Topic 1:
"Monetary Policy: From Inflation Targeting to Quantitative Easing"

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Liquidity Traps and Inflation

- **Paul Krugman recently commented in a *New York Times* editorial:**

  "…It's not hard to see where inflation fears were coming from. In its efforts to prop up the economy, the Fed has bought more than $2 trillion of stuff – private debts, housing agency debts, government bonds…..Here comes hyperinflation!

  Or, actually not. From the beginning, it was or at least should have been obvious that the financial crisis has plunged us into a "liquidity trap", a situation in which many people figure that they might just as well sit on cash.

  Economists who have studied such traps….knew that some of the usual rules of economics are in abeyance as long as the trap lasts. Budget deficits, for example, don't drive up interest rates; printing money isn't inflationary…" (May 2, 2013)

What Should Central Banks Do?

- **Recent theory suggests several principles that serve as guide to successful operation of central bank (Mishkin, 2000):**
  - **Price stability is beneficial**
  - **Fiscal policy should be aligned with monetary policy**
  - **Time-inconsistency is a serious problem**
  - **Monetary policy should be forward-looking**
  - **Policymakers should be accountable**
  - **Monetary policy should be concerned with output as well as price fluctuations**

What Should Central Banks Do?

- **Why is price stability beneficial?**

  Growing consensus has emerged that a low and stable inflation rate provides benefits to an economy:

  - **prevents over-investment in financial sector as economic agents (individuals and firms) attempt to escape costs of inflation**
  - **lowers uncertainty about prices, thereby improving decisions by agents and increasing economic efficiency**
  - **reduces distortions due to interaction of tax system and inflation**

  Price stability can increase level of resources productively used in an economy, i.e., inflation may be detrimental to economic growth

What Should Central Banks Do?

- **Why align fiscal and monetary policy?**

  Irresponsible fiscal policy may make it more difficult for central banks to pursue price stability:

  - **if independent central bank sets targets for growth of money supply, determines level of *seignorage**, fiscal authority financing any deficits through bond sales and seignorage**
  - **if fiscal authority independently sets budgets, and deficits cannot be financed by sale of bonds, central bank has to create money, resulting in additional inflation**

  Key is prevention of *fiscal dominance* (Sargent and Wallace, 1981)

  *** Seignorage: revenue central bank generates by printing money, i.e., interest earned on government bonds it purchases**

What Should Central Banks Do?

- **Why avoid time-inconsistency?**

  Key problem for monetary policymaker is *time-inconsistency* (Kydland and Prescott, 1977; Barro and Gordon, 1983):

  - **incentive to exploit short-run tradeoff between employment and inflation in order to pursue short-run objectives**
  - **expansionary monetary policy may produce growth in short-run, but will cause inflation in long-run**

  Does not imply central bank will pursue expansionary monetary policy, but may be under pressure to do so, i.e., moves time-inconsistency problem back one step to political process (McCallum, 1995)

What Should Central Banks Do?

- **Why should monetary policy be forward-looking?**

  There are lags between monetary policy and its intended effect:

  - **if policymaker waits until inflation occurs, likely too late – inflation expectations built into wage and price-setting**
  - **once inflation is underway, stopping it is slower and costlier**
  - **if economy is in a recession, and expansionary policy is implemented too late, could promote unnecessary output fluctuations and potentially inflation**

  Monetary policymakers need to be forward-looking, and be pre-emptive by heading-off any future inflationary surge

What Should Central Banks Do?

- **Why should central banks be accountable?**

  A basic principle of democracy is that government policymakers need to be held accountable to the public:

  - **there should be formal accountability mechanisms for central bank, e.g., Chairman of US Federal Reserve required to testify twice a year in front of Congress**
  - **requires an explicit nominal anchor by which to measure performance of central bank**
  - **if central bank goals and strategy are obscure, possibility of a political backlash, undermining its future independence**

  Accountability also important in terms of promoting efficient government

What Should Central Banks Do?

- **Why should monetary policy be concerned with output as well as price fluctuations?**

  Price stability is a means to a healthy economy, and not an end in itself:

  - **central bankers should not be obsessed with inflation control (King, 1997)**
  - **public cares about output as well as price fluctuations**
  - **central bank should aim to minimize output as well as inflation fluctuations**

  Policy objective functions in macroeconomics literature routinely account for both output and prices – the "Taylor rule" (1993)

The Inflation Record

- **In 1970s, inflation rose to high levels in most countries, by this decade much lower inflation rates**

Average Inflation Rates by Decade (%)				
Country	1970s	1980s	1990s	2000s
Australia	9.8	8.4	3.3	3.0
Canada	7.4	6.5	2.7	2.3
Germany	4.9	2.9	3.2	1.9
Japan	8.9	2.5	1.6	0.9
UK	12.7	6.9	4.6	1.7
US	7.1	5.5	3.5	2.9
Argentina	132.9	750.4	146.3	9.8
Brazil	30.7	468.7	674.4	6.9
Chile	162.0	20.9	10.9	4.0
Mexico	14.7	74.2	20.2	4.9

Source: IMF

Central Bank Behavior

- **Changes in conduct of monetary policy tied to history of and development of macroeconomic thought**
  - **<u>1960s</u>:**
  - **Inflation fairly benign (1-4% in advanced economies)**
  - **Monetary policy focused on "money market conditions" such as nominal interest rates**
  - **Economics profession dominated by Keynesian thinking – an era of policy activism, based on notion that full employment could be achieved with only slight inflationary consequences**
  - **Friedman (1963, 1968) argued growth rate of money supply key to explaining fluctuations in output and inflation, and that there was no long-run trade-off between unemployment and inflation**

Neoclassical vs. Keynesian Views

- **The Quantity Theory of Money:**
  - **Only asset in economy is money, held to facilitate transactions**
  - **Demand to hold stock of money over period of time is some fraction of value of national output:**

$$M^D = kY = kyP \qquad k < 1 \qquad (1)$$

where M^D = demand for money, k = constant, Y = nominal national output, y = real national output, P = index of prices

Re-writing (1), where $1/k = V$:

$$MV = yP \qquad (2)$$

where V = velocity of circulation of money – number of times a unit of money turns over in financing yP

Neoclassical vs. Keynesian Views

- **Demand for money must equal nominal money supply M^S:**

$$M^D = M^S = kyP \qquad (3)$$

- **To derive quantity theory, need two further assumptions:**

  (i) *y* is fixed at equilibrium level determined by interaction of supply and demand for goods and factors

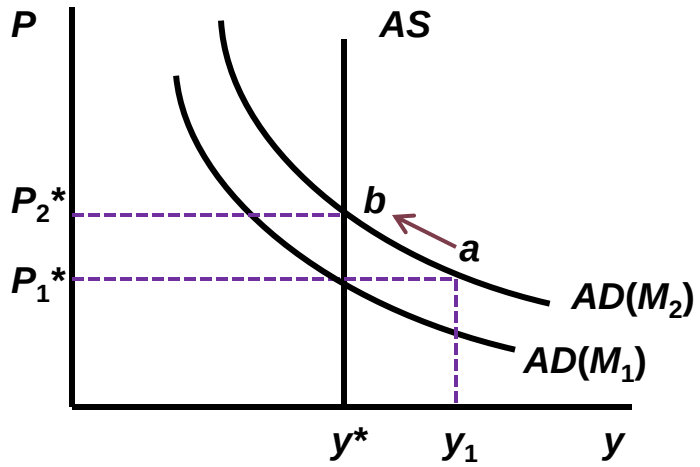
  (ii) M^S not affected by changes in *y*

- **If M^S is increased, equilibrium achieved by increase in M^D, and given *y* and *k* are fixed, price level *P* has to rise as excess money is spent on output – <u>implications</u>:**
  - **changes in money supply raises prices, and output is unaffected in long-run (neutrality)**
  - **price mechanism enables economy to adjust to equilibrium**

Neoclassical vs. Keynesian Views

- **Neoclassical Model: Aggregate Demand and Supply**

Figure 1



Aggregate supply *AS* is perfectly inelastic, equilibrium being at intersection with aggregate $AD(M_1)$, giving equilibrium prices P_1*

If money supply is increased to M_2, aggregate demand shifts to $AD(M_2)$, and at price level P_1*, there is excess demand $y_1 > y$*, so price level has to rise to P_2* to restore equilibrium

Neoclassical vs. Keynesian Views

- **Keynesian Model – Goods Market:**
  - **Assume closed economy with a government sector, where with unemployed resources, price level *P* is fixed – i.e., if *P* = 1, then *y* = *Y***

    Aggregate demand *E* in economy defined as:

    $$E \equiv C + I + G_0 \qquad (4)$$

    While national income *Y* is disposed of as:

    $$Y \equiv C + S + T \qquad (5)$$

    where: *C* = consumption, *I* = *I*(*i*) (d*I*/d*i* < 0) = investment, *i* = rate of interest, G_0 = exogenous government expenditure, *S* = savings, and *T* = tax revenue, i.e., *T* = *ty*, where *t* is constant tax rate – equilibrium being where *y* = *E*, or:

    $$S + T = I + G_0 \qquad (6)$$

Neoclassical vs. Keynesian Views

- **Assume consumption function is:**

$$C = a + by_d \qquad (7)$$

where b = the marginal propensity to consume, and y_d is real disposable income, i.e., $y_d = y - T$

Given (6), savings function is:

$$S = -a + sy_d \qquad (8)$$

where $s = (1-b)$ is the marginal propensity to save

Given definitions of y_d and T, (7) can be re-written as:

$$S = -a + s(1 - t)y \qquad (9)$$

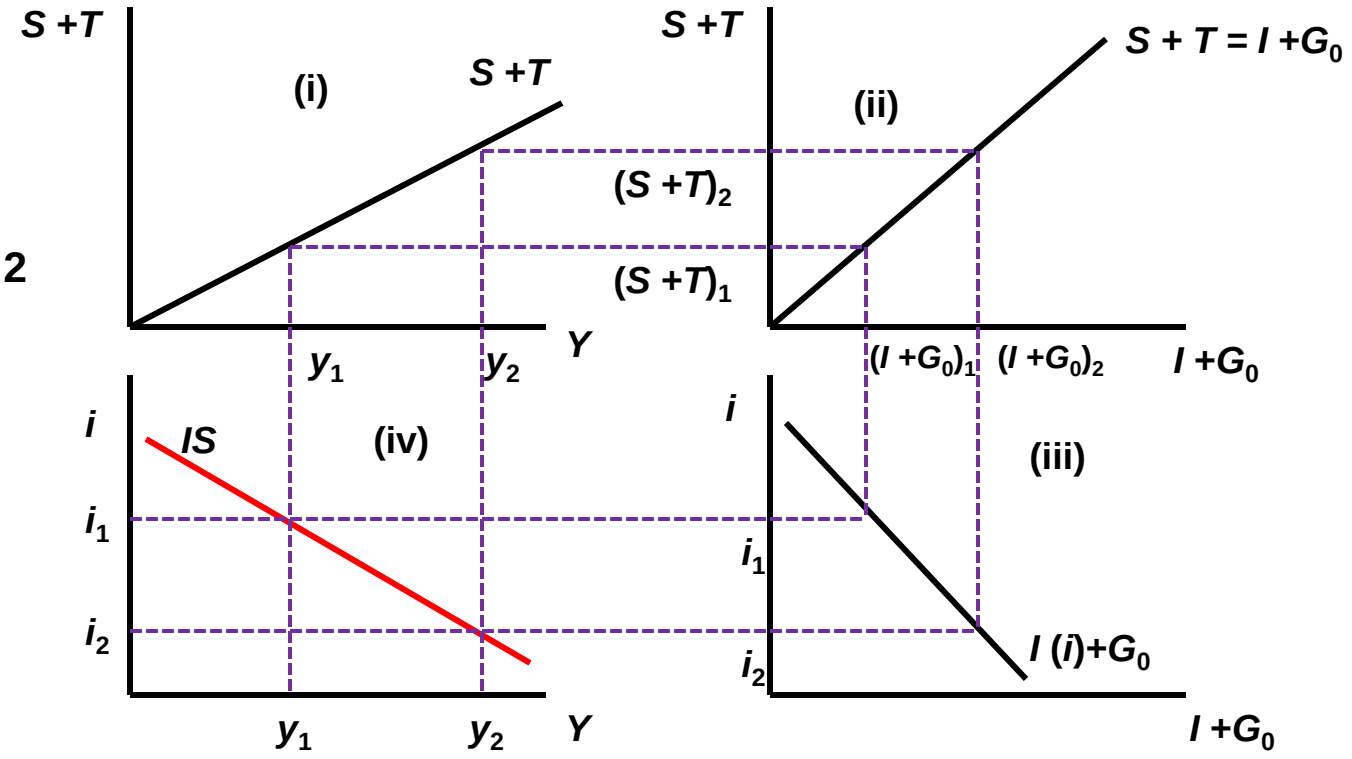
Equilibrium from (6) is:

$$-a + s(1 - t)y + ty = I(i) + G_0 \qquad (10)$$

Neoclassical vs. Keynesian Views

- (9) can be drawn as the *IS* function:

Figure 2



***IS* is locus of *i* and *y* ensuring $S+T = I + G_0$**

Neoclassical vs. Keynesian Views

- **Keynesian Model – Money Market:**
  - **Only two financial assets – money and bonds**

    Interest rate *i* is current yield on bonds making present value of future income from bond A_n equal to bond price B_p:

    $$B_p = A_n/i \qquad (11)$$

    i.e., bond prices are inversely related to interest rate

    Demand for real money balances, which is a function of real income and rate of interest, has to equal given money supply:

    $$M^D/P = f(y,i) = M_0^S/P \qquad (12)$$

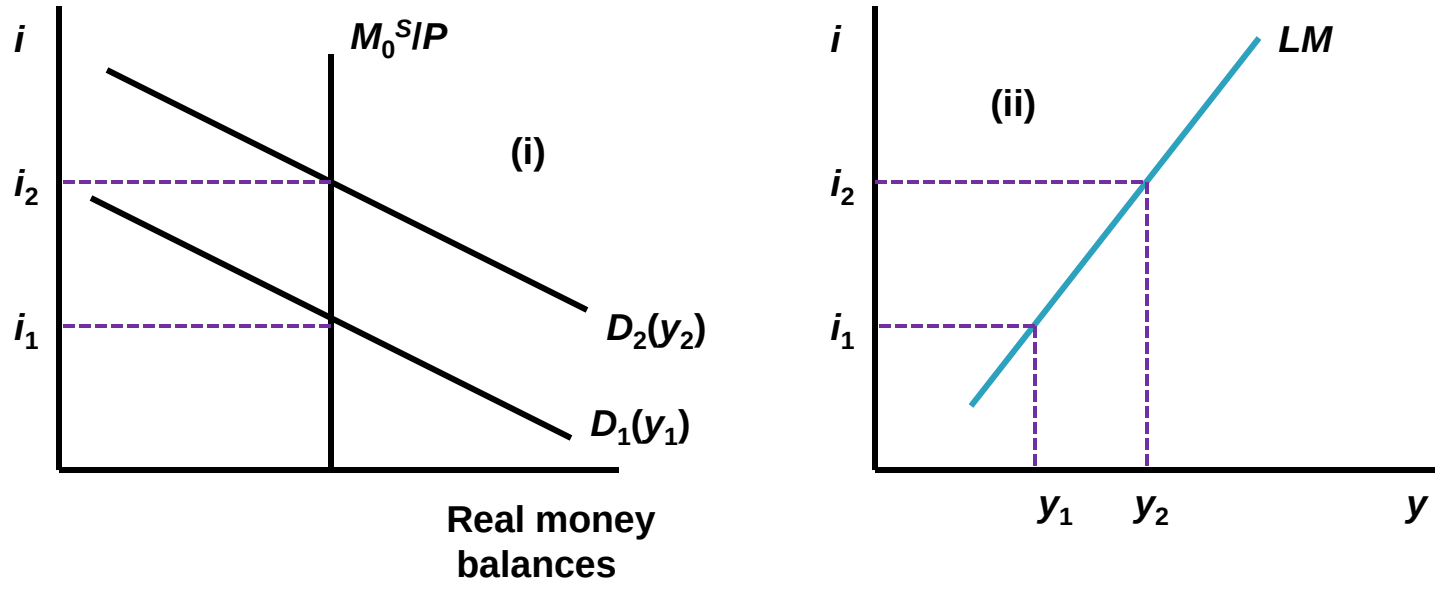
    with *f* in (12) replacing *k* in (3)

    Note: if bond market is in equilibrium, so is money market

Neoclassical vs. Keynesian Views

- (12) shown in (i), and *LM* curve in (ii):

Figure 3

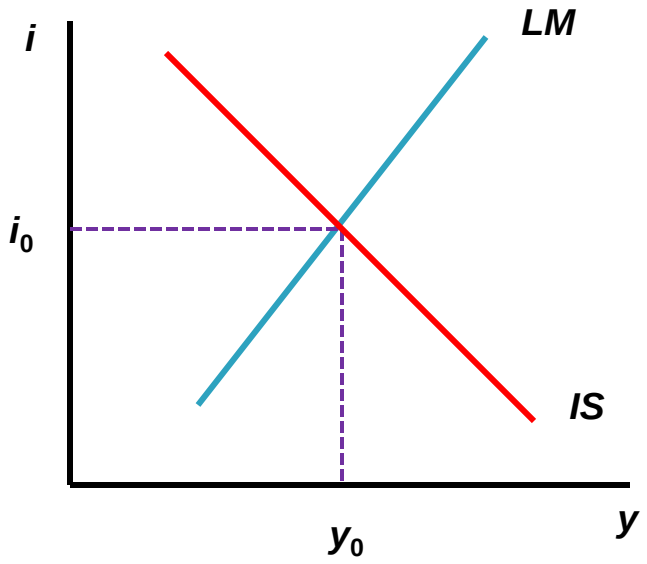


LM function is locus of *i* and *y* ensuring demand for money equals given supply, i.e., $M^D/P = M_0^S/P$

Neoclassical vs. Keynesian Views

- **Keynesian Model: Goods/Money Market Equilibrium**

Figure 4



Can solve for equilibrium i_0 and y_0, while price level P is fixed if output is less than full employment level y^f

Neoclassical vs. Keynesian Views

- **Keynesian Model: Fiscal Policy**

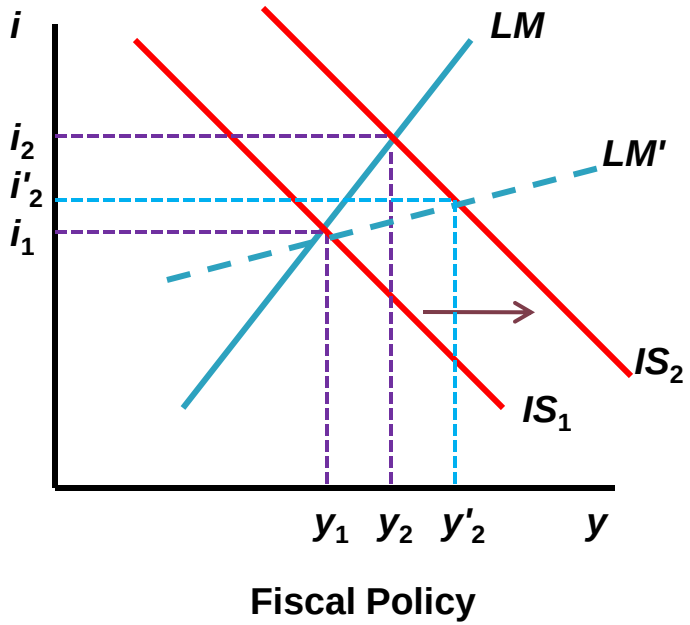


Figure 5

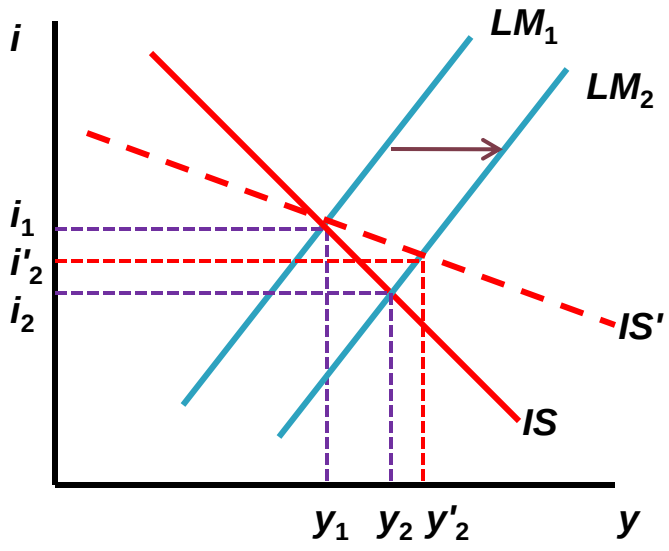
Fiscal policy funded by sale of bonds, so *LM* curve does not shift, resulting in an increase in *y* and *i*

Impact of fiscal policy on *y* is greater, the flatter the *LM* curve, e.g. *LM'* (demand for money is *more* interest-elastic)

Impact of fiscal policy on *y* is greater the steeper the *IS* curve (investment demand is *less* interest-elastic)

Neoclassical vs. Keynesian Views

- **Keynesian Model: Monetary Policy**



Monetary Policy

Figure 6

Monetary policy conducted via sale of bonds, *open-market operations*, *LM* curve shifts down , resulting in an increase in *y* and fall in *i*

Impact of monetary policy on *y* is greater, the flatter the *IS* curve, e.g. *IS'* (investment demand is *more* interest-elastic)

Impact of monetary policy on *y* is greater the steeper the *LM* curve (demand for money is *less* interest-elastic)

Neoclassical vs. Keynesian Views

- **Fiscal or Monetary Policy?**
  - **Part of debate between Keynesians and monetarists centered on relative effectiveness of fiscal vs. monetary policy, depending on view of interest elasticities**
  - **Keynesians held fiscal policy is more effective, assuming in extreme that *LM* is flat, i.e., demand for money is perfectly elastic and economy is in a *liquidity trap*, monetary policy being ineffective**
  - **Monetarists believed monetary policy is more effective, assuming in extreme that *LM* is vertical, i.e., demand for money is perfectly inelastic, fiscal policy being ineffective**
  - **What about price flexibility and inflation?**

Neoclassical vs. Keynesian Views

- **Keynesian Model: Aggregate Demand and Supply**

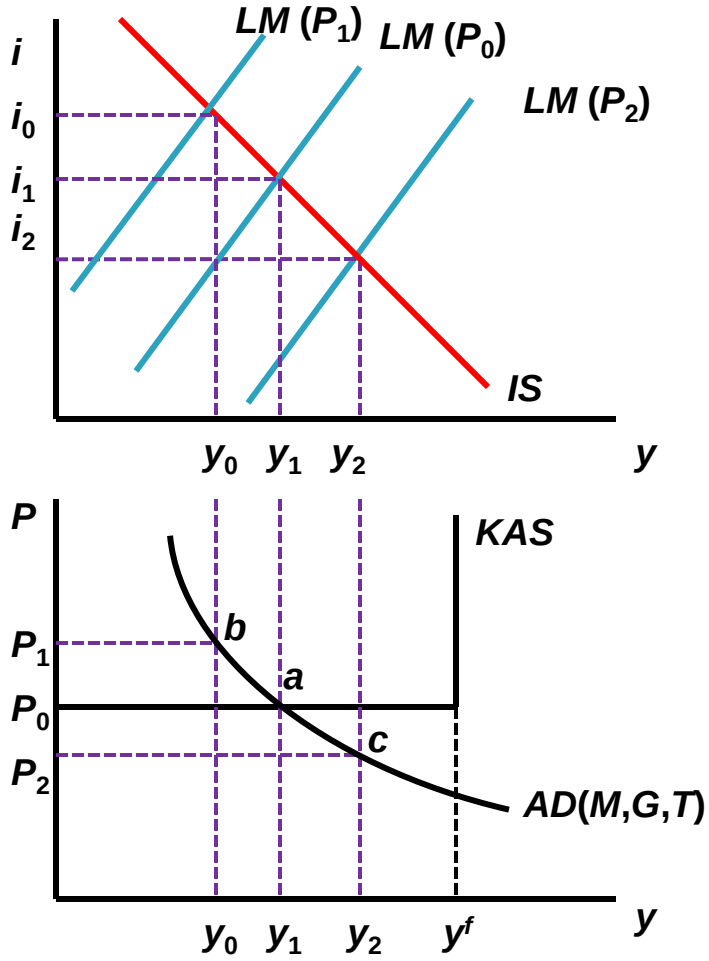


Figure 5

Neoclassical vs. Keynesian Views

- **Keynesian Model: Full Employment**

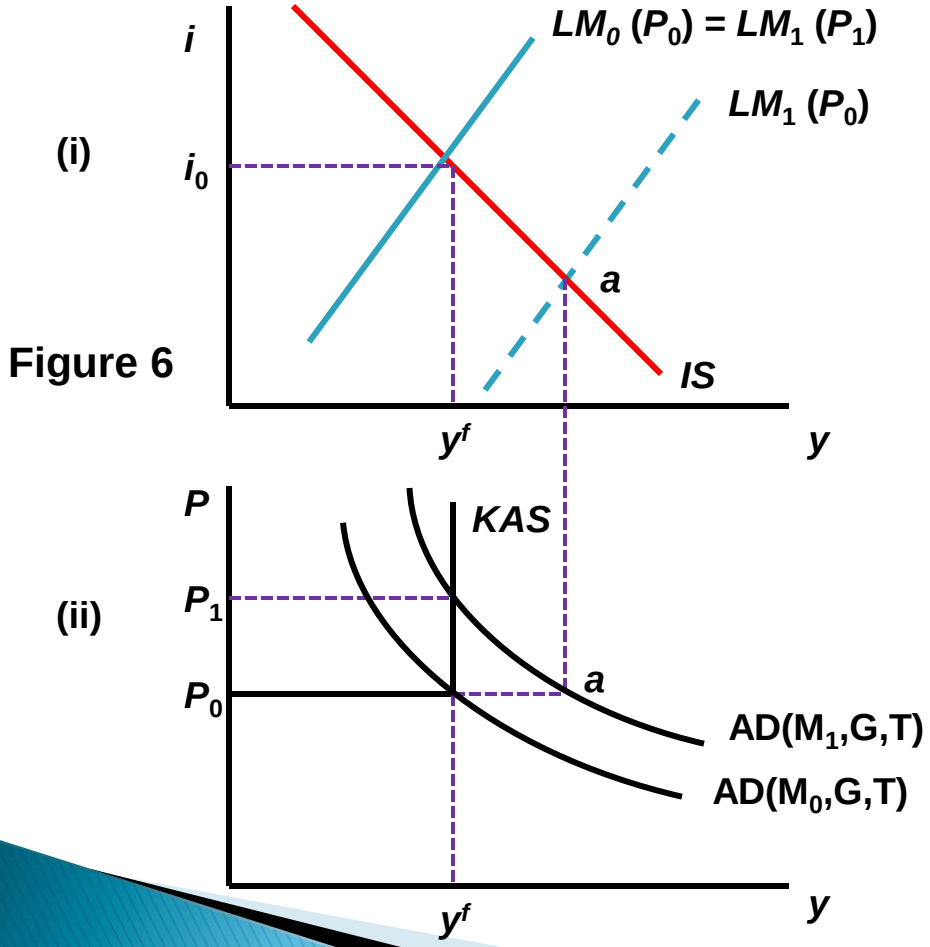


Figure 6

If money supply increases to M_1, *LM* and *AD* curves shift, economy going to *a* – but output cannot exceed full employment level y^f, prices have to increase to P_1, *LM* curve shifting back to its original position

This is exactly the same as the neoclassical model predicts when economy is at full employment (Figure 1)

Neoclassical Synthesis

- **What is the Neoclassical Synthesis?**
  - **Keynesian model came to be adapted in 1950s and 1960s due to persistent inflation in post-war period – *neoclassical synthesis* (Hicks and Samuelson)**
  - **This incorporated three elements:**

    (i) Keynesian theory of aggregate demand

    (ii) Neoclassical theory of aggregate supply

    (iii) Theory of price adjustment when aggregate demand does not equal aggregate supply (Phillips, 1958)
  - **Price adjustment assumed to be asymmetric, i.e., prices rise faster when $y^d > y^s$ compared to rate at which prices fall when $y^s < y^d$**

Neoclassical Synthesis

- **The Phillips Curve and the Neoclassical Synthesis**

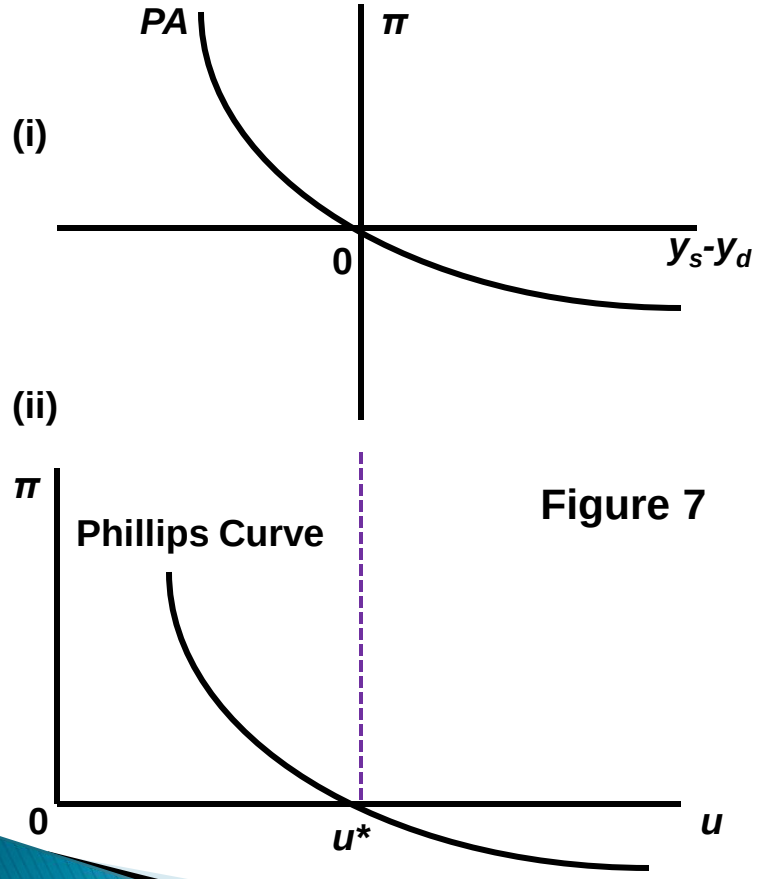


Figure 7

Price adjustment process *PA*, is plotted in (i) as rate of inflation *π* against excess supply over demand y_s-y_d

Phillips Curve is plotted in (ii) as rate of inflation *π* against unemployment rate *u*

There is some rate of unemployment, *u, *the natural rate of unemployment*, which is associated with zero excess demand, y_s-y_d = 0**

<u>Implication</u>: discretionary policy can take advantage of inflation/unemployment tradeoff

Critique of Neoclassical Synthesis

- **Expectations - Augmented Phillips Curve**

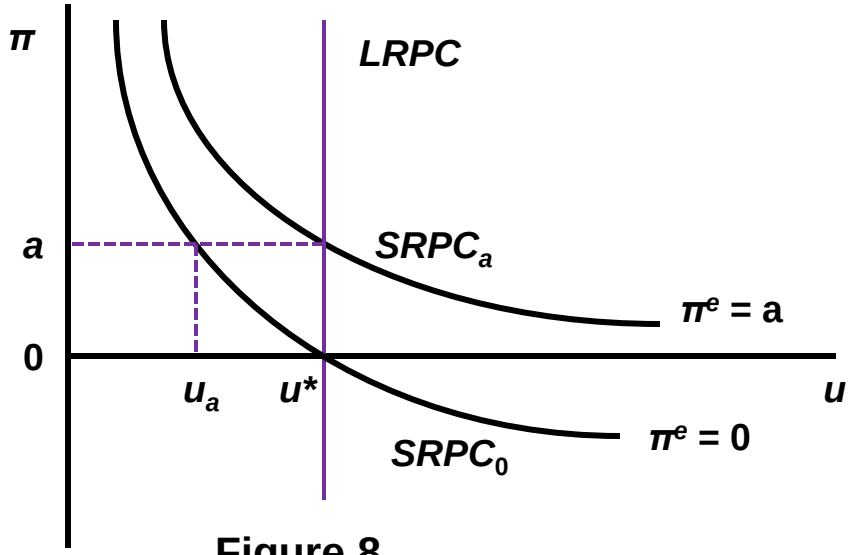


Figure 8

Friedman (1968) and Phelps (1968) pointed out flaw in Phillips Curve analysis – ignored *expectations*

***SRPC*$_0$ is same as curve in Figure 7, but based on expected inflation rate of zero**

If on average no inflation is expected, when *u* = *u, i.e., zero excess demand, there will be no inflation**

If *u* = u_a, there is excess demand, but if no inflation is expected, inflation will in fact occur at rate *a*

Critique of Neoclassical Synthesis

- **Expectations - Augmented Phillips Curve**

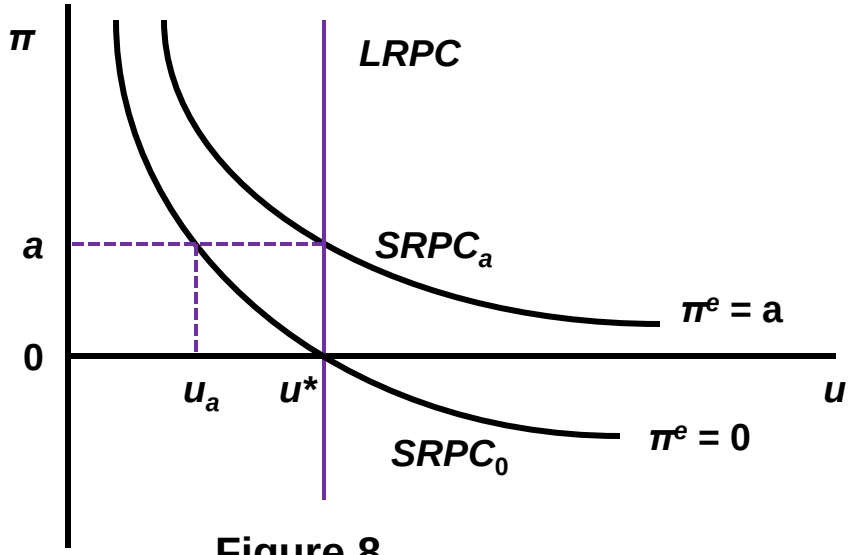


Figure 8

Suppose *a* continues and becomes anticipated – economic agents build it into their price adjustments

If *a* becomes fully expected, Phillips Curve moves to $SRPC_a$, lying directly above *u***

$SRPC_0$ and $SRPC_a$ are short-run, LRPC is long-run, embodying "natural rate" hypothesis: if inflation is fully expected, *u* = natural rate *u***

<u>Implication</u>: attempts to lower *u* below *u* are inflationary**

Central Bank Behavior

- **Monetarist view implied monetary policy should focus on controlling inflation by pursuing steady growth in money supply**
  - **<u>Early-1970s</u>:**
  - **Initially, monetarist counterattack not successful in getting central banks to focus on inflation and money supply growth**
  - **Estimated Phillips Curve parameters implied it was not vertical**
  - **Natural rate of unemployment estimates too low, suggesting inflation rates at then unemployment rates not due to expansionary monetary policy**
  - **Economists and policy makers not fully aware of importance of expectations to monetary policy – until after onset of *rational expectations* revolution**

Rational Expectations

- **Friedman and Phelps showed importance of incorporating expectations into macroeconomic models – but this also required a theory of how expectations are formed and changed**
- **One could assume agents adjust expectations of inflation over time based on recently observed inflation, i.e., *adaptive expectations* – eventually agents' expectations adapt to whatever rate of inflation the policymaker has chosen**
- **While assumption of adaptive expectations is plausible, probably too simple to apply in all circumstances – an alternative approach is that of *rational expectations* (Lucas,1972, 1973, 1976)**
- **Approach assumes agents optimally use all available information in forming their expectations, including information about current monetary and fiscal policies**

Rational Expectations

- **Due to monetary and fiscal policies affecting inflation, agents' expectations of inflation should also depend on monetary and fiscal policies**
- **According to theory of rational expectations, a change in monetary or fiscal policy will change expectations, and evaluation of any change in policy must incorporate this effect on expectations –**
- **Lucas (1976) argued use of traditional macroeconomic forecasting models failed to do this, the *Lucas critique* – which has important implications for cost of reducing inflation**
- **Analysis of Phillips Curve implies that if agents come to expect high rates of inflation, they will strike inflationary bargains based on these expectations, e.g., wage demands of workers**
- **Implies a *momentum* to present process of inflation (Sargent, 1982)**

Rational Expectations

- **Rational expectations indicates that Phillips Curve model does not accurately represent options facing policymakers**

  "…people expect high rates of inflation in the future precisely because the government's current and prospective monetary and fiscal policy warrant those expectations…Thus inflation only seems to have momentum of its own; it is actually the long-term government policy of persistently running large deficits and creating money at high rates which imparts momentum to the inflation rate…stopping inflation would require a change in the policy regime…" (Sargent, 1982)

- **<u>Implication</u>: if policymakers are credibly committed to reducing inflation, rational agents will understand the commitment and will therefore lower their expectations of inflation**

- **Therefore, a constant-money-growth-rate rule as suggested by Friedman (1968) would be an appropriate monetary policy**

Central Bank Behavior

- **Related ideas that inflation is costly, monetary policy is *neutral* in the long-run, and need for a nominal anchor, helped generate support for controlling growth of the money supply**
  - **<u>Mid-1970s</u>:**
  - **Recognized that focusing on a *nominal anchor*, i.e., inflation rate, an exchange rate or the money supply, is crucial element in achieving price stability**
  - **As a result *monetary targeting* was adopted in several advanced economies in mid-1970s**
  - **Monetary targeting involves:**
    - **reliance on *monetary aggregate* to guide monetary policy**
    - **announcement of *targets* for monetary aggregates**
    - ***accountability* for systematic deviation from targets**

Central Bank Behavior

- **What is a monetary aggregate?**

  Measure of supply/stock of money in economy – broken down into types of money based on impact of monetary policy, i.e., *narrow* measures (most affected) to broad measures (less affected:

  Narrow ↓ **Broad**

  M0: physical cash in economy

  M1: M0 + demand deposits

  M2: M1 + savings deposits

  M3: M2 + foreign bank deposits, e.g., Euro$s

- **1970s monetary targets: US (M2), UK (M3), Canada (M1), Germany (M0), Japan (M2), and Switzerland (M1)**

Central Bank Behavior

- **Potential advantage of monetary targeting: announcement of monetary aggregates/targets sends clear signal about monetary policy**
- **Advantage depends on strong and reliable relationship between inflation and targeted aggregate – breaks down if there are large swings in velocity**
- **<u>Late-1970s/1980s</u>:**
- **By early-1980s, US, UK and Canada formally abandoned monetary targeting. Why?**

  - central banks engaged in "game-playing"

  - instability in money-inflation relationship, doomed policy to failure, i.e., hitting target did not produce desired effect on inflation, the target becoming a poor signal of policy stance

Central Bank Behavior

- **With failure, search began for an alternative nominal anchor**
  - **<u>1990s</u>:**
  - **Work of Kydland and Prescott (1977), and Barro and Gordon (1983) had pointed out importance of *time-inconsistency* problem – faces all of us on a regular basis:**

    Suppose on New Year's Day, you resolve to quit smoking, but decide to have one last cigarette, and then another and another and so on and so on….eventually you are smoking a pack a day

    Agents are unable to *consistently* follow a good plan over *time*, i.e., the good plan is *time-inconsistent*, and will eventually be abandoned – easier to make short-run compromises compared to seeking long-run gains

Central Bank Behavior

- **Monetary policy makers face time-inconsistency problem – always tempted to pursue discretionary and expansionary monetary policy to boost output and employment in short-run above level consistent with expected inflation**
- **Once agents see policymaker pursuing expansionary monetary policy, they will build this into their inflation expectations, inflation eventually increasing**
- **Minimization of time-inconsistency problem requires:**

  (i) Strong nominal anchor that ensures central bank focuses on long-run objective of price stability, resisting temptation to pursue short-run policies inconsistent with long-run

  (ii) Also requires central bank independence from political process, where politicians are concerned with electoral cycle

Inflation Targeting

Advanced Countries with Inflation Targets				
Country	Introduction	Initial Inflation Rate	Inflation Target	Average Inflation Rate 2000s
Australia	1993	1.8	2-3	3.4
Canada	1991	6.2	1-3	2.3
Finland	1993	2.6	2	1.9
Israel	1991	18.0	8-11	2.0
New Zealand	1990	7.0	0-2	2.9
Spain	1995	4.4	< 3	3.4
Sweden	1993	4.8	2 ± 1	1.9
UK	1992	4.2	≤ 2.5	2.0

Source: IMF

Inflation Targeting

- **Initial adoption of inflation targeting by some advanced economies in early-1990s, e.g., Canada, Sweden and UK**
- **The common characteristics of inflation targeting regimes are:**

  - announcement of medium-term numerical target for inflation

  - commitment to price stability as main goal of monetary policy

  - increased independence for central bank

- **Inflation targeting has several key advantages:**

  - does not rely on a stable money-inflation relationship

  - inflation target readily understood by public

  - increased accountability, as performance is measurable

Inflation Targeting

- **Following Svensson (1997), suppose an economy is represented by an aggregate supply and demand curve:**

$$\pi_t = \pi_{t-1} + \mu y_{t-1} + \varepsilon_t \qquad (13)$$

$$y_t = \rho y_{t-1} - \varphi(i_{t-1} - \pi_{t-1}) + \eta_t \qquad (14)$$

where $\pi_t = p_t - p_{t-1}$ is inflation rate at time t, y_t = output gap, i_t is nominal interest rate, and ε_t and η_t are supply and demand shocks

Optimal monetary policy involves setting interest rate i for each period to minimize inter-temporal loss function:

$$E_t \sum_{\tau=t}^{\infty} \delta^{\tau-1} L_t \qquad (15)$$

δ<1= discount rate, and period-by-period loss function is:

$$L_\tau = \frac{(\pi_\tau - \pi^*)^2}{2} + \frac{\lambda y_\tau^2}{2} \qquad (16)$$

Inflation Targeting

- **Optimal setting of interest rate is a "Taylor rule":**

$$i_t = \pi_t + b_1(\pi_t - \pi^*) + b_2 y_t \qquad (17)$$

where interest rate responds to both inflation gap, $\pi_t - \pi^*$, and output gap, y_t

- **If central bank does not care about output fluctuations, $\lambda = 0$, $b_2 > 0$, i.e., output gap still enters aggregate supply curve (14), and, therefore, helps forecast future inflation**

  Optimal monetary policy still reacts to business cycle, even if focus of policy is entirely on hitting inflation target

- **If $\lambda > 0$, b_2 will be even larger as central bank attempts to minimize output fluctuations**

- **<u>Implication</u>: monetary policy should be "activist", i.e., react to deviations of output from potential (*output gap*)**

Inflation Targeting

- **Problem with "instrument rule" in (17), is that output gap y_t is hard to measure, i.e., hard to measure what is *potential output*, and not clear what the proper concept of the output gap is**
- **In this case a "target rule" may work better:**

$$E_t\pi_{t+2} = \pi^* \text{ when } \lambda = 0 \qquad (18)$$

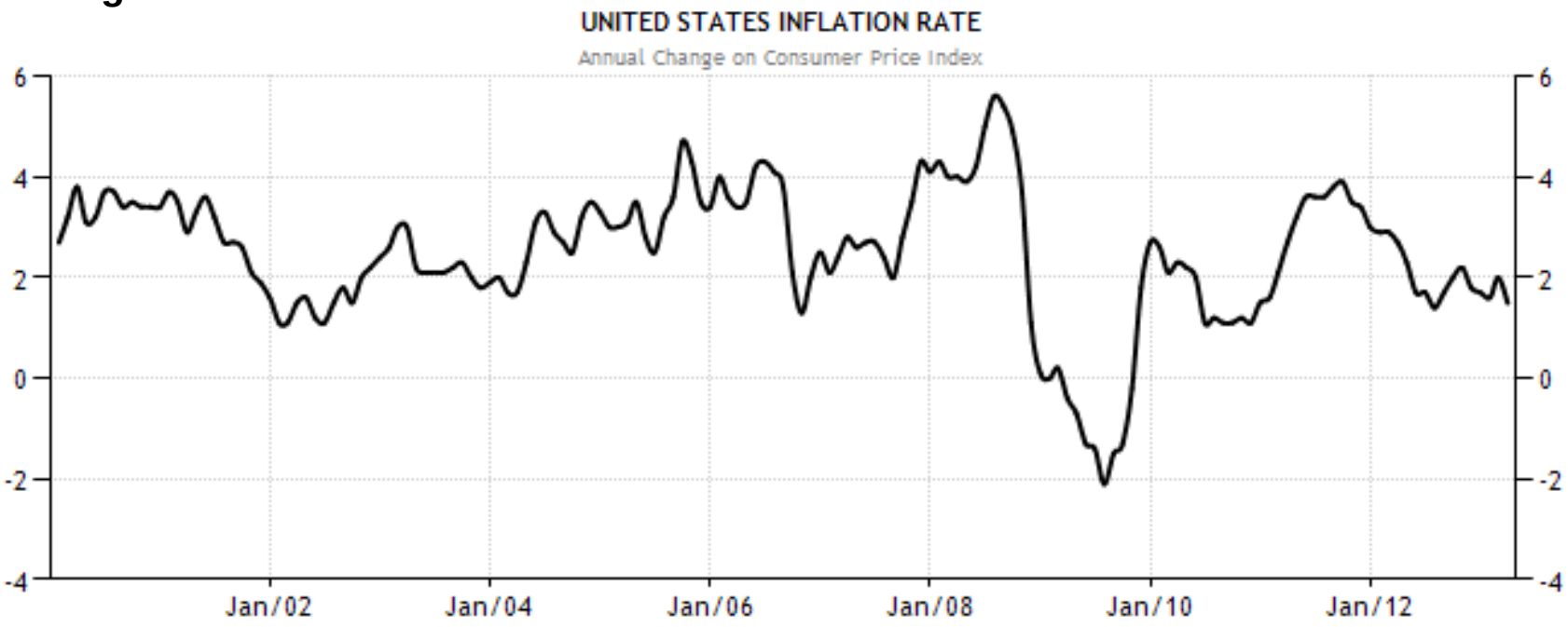
$$E_t\pi_{t+2} - \pi^* = c(E_t\pi_{t+1} - \pi^*) \text{ when } \lambda > 0 \qquad (19)$$

where (19) is equivalent to following a target rule where approach to inflation target is more gradual

- **Case-studies of monetary authorities who pursue inflation targeting indicate that they do care about output fluctuations – there is little doubt general public cares about tradeoff between output and input fluctuations (Bernanke *et al.*, 1999)**

US Inflation Rate

Figure 9

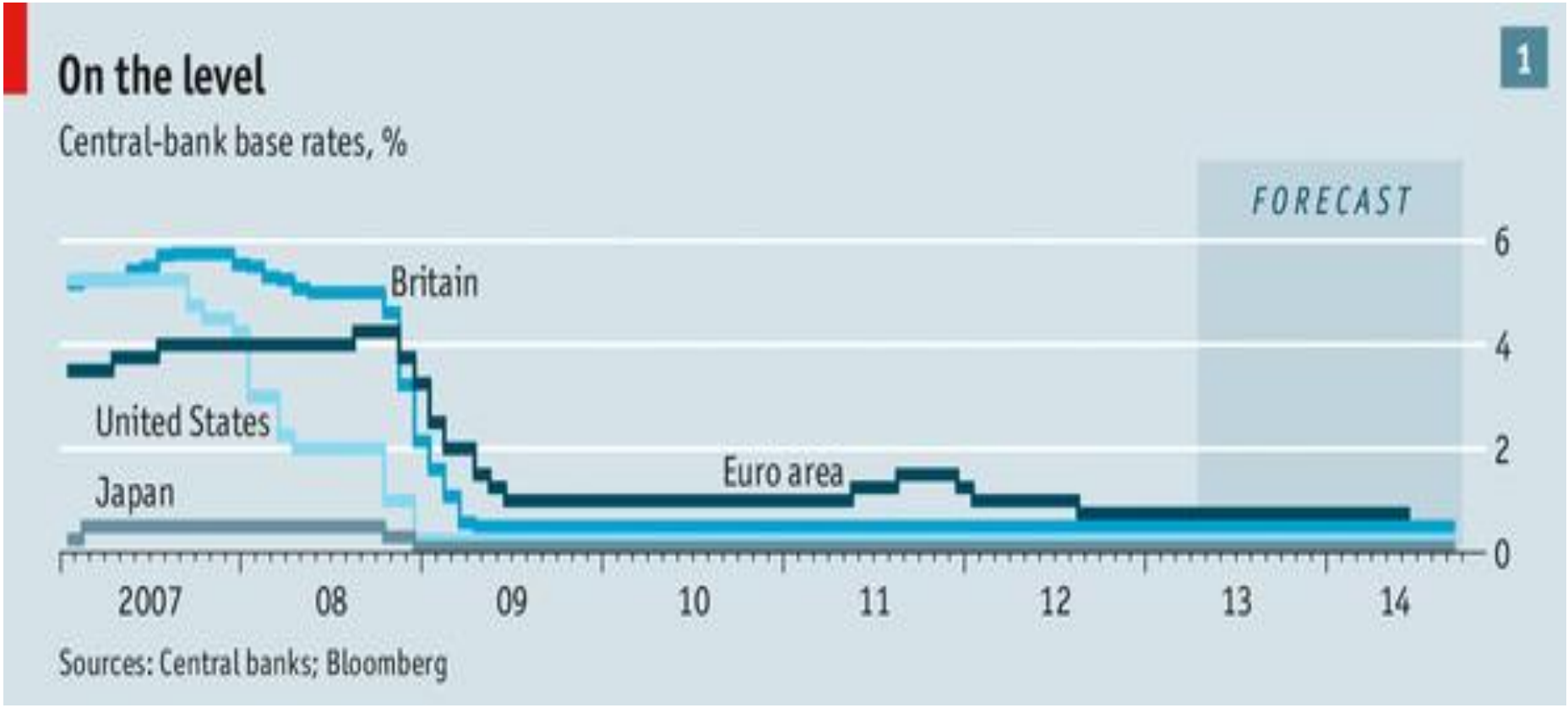


Source: Bureau of Labor Statistics

Low Inflation

- **Currently the US rate of inflation is running below 2 percent (Figure 9), a level Krugman (2013) describes as "dangerously low"**
- **Why is low inflation a problem? Essentially it discourages borrowing and spending, and instead encourages agents to sit on cash**
- **Low inflation also makes it much harder to pay down debt, exacerbating the already existing problem of private-sector debt that resulted from the financial crisis, and thereby keeping down aggregate demand**
- **Low inflation may result in nominal rate of interest declining to zero or very close to zero – once at zero, cannot decline further as lenders will not accept negative nominal rate - they hold cash instead, i.e., nominal rate hits "zero bound"**

Interest Rates at the “Zero Bound”



Back to Keynes

- **Monetary policy loses grip when nominal interest rates are essentially zero, i.e., economy is in a liquidity trap**
- **Liquidity trap occurs because money and bonds are seen as perfect substitutes, and therefore in the *IS*/*LM* model, the *LM* curve is perfectly elastic, making monetary policy ineffective:**

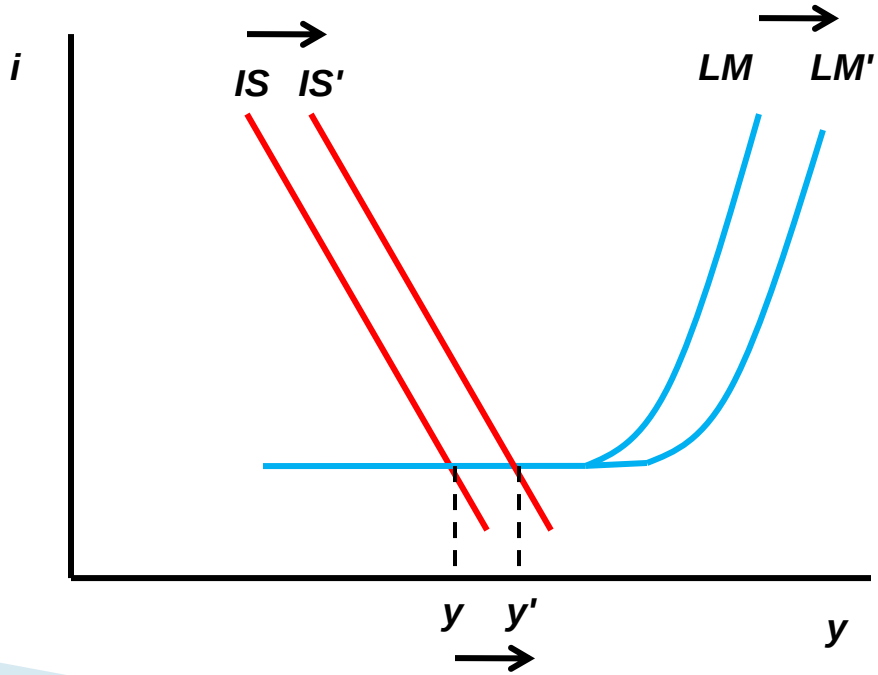


Figure 10

Liquidity Trap

- With inflation in post-war period, and nominal interest rates being well above zero, central banks were not “pushing on a string”
- However, since Japan hit the zero bound in the 1990s, analysis of monetary in liquidity traps has become fashionable again in macroeconomics
- Importantly, there has been recognition that IS/LM model was missing three crucial features:
  - formulation of expectations
  - role of foreign trade and capital mobility
  - financial intermediaries
- Krugman (1998) has laid out modern version of liquidity trap, and how to get out of it through monetary policy

Krugman's Basic Idea

- **Krugman argues that there is an "escape clause" in the concept of monetary neutrality, i.e., if an increase in the money supply is not expected to be maintained, there is a credibility problem on the part of the central bank**

- **The reason monetary policy does not work in a liquidity trap is because agents expect that whatever the central bank does now, given the chance, it will revert back to stabilizing prices near their current low level**

- **Consequently, what the central bank has to do is to credibly "promise to be irresponsible", i.e., convince the market that it will in fact allow prices to rise sufficiently – pulling the economy up by its bootstraps**

Money, Interest and Prices

- Assume a one-good, representative agent economy, where good is inelastically supplied, each agent receiving an endowment y_t in each period; utility takes form:

$$U = \frac{1}{1-\rho}\sum c_t^{1-\rho} D^t \qquad (17)$$

c = consumption, ρ = relative risk aversion, and D = discount factor

- Assuming a cash in advance constraint, at start of each period, there is a capital market where cash can be traded for one-period bonds at nominal interest rate i
- Consumption during period constrained by cash left after trading, where nominal value of consumption, $P_t c_t$ cannot exceed money holdings M_t
- After capital market is held, each individual purchases desired consumption, while receiving cash from sale of endowment

Money, Interest and Prices

- **Government policy takes two forms: in first period, central bank engages in open market operations by buying or selling bonds; at end of period, government can collect or distribute lump sum taxes and transfers**
- **Assume from second period forward that output (and hence consumption) will remain constant at y^*, and money supply will be held constant at M^* - so from period two on, price level remains constant at $P^*=M^*/y^*$, and interest rate will be constant at $i^*=(1-D)/D$**
- **Action is in determining price level and interest rate in first period; on the monetary side, cash in advance constraint is binding: $Pc=Py=M$, so that:**

$$P=M/y \qquad (18)$$

i.e., there is a simple proportional relationship between money supply and price level under normal circumstances

Money, Interest and Prices

- From inter-temporal choice, by holding one less dollar in period one, individual gives up $1/P$ units of first period consumption but is able to consume $(1+i)/P^*$ additional units in period two
- Marginal utility of consumption in two periods is $c^{-\rho}$ and $D(c^*)^{-\rho}$ then:

$$(c/c^*)^{-\rho} = DP(1+i)/P^* \qquad (19)$$

or, since consumption must equal output in each period:

$$1+i = \frac{P^*}{DP}(y^*/y)^{\rho} \qquad (20)$$

- (20) states, the higher the current price level, the lower the nominal interest rate; and since P^* is fixed, any rise in current level creates expected deflation – higher P lowers i
- (18) and (20) shown as functions *MM* and *CC* in Figure 11

Prices and Interest Rate

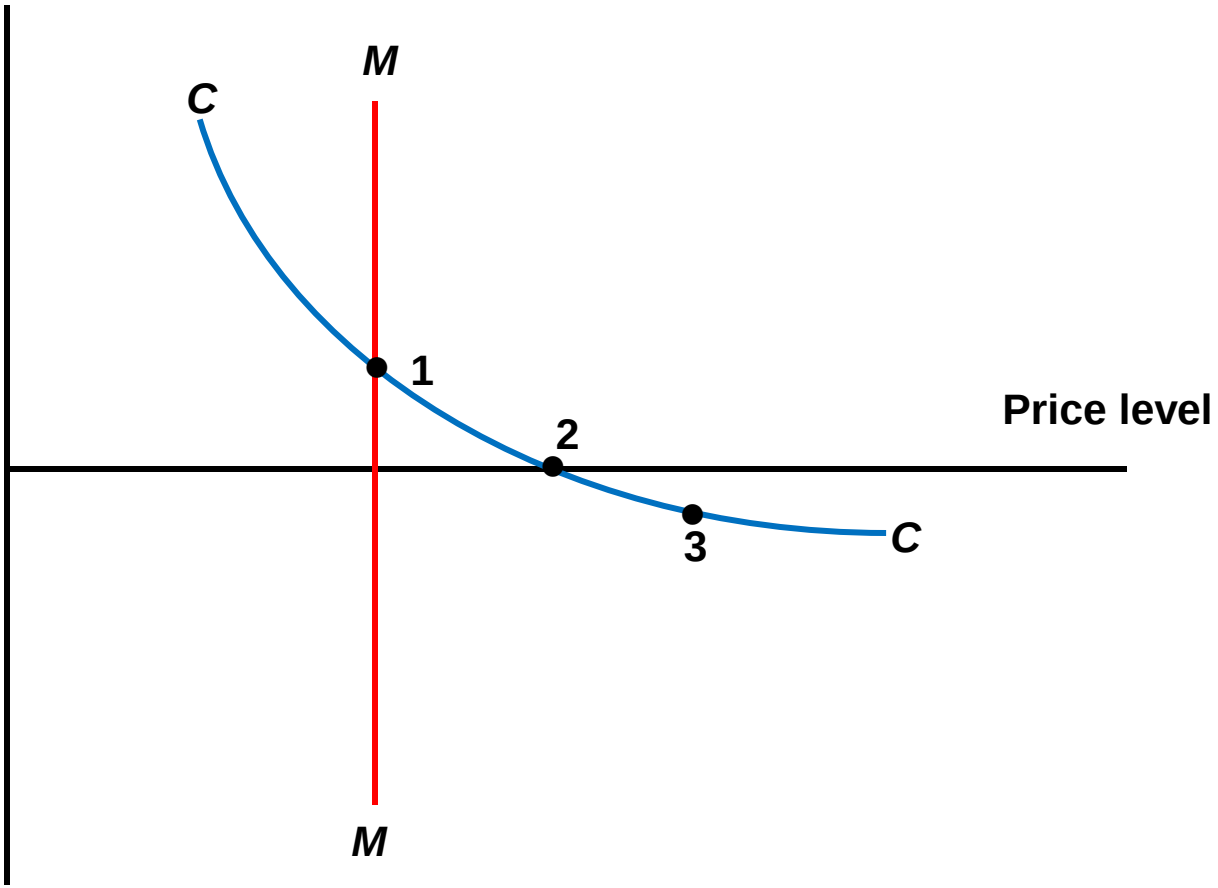


Figure 11

Money, Interest and Prices

- **Suppose economy starts at 1, and in first period, central bank increases money supply, moving equilibrium to 2, resulting in a higher price level and lower interest rate**
- **What if money supply is increased further, intersection of *MM* with *CC* being at point 3? Clearly, nominal interest rate cannot be negative, *i* being pushed to zero bound**
- **Increase in money supply is substituted into portfolios for zero interest bonds, with no further effect on prices and interest rate; *MM* curve becomes irrelevant, economy staying at point 2 (Note: interest rate is zero on one-period bonds, but not longer term bonds)**
- **Money becomes irrelevant at the margin – but aside from frustrating central bank which presides over inflation whatever it does, this version of liquidity trap has no adverse real consequences**

Hicksian Liquidity Trap

- **Suppose consumption good is produced with maximum capacity of y_f in period one, but this capacity need not be fully employed**
- **Assume price level in period one is fixed, so that economy has a Keynesian feel, and monetary policy can affect output; in period two, output takes on value y^***
- **From this, and given utility function, an expression for current real consumption becomes the IS curve determining real output:**

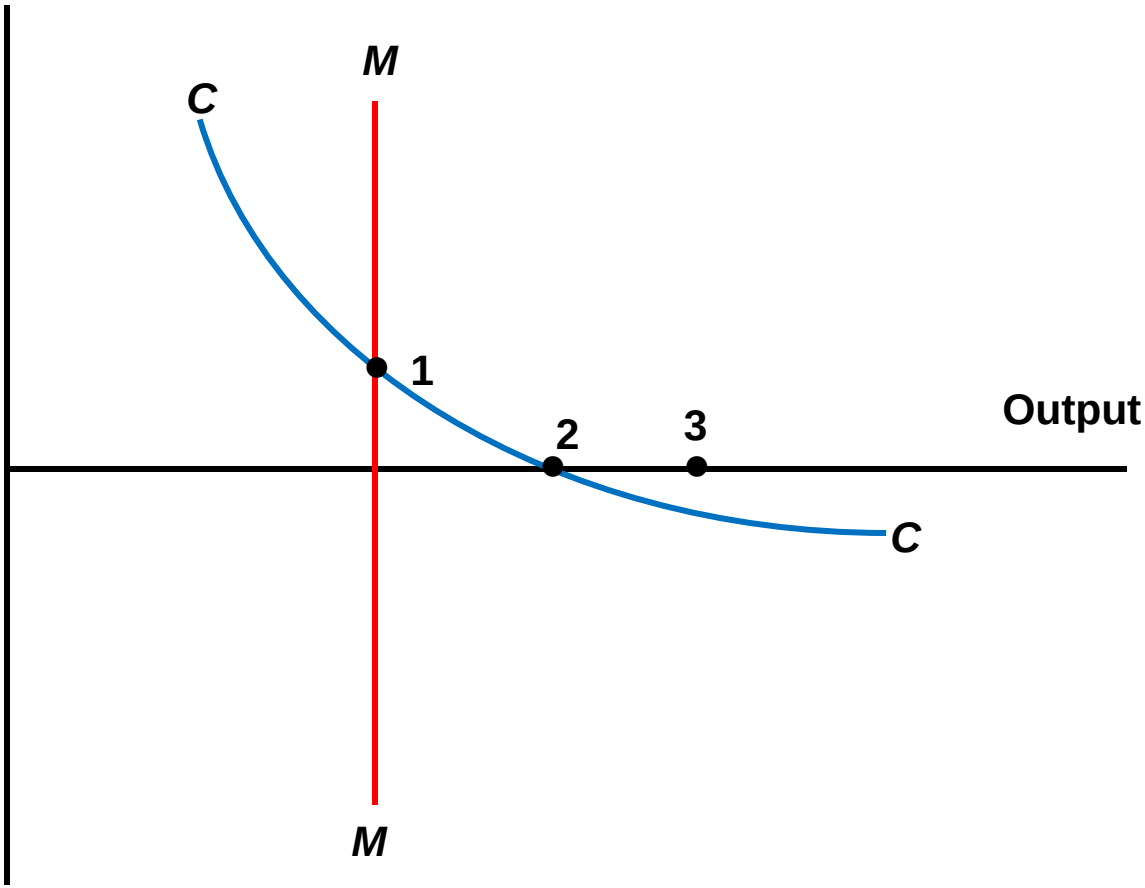
$$c = y = y^* (P^* / DP)^{1/\rho} (1+i)^{-1/\rho} \qquad (21)$$

- **In Figure 12, the IS curve shows how output is determined by consumption demand, which is decreasing in the interest rate; and as long as nominal interest rate is positive, cash in advance constraint is binding giving *MM* curve:**

$$y = M/p \qquad (22)$$

Output and Interest Rate

Figure 12



Hicksian Liquidity Trap

- **Increasing money supply up to point 2 can increase output, but what if point 3 is productive capacity of economy?**

- **As nominal rate of interest cannot be below zero, any increase in money supply has no effect as it is substituted for bonds, with no effect on spending – open market operations cannot get economy to full employment, i.e., the Hicksian liquidity trap**

- **Monetary policy can only be effective if the expansion in the money supply is expected to be permanent – a rise in expected future price level *P** in (6) will shift out the IS curve in the current period**

- **Krugman's analysis, along with others, including Eggertsson and Woodford (2003) provides theoretical underpinnings to current policy choices of Federal Reserve and other central banks**

Hicksian Liquidity Trap

- **Classic Keynesian response to liquidity trap is fiscal expansion in the IS/LM framework (see Figure 10), but how does it look in a modern version of liquidity trap theory?**

- **Framework developed here is strongly biased against finding a role for fiscal policy, because for representative agent, inter-temporal optimization implies Ricardian equivalence**

- **This bias is a by-product of model, not empirical judgment – a sufficiently large temporary fiscal expansion could jolt economy out of equilibrium into one where conventional monetary policy works**

- **This is conventional wisdom of how Great Depression ended, but Romer's (1992) work suggests it was actually monetary policy that caused a very sharp decline in real interest rates, the output gap having been eliminated before any fiscal stimulus**

Monetary Policy and the Zero Bound

- **How should monetary authorities deal with low inflation?**
  - **Once the nominal interest rate hits a zero bound, it clearly imposes a limitation on monetary policy**

    Under normal conditions, most central banks implement their policy by targeting a short-term interest rate – in the US it is the overnight federal funds rate – where the target is enforced by buying and selling of securities

    When short-term interest rate hits zero, central bank can no longer ease policy by lowering its interest rate target – but does it mean the central bank has "run out of ammunition"?
  - **"…a variety of policy responses are available should deflation appear to be taking hold…policymakers would be far from helpless in the face of deflation, even should the federal funds rate hit its zero bound…" Bernanke (2002)**

Monetary Policy and the Zero Bound

- **Bernanke and Reinhart (2004) have put forward three strategies for when central bank is at/near zero bound:**
- **Shaping Interest Rate Expectations:**

  Pricing of assets such as mortgages depends on both current short-term interest rate and expected future path of short-term rates

  Central bank can affect asset prices and hence activity by influencing agents' expectations of future short-term rates

  To do this it must credibly commit to keeping short-term rates lower than expected, which lowers yields throughout *term structure*, and therefore supports other asset prices, i.e., it can pledge to hold rates at a low level until conditions improve

Monetary Policy and the Zero Bound

- **Altering Composition of Central Bank Balance Sheet:**

  Central banks typically hold a variety of assets, composition of balance sheet offering another possible lever for monetary policy

  For example, Federal Reserve holds government bonds (US Treasury securities) of different maturities – 4 weeks to 30 years, so it could restructure its portfolio by switching from short-term to longer-term securities

  This will have effect of altering relative prices of securities, i.e., short-term prices fall - long-term prices increase, as well as affecting term structure of interest rates

  However, attempts to enforce floor on prices of long-dated Treasury securities depends on market expectations about whether short-term rate is kept low

Monetary Policy and the Zero Bound

- **Expanding Size of Central Bank's Balance Sheet:**

  Central bank can also buy and sell securities to influence overall supply of bank reserves and stock of money

  Essentially, with a zero bound, this means switching from targeting the price of reserves to the growth and quantity of reserves

  Specifically, it can expand amount of money beyond that necessary to hold short-term interest rate at zero – this is known as *quantitative easing* (QE)

  There is evidence from the Great Depression that this can stimulate the economy, even when economy is near zero bound (Romer, 1992)

Monetary Policy and the Zero Bound

- **How does QE work?**
- **If money is an imperfect substitute for other financial assets, large increases in money supply will lead investors to rebalance their portfolios - has effect of raising asset prices and lowering yields, stimulating economic activity**
- **It may alter expectations about future path of short-term rate if reserves are kept at a level higher than necessary to ensure a zero rate until economic conditions improve – more visible/credible than a verbal pledge**
- **May have expansionary fiscal effects – by expanding monetary base, public debt replaced with non-interest bearing money, thereby lowering interest costs of government and lowering public's expected tax burden (Auerbach and Obstfeld (2003)**

Current Monetary Policy

- **To what extent has QE been used following the financial crisis?**
  - **Used extensively by US Federal Reserve:**

QE1: 2008-09, purchased $1.25 trillion of mortgage-backed securities (MBSs) and agency debt, and $300 billion in Treasury securities

QE2: 2010-11, purchased $600 billion in US Treasury securities

Operation Twist: 2011-12, purchase of $400 billion of bonds with maturities of 6-30 years and sale of bonds with maturities less than 3 years

QE3/QE4: 2012-, commitment to purchasing $40 billion a month in MBS, and $45 billion of long-term Treasury securities until US labor market improves

Channels Through Which QE Might Work

- **Signaling channel:**

  Eggertsson and Woodford (2003) argue non-conventional monetary policy can have beneficial effect in lowering long-term bond yields only if such policy is credible commitment to keep interest rates low even after economy recovers (lower than Taylor rule may call for)

  Such a commitment can be achieved when central bank purchases large quantity of long-duration assets in QE – if central bank later raises rates, it will take a loss on these assets

  Signaling channel affects all bond market rates, effects depending on bond maturity, since lower future federal funds rates, via expectations hypothesis, can be expected to affect all interest rates

Channels Through Which QE Might Work

- **Duration risk channel:**

  Theory suggests a risk premium that is approximately product of duration of a bond and price of duration risk

  Duration risk is sensitivity of bond price to changes in interest rate, so price of duration risk is a function of duration risk borne by marginal bond investor and their risk aversion

  By purchasing long-term Treasuries, agency debt or MBSs, policy can reduce duration risk and thereby alter yield curve, notably lowering long-maturity bond yields relative to short-maturity yields

  This channel implies that QE reduces yield on all long-term assets, including Treasuries, agency and corporate bonds, and MBSs

Channels Through Which QE Might Work

- **Liquidity channel:**

  QE strategy involving purchase of long-term securities and paying for them by increasing reserve balances, which are more liquid than long-term securities

  QE therefore increases liquidity in hands of investors, decreasing liquidity premium on most liquid bonds, and hence raising yields on liquid assets such as Treasuries relative to less liquid assets

- **Safety channel:**

  QE lowers yields on safe assets such as Treasuries, agencies and possibly high-grade corporate bonds relative to less safe assets such as lower-grade corporate bonds or bonds with pre-payment risk such as MBSs

Channels Through Which QE Might Work

- **Pre-payment risk premium channel:**

  Evidence that prepayment risk carries a positive risk premium, premium depending on amount of prepayment risk borne by mortgage investors

  MBS purchases through QE will lower their yields relative to other bond yields

- **Default risk channel:**

  Lower-grade bonds carry more risk than Treasury bonds, so that if QE succeeds in stimulating economy, default risk of corporations will fall, and hence rates on lower-grade bonds

  Some asset pricing models also predict that investor risk aversion will fall as economy recovers, implying lower default risk premium

Channels Through Which QE Might Work

- **Inflation channel:**

  To extent that QE is expansionary, it increases inflation expectations, which can affect interest rates

  QE may also increase tail risks surrounding inflation, i.e., policy actions might lead to greater uncertainty over inflation outcomes

  Others argue that aggressive policy reduces uncertainty about inflation in that it combats possibility of deflationary spiral

  QE may change inflation expectations, reflected in increases in fixed rate on inflation swaps

  QE may increase or decrease interest rate uncertainty as measured by volatility on "swaptions" (financial derivative on interest rates)

Channels Through Which QE Might Work

- **Suppose focus is on real-yield on a *T*-year long, risky, illiquid asset such as a corporate bond, $r_{risky,\ illiq,\ long\text{-}term}$**

  Also, suppose expected average interest rate over next *T* years on short-term, safe and liquid nominal bonds is $E[i_{safe,\ liq,\ short\text{-}term}]$, and expected inflation over same period is π^e then, long-term real yield is:

$$r_{risky,\ illiq,\ long\text{-}term} = E[i_{safe,\ liq,\ short\text{-}term}] - \pi^e + Duration \times P_{DurationRisk} + Illiquidity \times P_{Liquidity} + Lackofsafety \times P_{Safety} + DefaultRisk \times P_{DefaultRisk} + PrepaymentRisk \times P_{PrepaymentRisk}$$

  Each part of equation relates to a channel through which QE may work, and different interest rates are affected by QE differently

Channels Through Which QE Might Work

- **Based on these channels, Krisnamurthy and Vissing-Jorgensen (2011) examine the impact of QE1 and QE2 through event studies:**
- **QE1 and QE2 significantly lowered nominal interest rates on Treasuries, agencies, corporate bonds and MBSs, the magnitudes differing across bond types, maturities and QE1 and QE2**
- **For both QE1 and QE2: (i) signaling channel drove down yield on all bonds; (ii) safety channel caused yields on medium and long-maturity safe bonds to fall; and (iii) inflation channel indicated expected inflation has increased**
- **For QE1 only: (i) risk premium channel lowered yields on MBSs; (ii) default risk channel lowered yields on corporate bonds; and (iii) liquidity channel raised yields on liquid compared to less liquid bonds**

Policy Implications

- **Krisnamurthy and Vissing-Jorgensen (2011) suggest three key policy implications of their findings:**
- **Focusing on only Treasury rates does not carry over into mortgage and lower-grade corporate borrowing rates**
- **Benefits of QE for mortgage and lower-grade corporate rates are highest when purchases involve non-Treasury assets such as MBSs**
- **A Treasuries-only policy such as QE2 primarily works through a signaling channel, the market lowering its anticipation of future federal funds rates**

However, could Federal Reserve have done this instead through direct commitment to keeping interest rate low rather than taking on balance sheet risk?