g. a big discovery of gold led to inflation, while a dearth of gold discoveries led to deflation since the world economy (and therefore money demand) was growing rapidly. This system worked sufficiently poorly that US presidential elections revolved around monetary policy, e.g., the election of 1896.

One idea would be to replace this gold backing of the monetary stock with a money supply growing at a constant rate (the central idea of monetarism). But that too has major, essentially unsurmountable practical problems

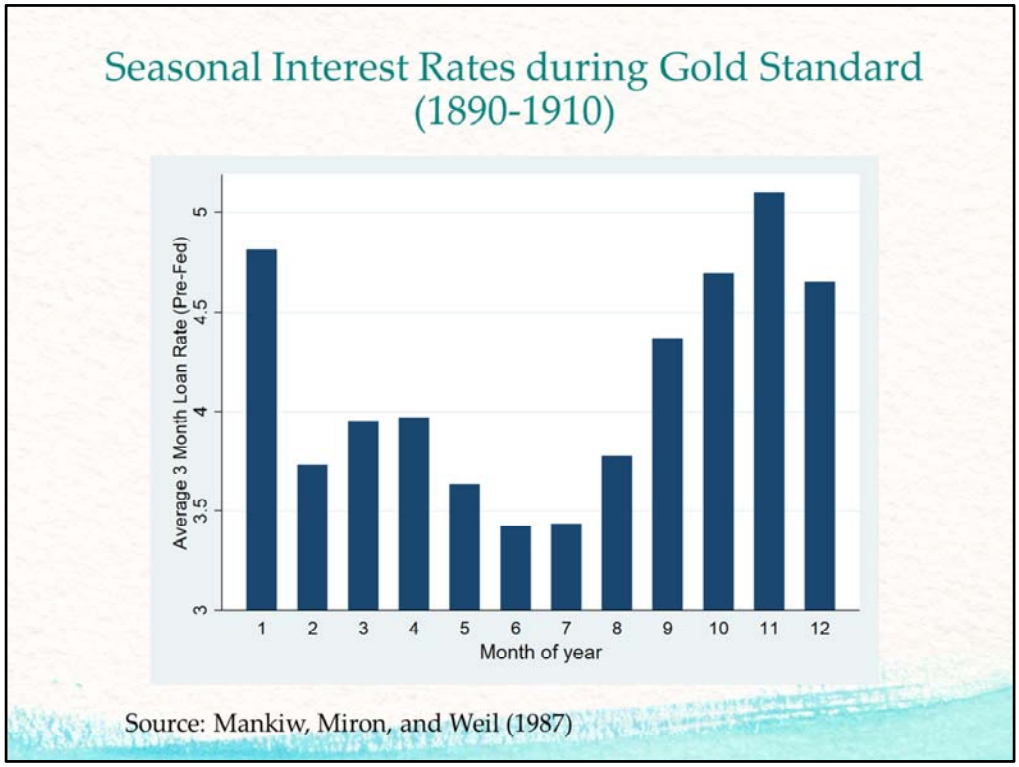


In particular, money demand shocks are huge!

There are all sorts of things that lead to variation in the amount of money people want to carry out transactions
-In the modern world, a major source of fluctuations is Christmas– people need more money to buy Christmas presents
-Also at the end of the month, when people get paid
-In an agricultural economy: during the harvest/planting season

And then the advent of credit cards: since now you don't have to carry around cash to buy things.
And interest bearing accounts that you can access with credit cards: since now you can walk into a store and buy things using an interest bearing asset

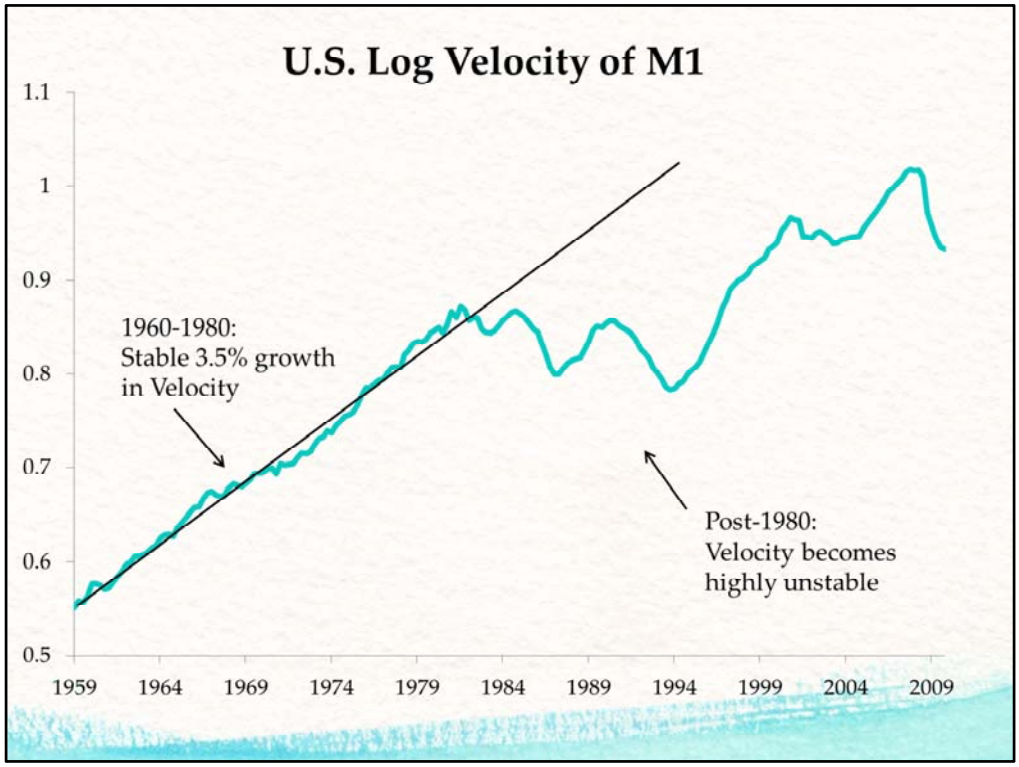
We do not want to have monetary policy respond to these things. This is a BIG practical problem.



Here is an illustration of the seasonality, emphasized for example by Mankiw, Miron and Weil (1987) (these are my own calculations from their data).

These are interest rates over different months of the year during the classical gold standard

You can see that interest rates were more than a percentage point higher in fall and winter, and this was believed to be a consequence of the increased money demand during the harvest and planting seasons.



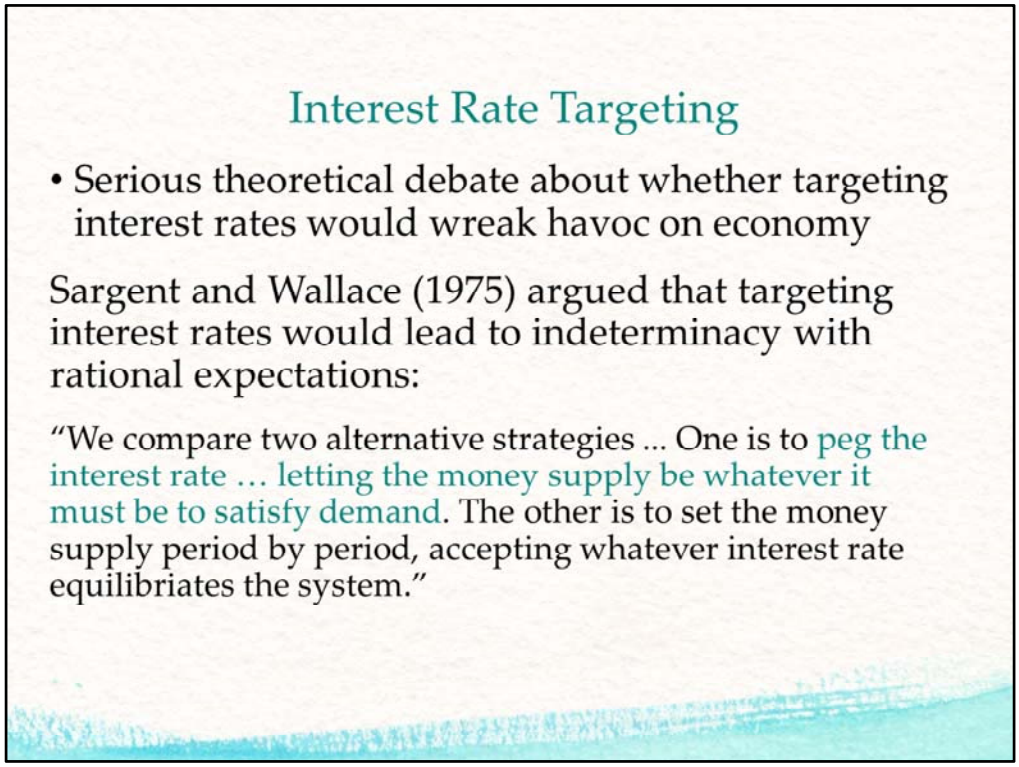
Here is a plot of velocity, the ratio of nominal aggregate demand to money. You can see that while it grew at a roughly linear rate before 1980, the period Anna Schwartz and Milton Friedman had focused on to advocate monetarism, the growth rate became highly unstable after that.

These fluctuations in velocity reflect money demand shocks (among other things). To the extent that the central bank tried to maintain a constant growth rate of the money supply, the interest rate and inflation would reflect these money demand shocks, and be highly unstable.

From a practical standpoint, the large money demand shocks made targeting money growth very problematic.

I should note that Friedman and Schwartz tended to advocate focusing on M2, not M1. Velocity for M2 looks quite different, but also very volatile (even before 1980).

[Aside: High point of monetarism was around 1980. Milton Friedman's argument at the time was that since velocity had been growing at a 3.5% rate for some time, a good monetary policy would be a stable growth rate of the money supply, and this would lead to a stable inflation rate. If you think that real growth in output is 2%, then this suggests that the money supply should shrink by 1.5% per year, if velocity grows at a stable 3.5% rate; or to achieve stable 2% inflation, you would want the money supply to grow at 0.5% per year.]



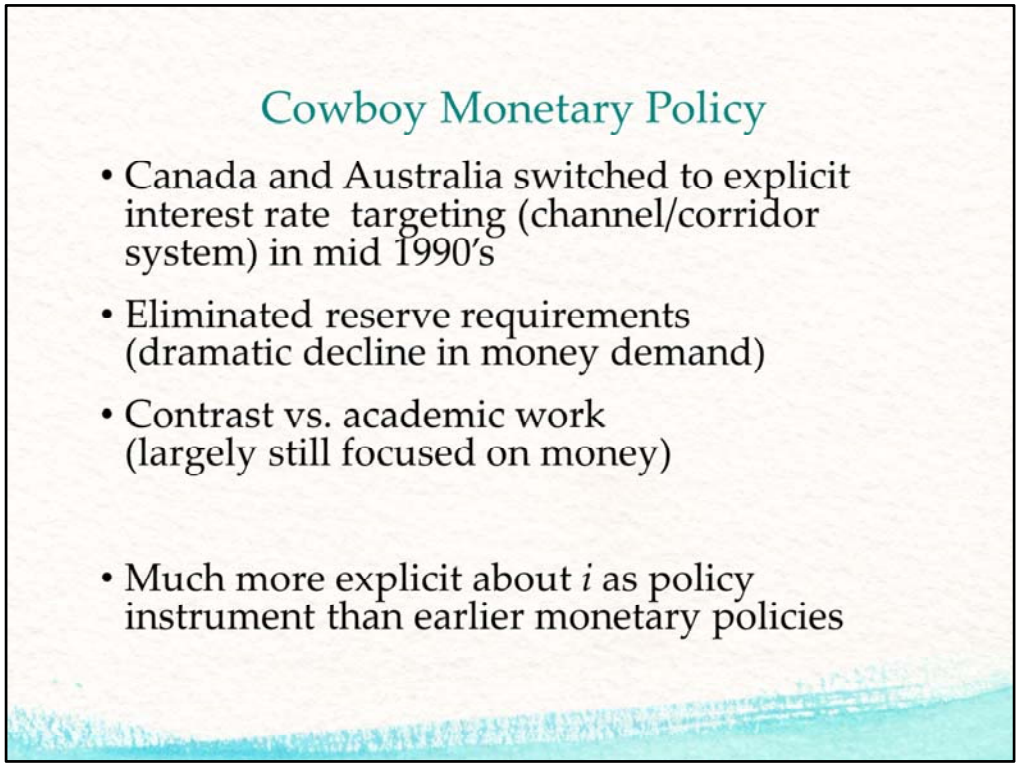
A practical alternative was to target the interest rate, not the money supply. However, there was considerable debate in the academic literature about whether interest rate rules were a viable monetary policy.

A famous 1975 article by Sargent and Wallace compared the implications of monetary policies targeting the money supply versus those targeting the interest rate under rational expectations. The conclusion of the article was that targeting the interest rate would lead to indeterminacy in the price level!

I should note that it later became clear in this literature that a crucial distinction was between the central bank targeting an exogenous target for the money supply or interest rate, that didn't respond to economic conditions, versus an endogenous rule responding to inflation (as in the Taylor principle). But that was a distinction emphasized by the subsequent literature and wasn't a focus of this early article.

In any case, Sargent and Wallace's article was certainly viewed as a cautionary note regarding the consequences of interest rate targeting.

[Note: Milton Friedman also discussed interest rate pegs in his presidential address, and argued they would lead to unstable inflation.]



In this context, it can be viewed as a pioneering act when the central banks of Canada and Australia switched to a completely explicit interest rate targeting policy in the mid 1990's.

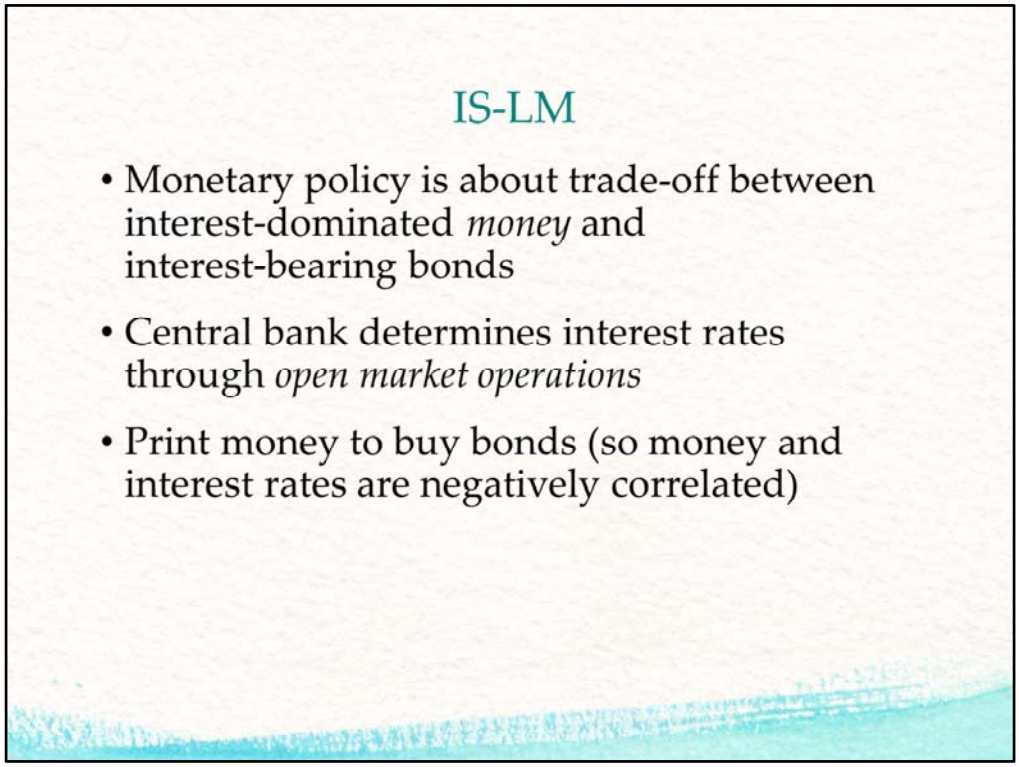
- They also eliminated reserve requirements, leading to a dramatic decline in money demand

I am not sure if the central bankers in Canada and Australia thought of what they were doing as revolutionary. (Canadians like me usually are not known for being revolutionary.)

- The minutes of the US Fed (and probably other central banks) also suggest that US monetary policy had also been interest rate targeting for a long time, but this wasn't explicitly stated, and some would dispute this (and occasionally the Fed did clearly look at monetary aggregates)

From talking to Mike, I understand that the Bank of Canada economists realized that their policies did not jive well with existing theoretical models of monetary policy, and expressed a desire for the academic literature to provide a theory of what they were doing– which Mike subsequently did.

I think it is worth going through a few details of what the Channel or Corridor system is, since it is quite different from the IS-LM ideas of how the central bank controls interest rates using open market operations.

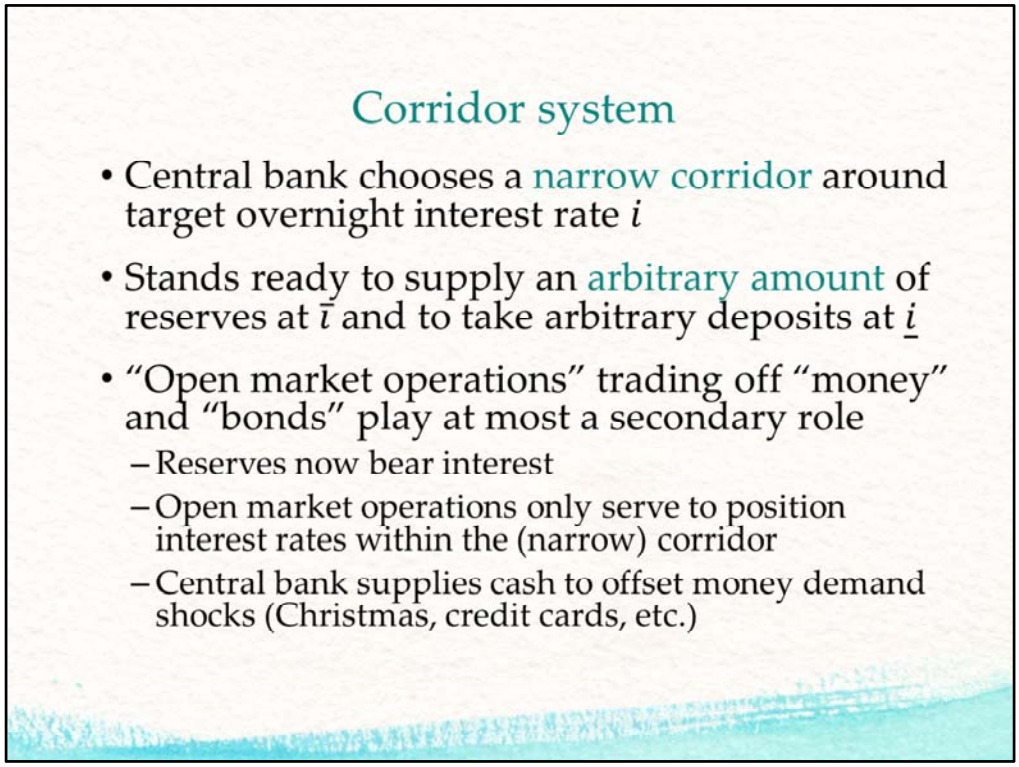


Let be start by reviewing the basic IS-LM idea, which is still widely taught as an explanation of how monetary policy works, even though, as I will describe next, the practical approach to monetary policy today is quite different from this set of ideas.

The key idea for controlling interest rates in IS-LM is the open market operation. The central bank exchanges money (an interest dominated, asset) for bonds (an interest bearing asset)

- To lower the interest rate, the central bank prints money and buys bonds. This drives up the price of bonds (and lowers the interest rate).
- So there is a negative correlation between interest rates and the quantity of money
- The key tradeoff is the liquidity services of money versus the fact that it doesn't earn interest (or at least is interest rate dominated)

But the corridor system works in a fundamentally different way.



In the corridor system, the central bank defines a very narrow corridor– say 50bp—around the target interest rate.

- The "ceiling" interest rate is an upper bound, and the central bank stands ready to supply an arbitrary quantity of reserves at that interest rate.
- Banks can also deposit an arbitrary amount at the central bank at the floor interest rate.
- The interbank interest rate is bounded between these interest rates because banks have the option of borrowing and lending at these rates

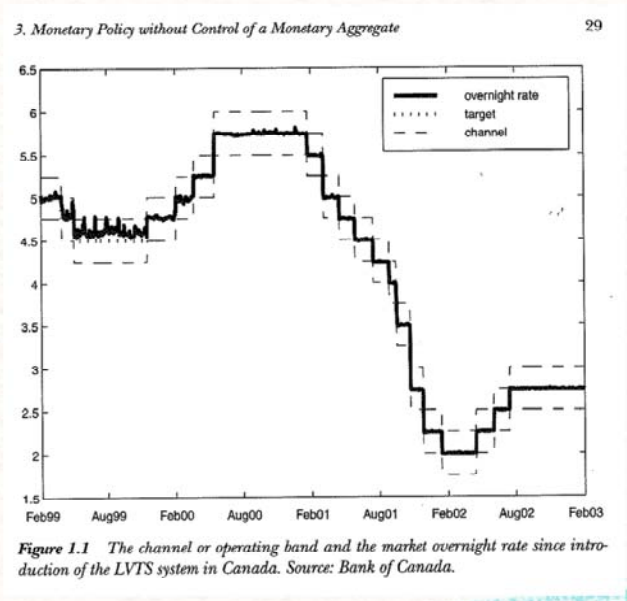
Open market operations, if I define them as trading off interest-dominated money for bonds play at best a secondary role here.

- Reserves now pay interest. They are only interest-rate dominated by a tiny amount– the distance between the middle and the bottom of the corridor.
- So now, the IS-LM type ideas only serve to position the interest rate within the (narrow) corridor. But since the corridor is so narrow, this is of very limited importance.

Again, some might say that the US had been interest rate targeting for many years so there was nothing revolutionary about this. But this system was much more explicit about its goals and functioning than the US system was.

- Given the previous literature on the perils of interest rate targeting, you might have worried something bad would happen. Did it?

Did it Work? Canada



Source: Woodford (2003)

I think that by any measure of success, the corridor system worked.

The nominal interest rate was kept within a small bound after the first year of the system. Fluctuations from the target were tiny, at least after the very start. Indeed, they were much smaller than in the US during a similar time period.

Comparison to US

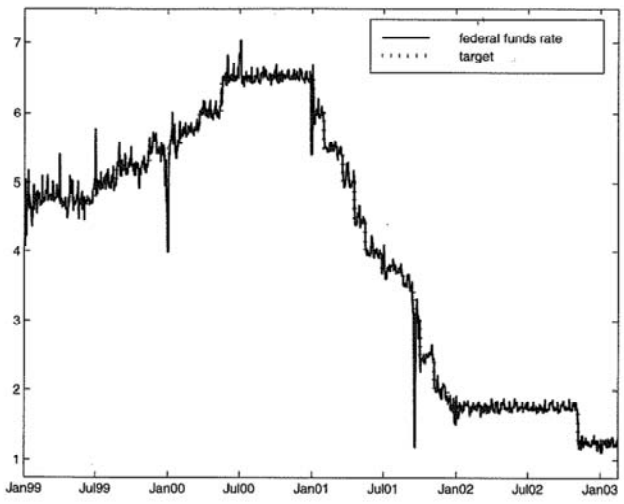
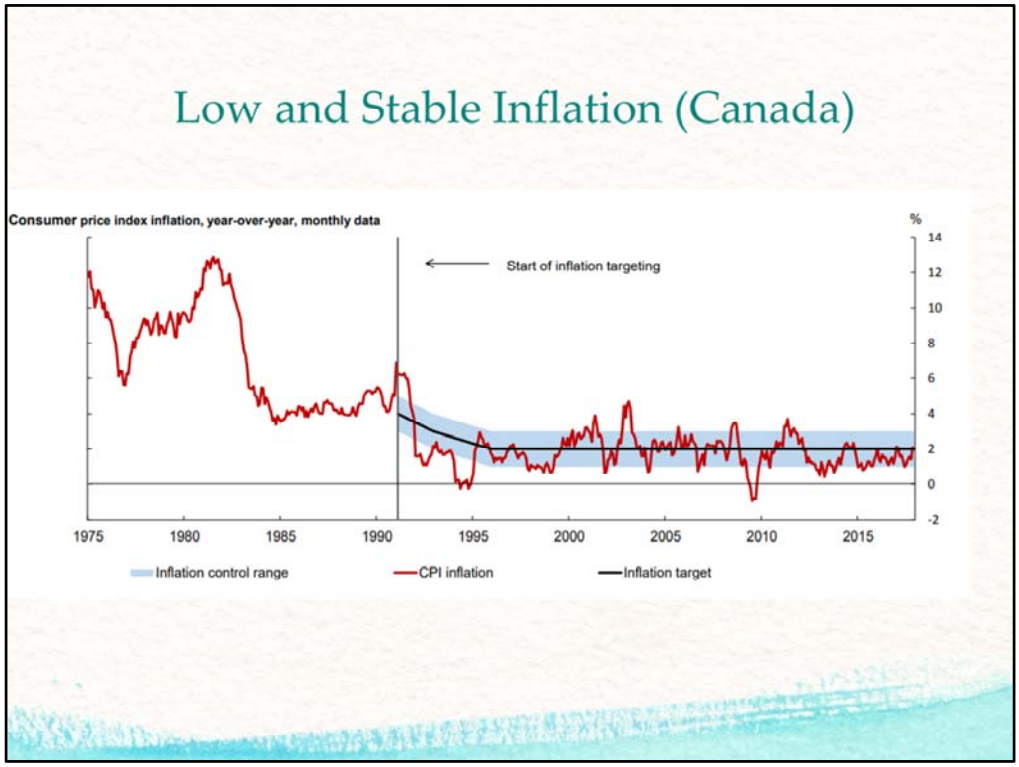
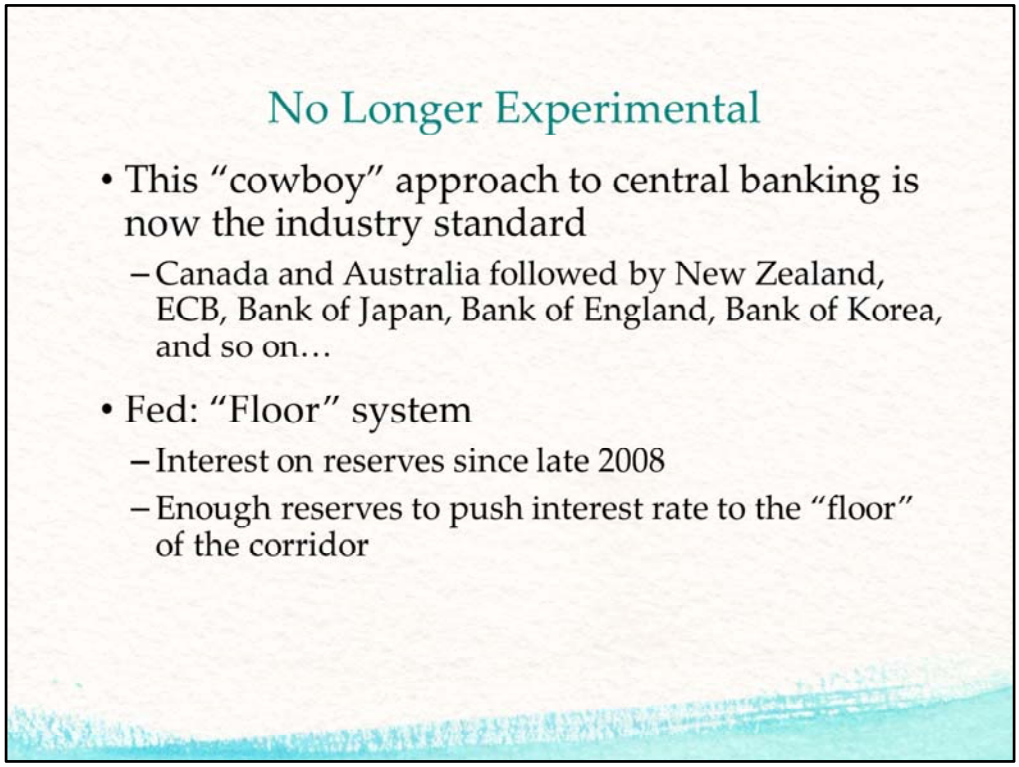


Figure 1.2 *The U.S. federal-funds rate and the Fed's operating target. Source: Federal Reserve Board.*

Source: Woodford (2003)

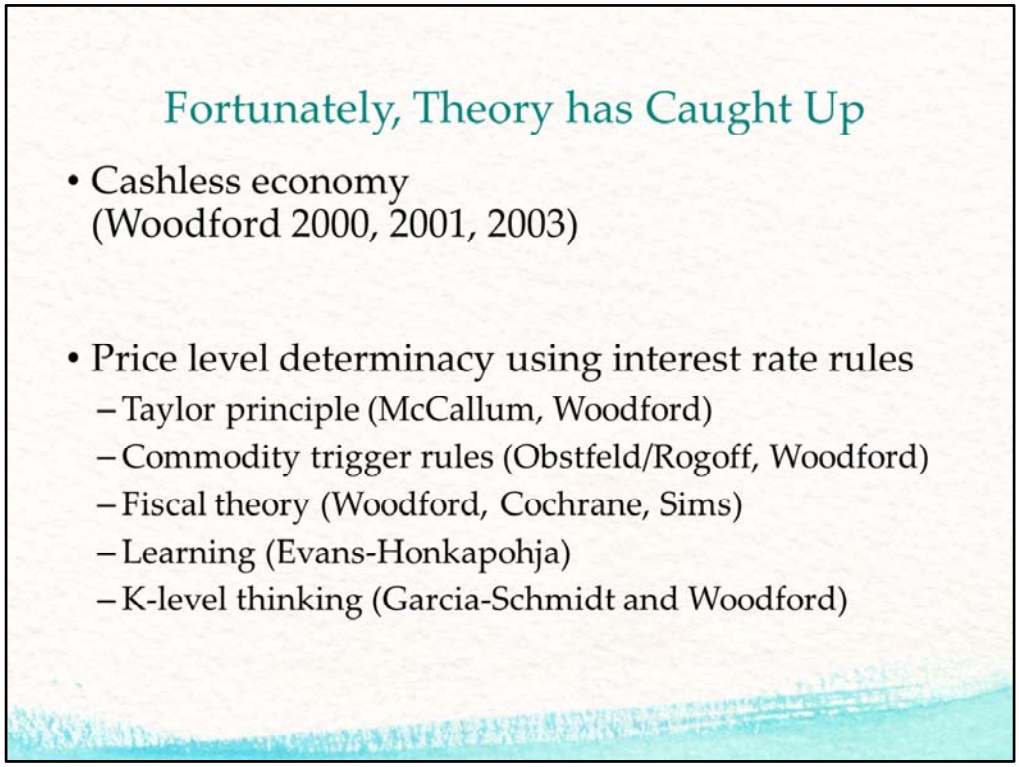


Inflation dynamics have not changed in any appreciable way since move to this new system (post 1999 in this graph).



- This type of monetary policy implementation system has a lot of practical appeal because it "automatically" offsets money demand shocks
- This helps explain why this system is now the industry standard and many other countries followed the lead of Canada and Australia.

Evidently, there has been an amazing convergence over these decades among central banks toward explicit targeting of interest rates.



If theory hadn't also advanced in the meantime then macroeconomists would be sitting on one side of an enormous canyon between academic work, and how monetary policy is implemented in practice. The older theories, with money at the core are not well suited to interpret the type of monetary policies that have become the industry standard in the modern world.

Fortunately, theory has caught up.

- A key early contribution was to notice that if the Taylor principle holds, there is a unique bounded solution for prices (unlike in the Sargent and Wallace case). This echoed earlier, less formal discussion of these ideas in the earlier literature.
- And then there are a variety of different proposals on why it might be reasonable to focus on the unique bounded solution.
    - Obstfeld and Rogoff showed that a commodity trigger rule could pin down the price level given a money supply rule, and Mike pointed out the same approach could also work with interest rate rules.
    - Another alternative is the fiscal theory, which John Cochrane has studied.
- Both of these approaches rely heavily on the rationality of households, and their beliefs about far future time periods and off-equilibrium path outcomes to rule out hyper-inflationary and hyper-deflationary outcomes.
- Other approaches to arriving at the unique bounded solution, which do not rely on this kind of hyper-rational behavior by households
    - Learning and K-level thinking, as developed by Evans and Honkapohja. Marty Eichenbaum and Larry Christiano have emphasized this in recent

work, partly responding to some of John Cochrane's critiques.

- Similarly, Mike has studied these issues in a model of bounded rationality with Garcia-Schmidt.
- These learning models try to align the theory of price level determination more accurately with empirical evidence on how people form expectations.

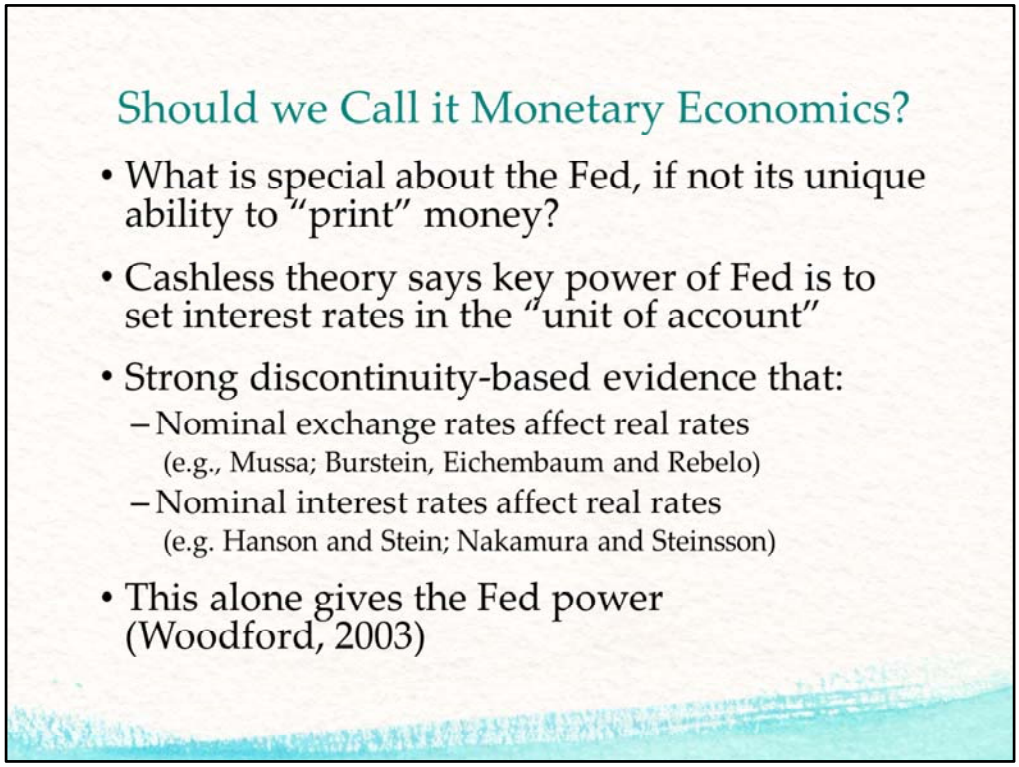
Empirics: Money to interest rates

Barro (1977)	Money
Sims (1980)	Money
Bernanke (1986)	Money
Bernanke and Blinder (1992)	Interest rates
Sims (1992)	Money and Interest Rates
Eichenbaum and Evans (1995)	Money
Christiano, Eichenbaum and Evans (1999)	Money
Bernanke and Mihov (1998)	Money and Interest Rates
Romer and Romer (2004)	Interest Rates
Christiano, Eichenbaum and Evans (2005)	Money and Interest Rates
Bernanke, Boivin and Eliasz (2005)	Interest Rates
Gurkaynak Sack and Swanson (2005)	Interest Rates
Gertler and Karadi (2015)	Interest Rates
Nakamura and Steinsson (2018)	Interest Rates

The same trend away from money and toward interest rates has occurred in empirical work.

- Here I have a list of empirical papers on monetary economics
- Evidently, the standard indicator of the monetary instrument has shifted gradually from "money" to "interest rates"

This has important advantages from a statistical standpoint in the presence of large money demand shocks, which lead to volatile monetary aggregates.



At some point, you may have a nagging feeling that there is something wrong with this:

- I have argued that in a corridor system for implementing monetary policy– which is becoming increasingly popular around the world today—money does not play a crucial role
- But you may wonder; Where does the unique power of the Fed come from if not from its unique ability to print money?

- In the US, there is still a large amount of money in circulation. Less true in places like Sweden and Iceland where cash increasingly does not exist.
- Suppose we consider the logical extreme where you can buy anything you want using a credit card linked to an interest bearing account
- There would be no interest rate dominated "money" or "cash" in this economy– this is what Mike refers to as a "cashless economy"

What happens then? Would the Fed lose it's power?

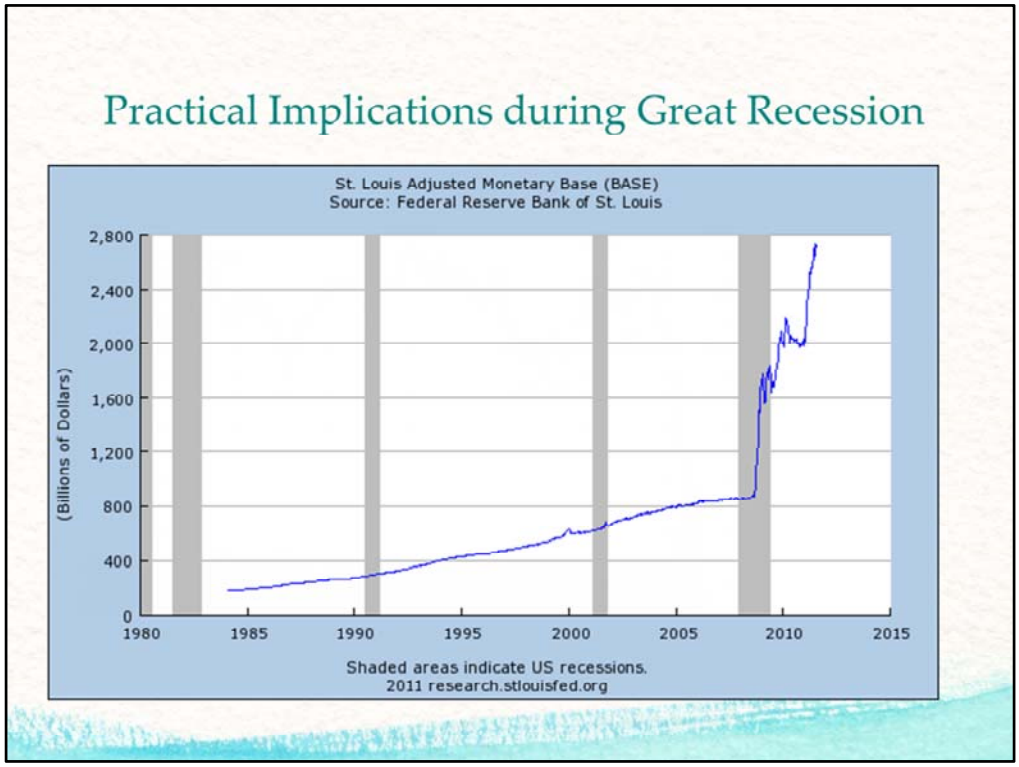
- The key idea is that what makes the Fed special is not its unique ability to print little green pieces of paper (that pay zero interest)
- Even in the absence of interest-dominated "money" the Fed still has a unique power to determine the interest rate *in dollars* because it can supply arbitrary amounts of (interest bearing) reserves in dollars
- Of course, the unit of account might be irrelevant if prices were completely flexible. But there is fairly irrefutable discontinuity-based evidence that the

inflation is a sluggish variable, and US prices don't adjust in a completely flexible way (in dollars). As a consequence,

-A nominal exchange rate depreciation leads to a real exchange rate depreciation
-A nominal interest rate change leads to a real interest rate change

The Fed sets the interest rate in this "unit of account" and this gives it power, even if there is no cash.

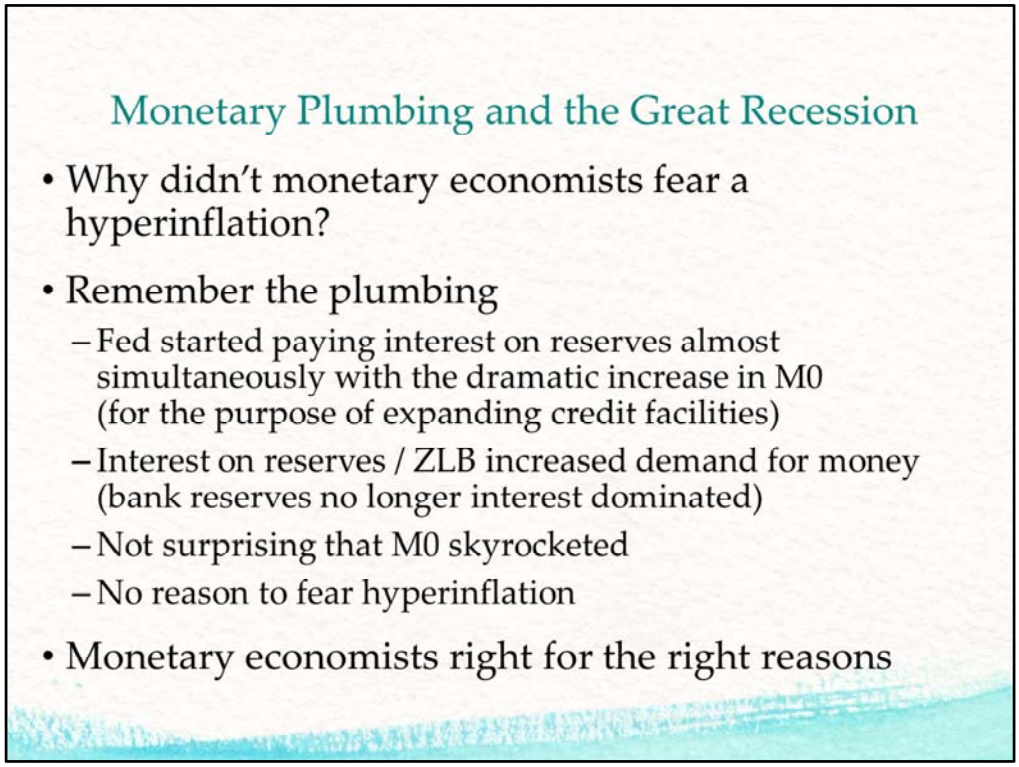
[Aside: What makes the Fed special? Couldn't the Boy Scouts of America make up their own currency and set the interest rate in those units? Yes, but the Fed is unique in that *its* interest rate applies to the unit of account that is actually used in setting prices and writing contracts in the economy.]



Finally, let me say that while some of these theoretical issues may seem abstract, they have important practical implications.

Consider the financial crisis, in which there was a massive increase in M0

- This led many observers, particularly in financial markets and the popular press, to warn of a hyperinflation.
- Monetary economists, almost uniformly, did not
- Why?



This is a case in which it's important to remember some of the nitty gritty details I've discussed so far.

- It's hard to see the exact timing of the explosion in the monetary base on the graph I just showed. But the explosion of M0 happened before interest rates hit zero.
- The Fed wanted to institute large-scale credit easing programs.
- Interest rates would have hit zero, but the Fed started paying interest on reserves, which meant there was no longer a penalty for holding them.
- This made the money supply variable very hard to interpret as a metric of how "expansionary" the stance of monetary policy was.

In my view, this was one– perhaps too infrequent– case in which monetary economists were right for the right reasons!

But it is also a reflection of the massive benefits there have been to the growing convergence between theory and practice of monetary policy over the past several decades.

Finally, the credit easing policies that occurred during this time period in some sense resurrected some of the "LM curve" ideas of exchanging one asset for another bearing higher interest– in that the Fed bought risky assets to drive down spreads. This illustrates that while the original LM curve ideas no longer play much role in explaining conventional monetary policy they were in some ways reincarnated in

the analysis of unconventional policies.