

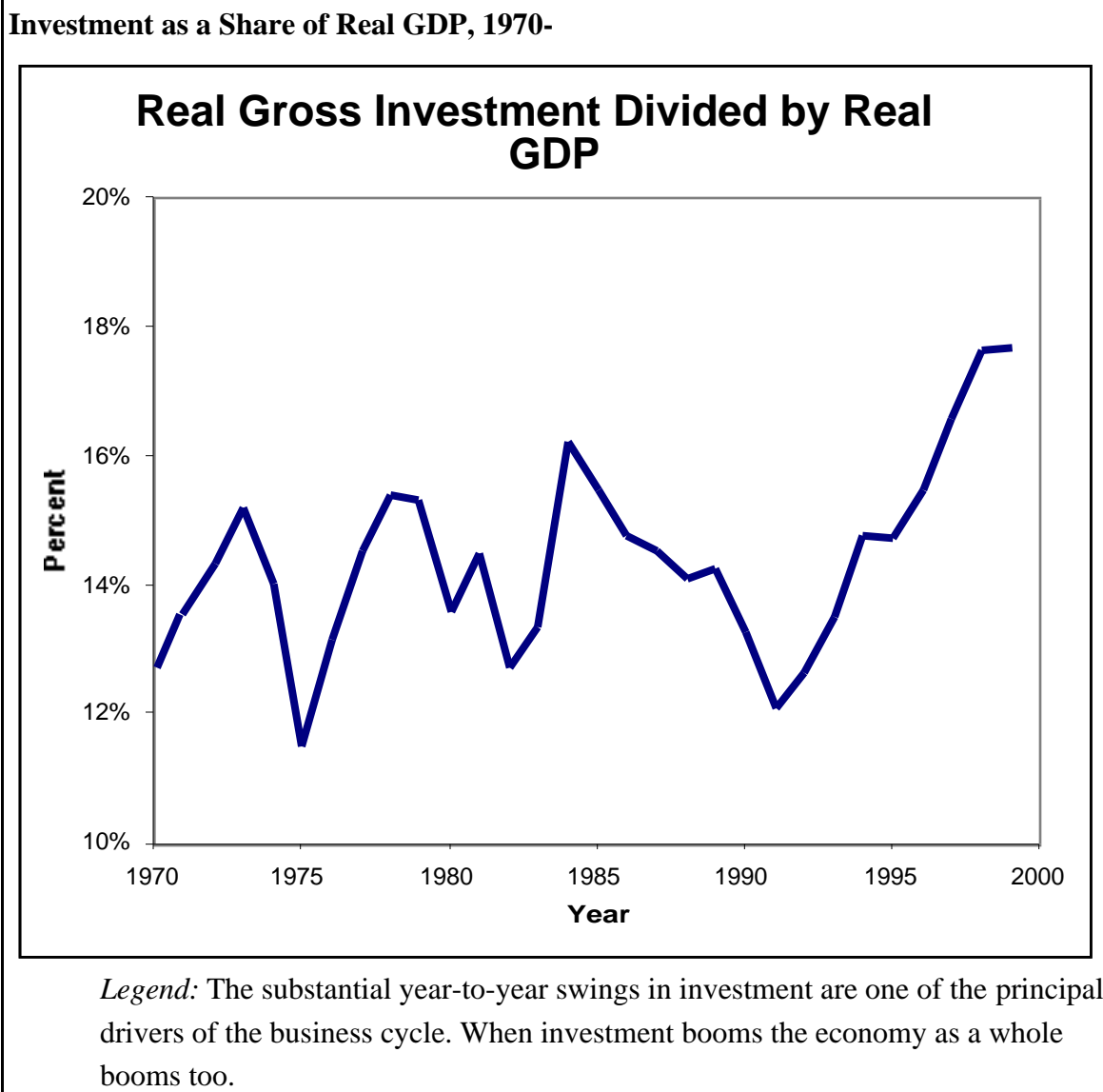
Lecture Notes: Chapter 10: Investment, Net Exports, and Interest Rates

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Interest Rates and Aggregate Demand

The Importance of Investment

Changes in investment spending are the driving force behind the business cycle. Without exception, reductions in investment have played a powerful role in every single recession and depression. Increases in investment have spurred every single boom. Thus if we can understand the causes and consequences of changes in investment spending, we will understand most of what we need to know about business cycles.



In the flexible-price model, the real interest rate was a market-clearing price. It was pushed up or down by supply and demand to equate the flow of savings into financial markets (from households and businesses, the government, and foreigners) to the flow of investment funding out of financial markets (to finance increases in the capital stock). Supply and demand in the loanable funds market determined the interest rate. In the flexible-price model, the level of savings determined the level of investment, and the strength of investment demand determined the interest rate.

In the sticky-price model, the interest rate is not set in the loanable funds market. Instead, it is set directly by the central bank or indirectly by the combination of the stock of money and the liquidity preferences of households and businesses. The interest rates then determines the level of investment, which then plays a key role in autonomous spending. Together, autonomous spending and the multiplier determine the level of output.

“What happened to equilibrium in the loanable-funds market?” you may ask. In a sticky-price model the fact that businesses match the quantity they produce to aggregate demand *automatically* creates balance in the financial market, no matter what the interest rate. Any interest rate can be an equilibrium interest rate because the inventory-adjustment process has already made savings equal to investment.

Fluctuations in investment have two sources. Some are triggered by changes in the real interest rate r . A lower real interest rate means higher investment spending, and a higher interest rate means lower investment spending. Other fluctuations are triggered by shifts in investors' expectations about future growth, profits, and risk. These two sources of fluctuations in investment correspond, respectively, to (i) changes in investment spending I produced by the interest sensitivity of investment parameter I_r times changes in r , and (ii) changes in the baseline level of investment I_0 in the investment function:

$$I = I_0 - I_r \times r$$

Investment and the Real Interest Rate

A business that undertakes an investment project always has alternative uses for the money. One alternative would be to take the money that would have been spent building the factory or buying the machines and place it instead in the financial markets—that is, lending it out at the market real rate of interest. Thus the *opportunity cost* of an investment project is the real interest rate. The higher the interest rate, the fewer the number and value of investment projects that will return more than their current cost, and the lower the level of investment spending.

But which interest rate is the relevant one? There are many different interest rates. First, the interest rate that is relevant for determining investment spending is a long-term interest rate. This distinction matters, because long and short-term interest rates are

different and do not always move in step. Looking at the shifts over time in the *yield curve* chart shows that different interest rates do not always fluctuate together. It also shows that long-term interest rates are usually higher than short-term ones.

Second, the interest rate that is relevant for investment spending decisions is not the nominal but the real interest rate. The nominal prices a business charges rise with inflation. If a business is willing to invest when the interest rate is 5% and inflation is 2% per year (and so the real interest rate is 3% per year), then the business should also be willing to invest when the interest rate is 10% and inflation is 7% per year (and so the real interest rate is still 3% per year).

Third, there is risk. Lending money to a business always carries an element of risk. Perhaps the borrower will go bankrupt before the loan is due. Perhaps the creditors will find themselves last, or nearly last, in line as a small amount of left-over post-bankruptcy assets are divided up. Financial institutions lending money are keenly interested in the financial health of those to whom they lend. The riskier they believe the loan is--the larger the possibility of a bankruptcy or a debt rescheduling appears to be--the higher is the interest rate that lenders will demand to compensate them for risk.

Thus to determine the level of investment spending take the baseline level of investment I_0 (determined by businesses' optimism, expected economic growth, and a bunch of other factors for which the level of the stock market serves as a convenient thermometer). Subtract from this baseline level the interest sensitivity of investment parameter I_r times the relevant interest rate r . The relevant interest rate must be *long-term* because most investments are long-term. The relevant interest rate must be *real* because investment projects are real assets: their value rises with inflation. And the relevant interest rate must be *risky* because businesses borrowing to invest may go bankrupt. In the investment function:

$$I = I_0 - I_r \times r$$

the relevant interest rate r is the long-term, real, risky interest rate.

Exports and Autonomous Spending

Investment spending is not the only component of autonomous spending that is affected by the real interest rate. In the planned-expenditure function:

$$E = A + MPE \times Y$$

autonomous spending includes gross exports as well:

$$A = C_0 + I + G + GX$$

So we can expand the determinants of gross exports in the expression for autonomous spending:

$$A = C_0 + (I_0 - I_r \times r) + G + (X_f Y^f + X_\varepsilon \times \varepsilon)$$

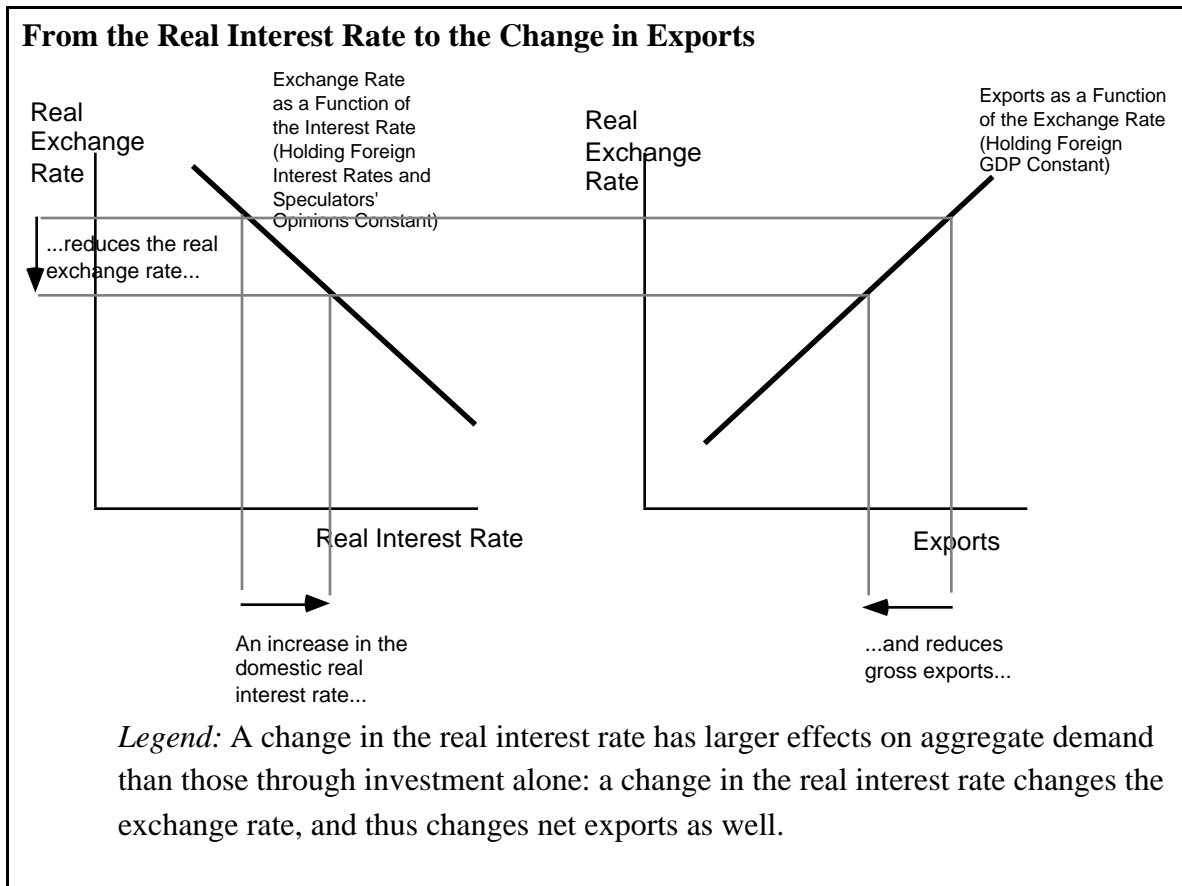
The real exchange rate ε depends on the domestic real interest rate r (as well as on foreign-exchange speculators' opinions of fundamentals and foreign interest rates):

$$\varepsilon = \varepsilon_0 - \varepsilon_r \times (r - r^f)$$

Substituting the determinants of the exchange rate into the autonomous spending equation:

$$A = C_0 + (I_0 - I_r \times r) + G + (X_f Y^f + X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r \times r^f) - X_\varepsilon \varepsilon_r \times r$$

it becomes clear that there are two components of autonomous spending affected by changes in the real interest rate. A higher real interest rate reduces autonomous spending by reducing exports ($X_\varepsilon \varepsilon_r \times r$) as well as by reducing investment ($I_r \times r$).



Why does a higher domestic interest rate reduce exports? A higher real interest rate makes investing in the home country more attractive: foreign exchange speculators try to take advantage of this opportunity to earn higher returns by shifting their portfolio holdings to include more home currency-denominated assets. This increase in demand for home currency-denominated assets and decrease in demand for foreign currency-denominated assets drives down the exchange rate, which is the value of foreign currency.

A lower value of foreign currency makes exports more expensive to foreigners: their currency buys less here because it is less valuable.. It diminishes their ability to purchase exports. Since exports are a part of autonomous spending, a rise in the real interest rate diminishes autonomous spending through this channel as well. Thus a change in interest rates has a bigger effect on output than one would think from the effect of interest rates on investment alone.

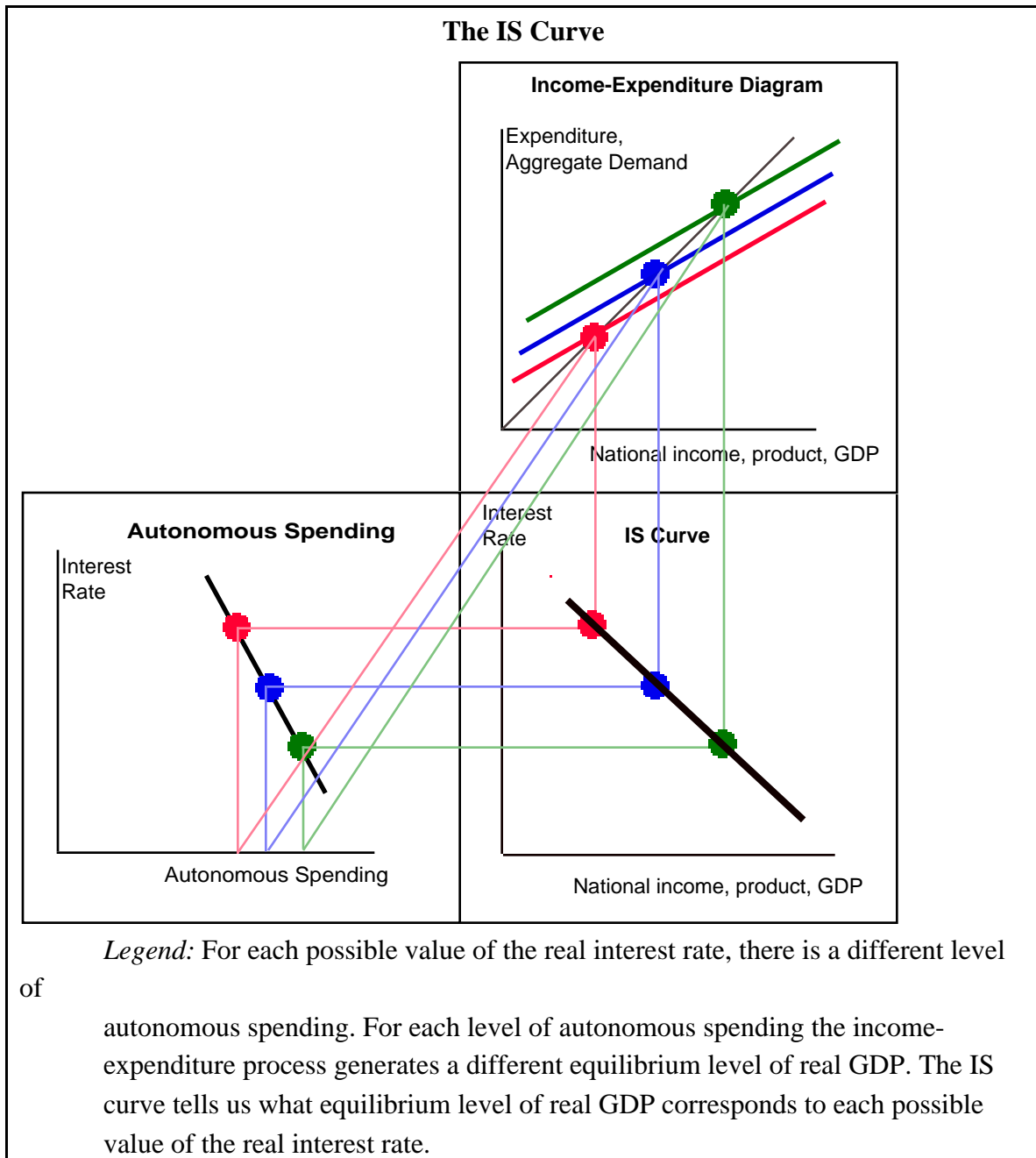
The IS Curve

If we put the two interest rate terms in the equation for autonomous spending together:

$$A = \left[C_0 + I_0 + G + (X_f Y^f + X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r r^f) \right] - (I_r + X_\varepsilon \varepsilon_r) \times r$$

We see that a one-percentage-point increase in interest rates reduces autonomous spending by an amount $(I_r + X_\varepsilon \varepsilon_r)$.

By how much does a change in the interest rate change equilibrium real GDP? The effect will be equal to the interest sensitivity of autonomous spending $(I_r + X_\varepsilon \varepsilon_r)$ times the *multiplier*. This relationship between the level of the real interest rate and the equilibrium level of real GDP has a name that was coined by economist John Hicks more than 60 years ago: the "IS curve," where IS stands for "Investment-Saving curve."



The algebra of the IS curve is straightforward, if a little crowded and complicated. We start from the formula for autonomous spending in terms of the factors underlying aggregate demand:

$$A = \left[C_0 + I_0 + G + (X_f Y^f + X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r r^f) \right] - (I_r + X_\varepsilon \varepsilon_r) \times r$$

Then we divide the determinants of autonomous spending into (i) those that don't depend on the interest rate and (ii) those that do, calling the first set of determinants "baseline autonomous spending" or A_0

$$A_0 = \left[C_0 + I_0 + G + (X_f Y^f + X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r r^f) \right]$$

$$A = A_0 - (I_r + X_\varepsilon \varepsilon_r) \times r$$

We recall from the income-expenditure analysis that real GDP is equal to autonomous spending A divided by one minus the MPE:

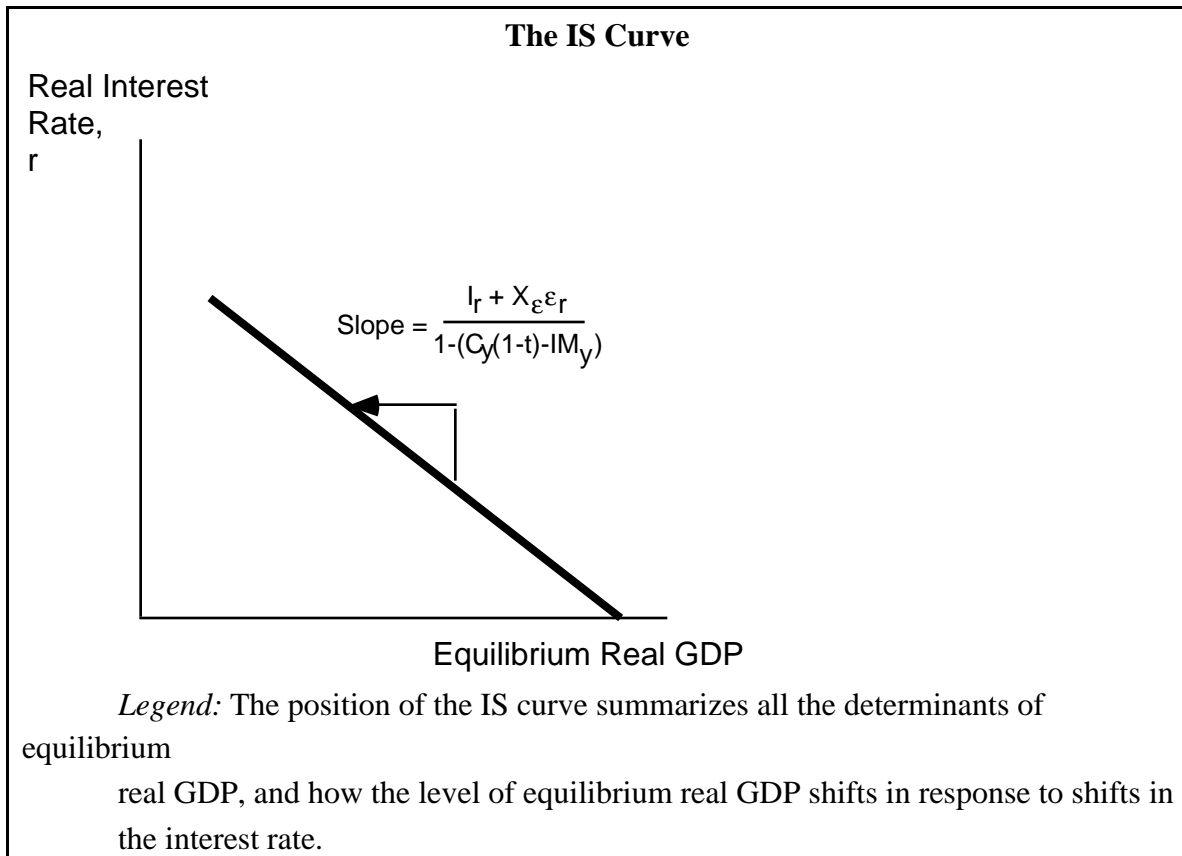
$$Y = \frac{A}{1 - MPE}$$

Replacing A with its components, we see that real GDP Y is:

$$Y = \frac{A_0}{1 - MPE} - \frac{(I_r + X_\varepsilon \varepsilon_r)}{1 - MPE} \times r$$

This equation can be expanded if we want to express the MPE and the baseline level of autonomous spending A_0 in terms of the underlying model parameters and policy variables:

$$Y = \frac{\left[C_0 + I_0 + G + (X_f Y^f + X_\varepsilon \varepsilon_0 + X_\varepsilon \varepsilon_r r^f) \right]}{1 - (C_y(1-t) - IM_y)} - \frac{(I_r + X_\varepsilon \varepsilon_r)}{1 - (C_y(1-t) - IM_y)} \times r$$



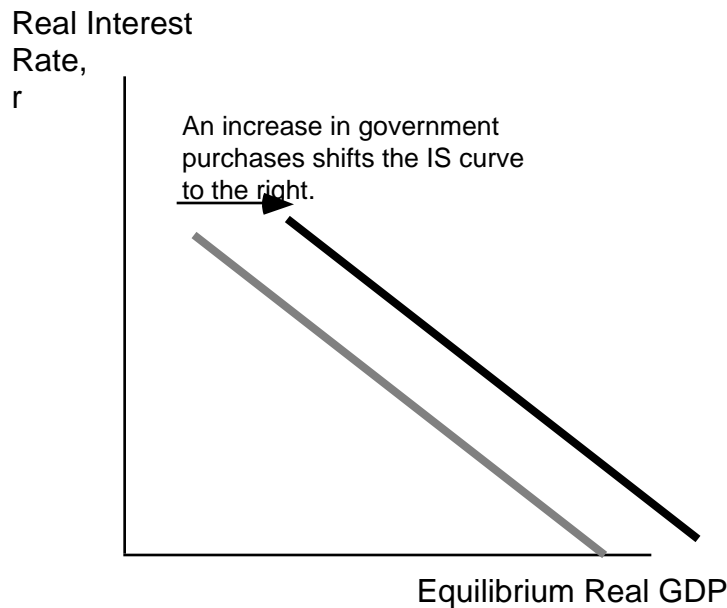
The slope of the IS curve depends on three factors, all clearly visible in its algebraic expression:

$$IS \text{ slope} = - \left(\frac{1}{1 - (C_y(1-t) - IM_y)} \right) \times (I_r + X_\epsilon \epsilon_r)$$

The position of the IS curve depends on the baseline level of autonomous spending A_0 times the multiplier $1/(1-MPE)$.

$$\frac{A_0}{1 - MPE} = \frac{[C_0 + I_0 + G + (X_f Y^f + X_\epsilon \epsilon_0 + X_\epsilon \epsilon_r r^f)]}{1 - (C_y(1-t) - IM_y)}$$

A Change in Fiscal Policy and the Position of the IS Curve



Legend: Practically any shift in policy or in the economic environment will change the position of the IS curve. In this case an increase in government purchases shifts the IS curve to the right.

Economic Fluctuations in the United States: the IS Curve as a Lens

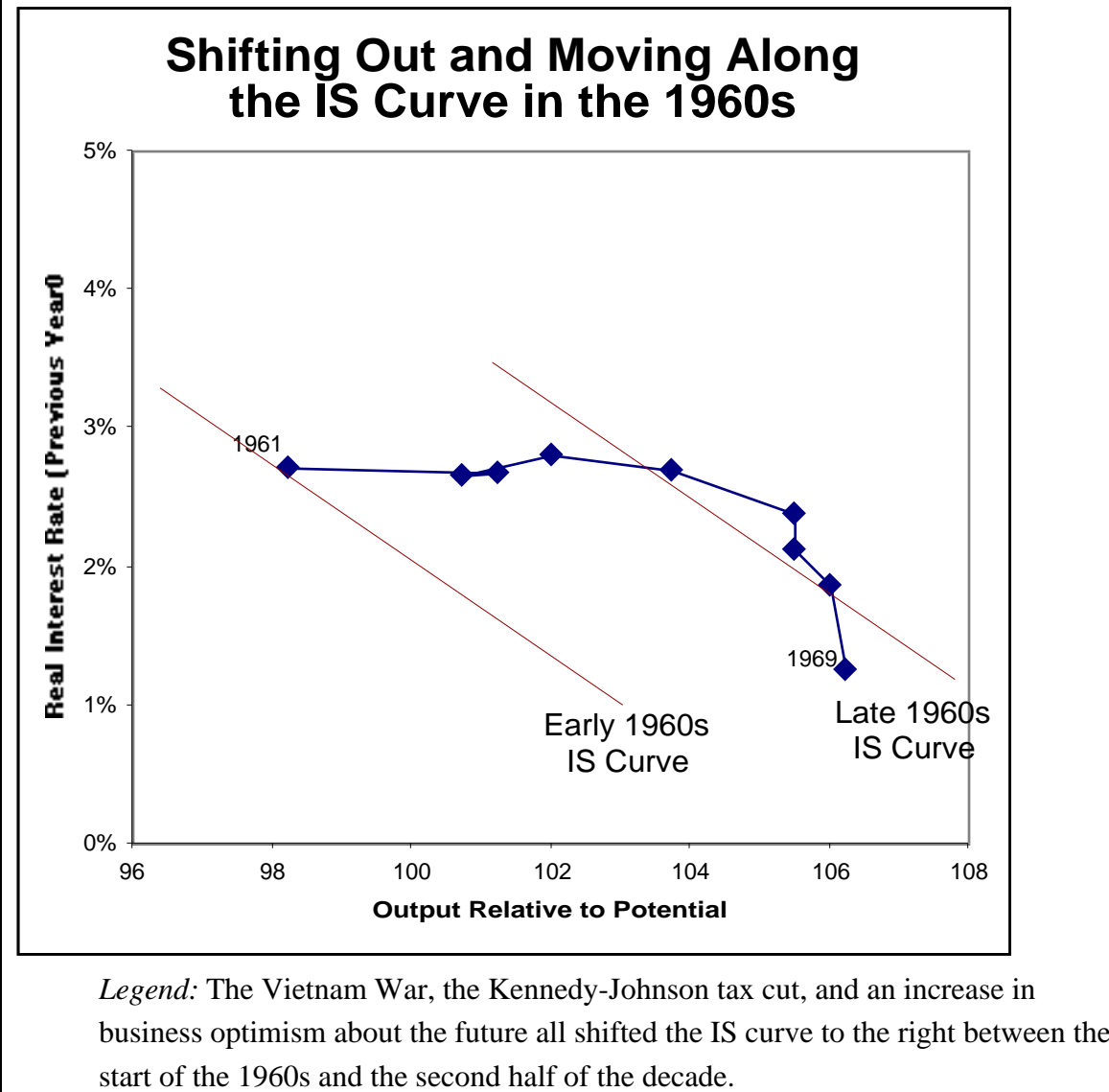
How useful is the IS curve in understanding economic fluctuations in the U.S. over the past generation or so? If we plot on a graph the points corresponding to the long-term real interest rate and output relative to potential attained by the U.S. economy since 1960, we see that the economy has been all over the map—or at least all over the diagram. Yet we can make sense of what has happened using shifts in and along the IS curve. That in fact is what the IS curve is for. It is a useful tool: that is why we have spent so many pages developing it. In the next four sections we will apply the IS curve to gain insight into business cycle fluctuations in each of the past four decades.

The 1960s

The 1960s saw a substantial rightward shift in the IS curve. Increased optimism on the part of businesses, the Kennedy-Johnson cut in income taxes, and the extra government

expenditures needed to fight the Vietnam War all increased aggregate demand. The IS curve rightward by perhaps five percent of potential output in the 1960s.

The IS Curve in the 1960s



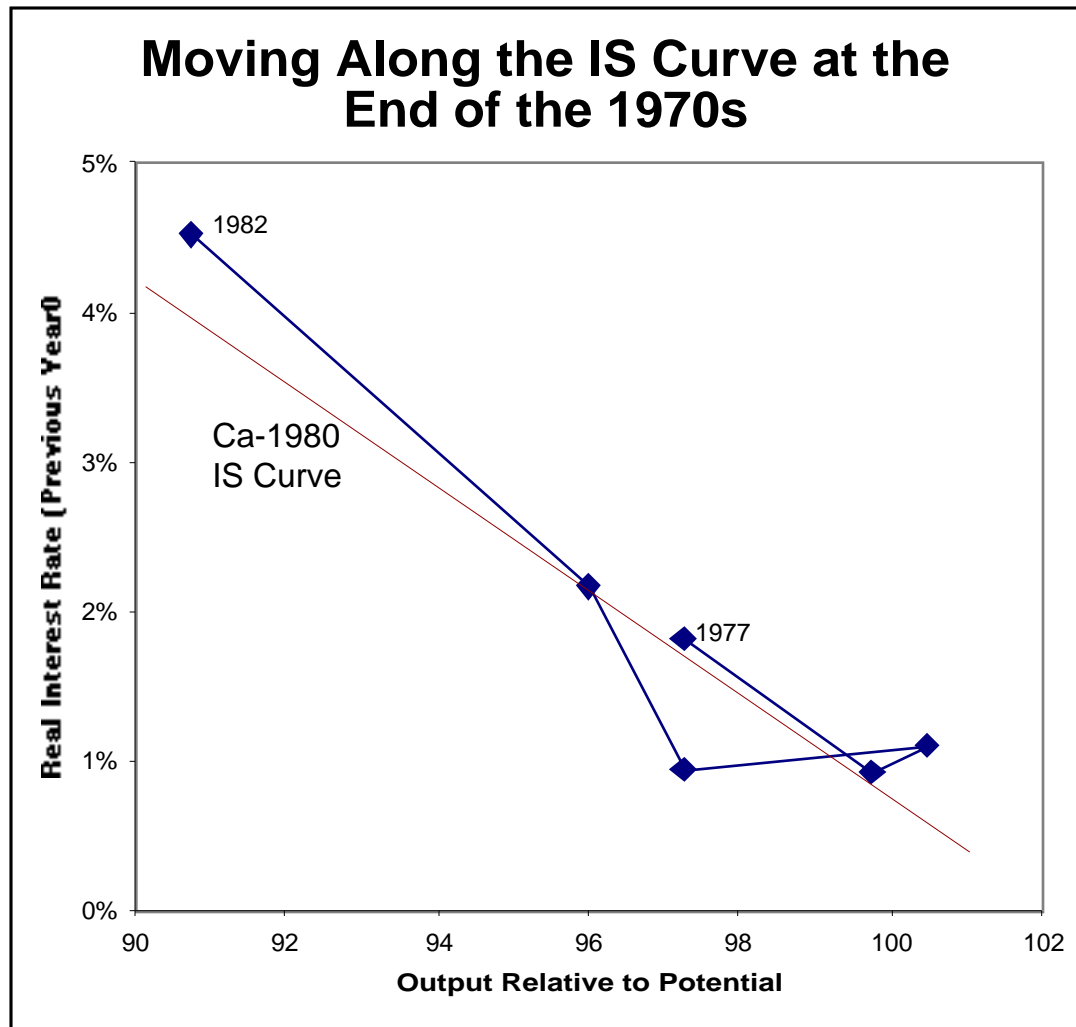
The late 1960s also saw a movement downward and to the right along the IS curve, as real interest rates declined. In large part real interest rates declined by accident. The Federal Reserve did not fully gauge the amount by which inflation was rising. Rising inflation increased the gap between the nominal interest rates directly controlled by

monetary policy and the real interest rates that determine aggregate demand. the Federal Reserve did not recognize this as it was happening, and thus allowed real interest rates to drift downward.

The Late 1970s

The second half of the 1970s saw the level of real GDP in the U.S. significantly below the level of potential output. From 1977 to 1979 the U.S. economy moved down and to the right along the IS curve. However, the expansion of output toward potential was accompanied by unexpectedly high and rising inflation. This rise in inflation was further fueled by a supply shock: the sudden rise in oil prices triggered by the Iranian Revolution.

1979 saw a sudden shift in Federal Reserve policy when Paul Volcker became Chair of the Federal Reserve, replacing G. William Miller. Under Miller fighting inflation had been a relatively low priority. Under Volcker fighting inflation became the highest priority of all. The Federal Reserve raised annual real interest rates step-by-step from 1979 to 1982 up to nearly five percent. The increase in real interest rates moved the economy up and to the left along the end-of-the-1970s position of the IS curve: the unemployment rate reached nearly ten percent in 1982, and real GDP fell to only 91 percent of the economy's potential output.

Moving Along the IS Curve

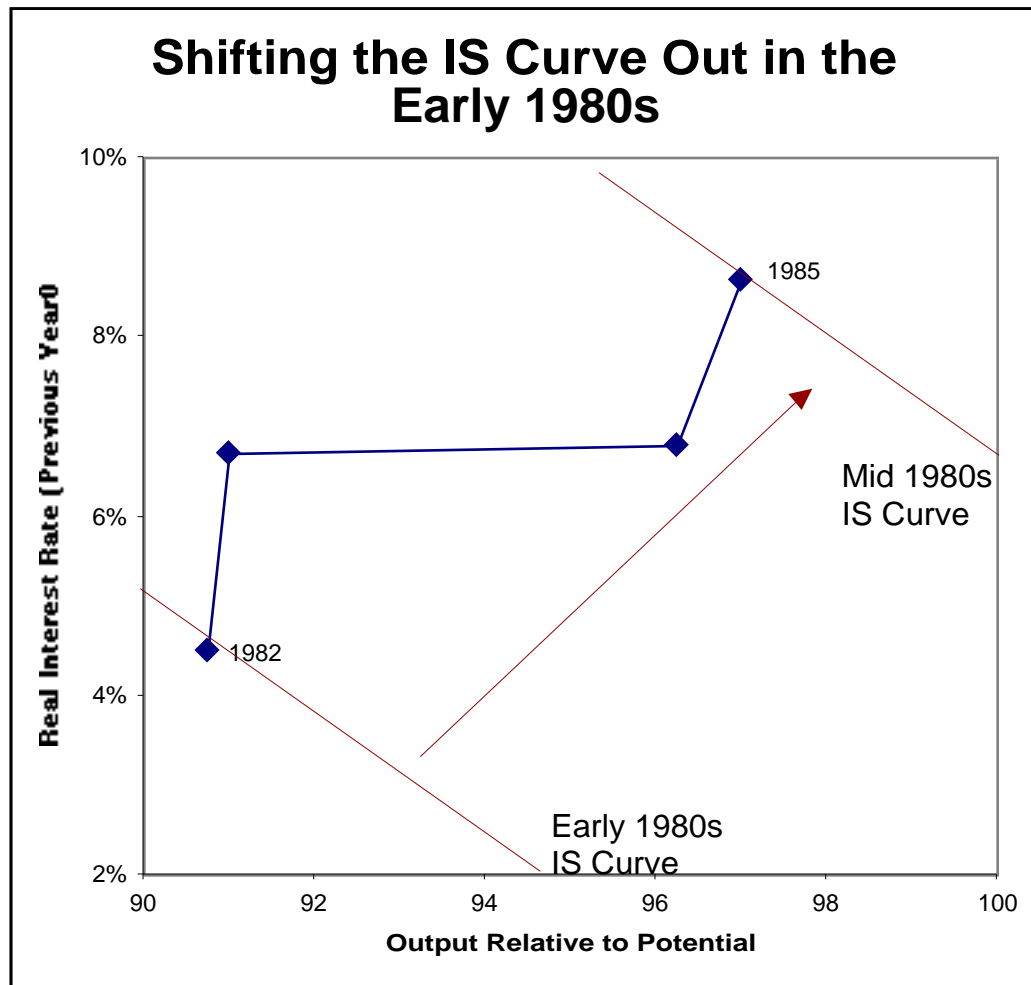
Legend: Sharp rises in real interest rates at the end of the 1970s after Paul Volcker became Chair of the Federal Reserve pushed the U.S. economy up and to the right along the IS curve.

The 1980s

The election of Ronald Reagan in 1980 was followed by a massive fiscal expansion. Military spending was increased and income taxes were cut in a series of steps that became effective between 1982 and 1985. The result of these increases in government purchases and cuts in taxes was an enormous government deficit and an outward shift in

the IS curve. A simultaneous increase in investor optimism triggered by falling inflation combined with the government's fiscal stimulus to shift the IS curve outward relative to potential output by at least 12 percent.

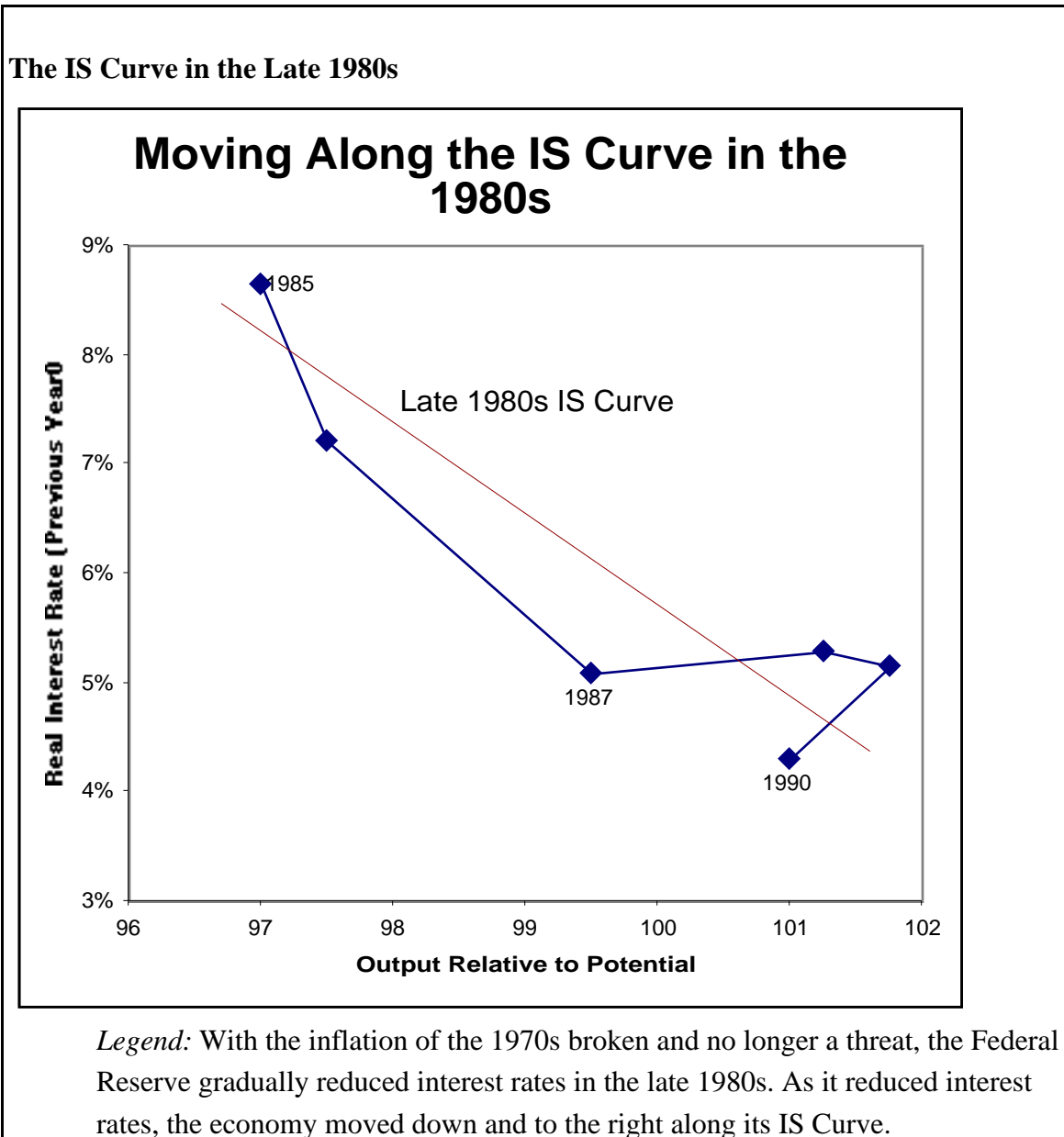
The IS Curve in the Mid-1980s



Legend: The Reagan budget deficits of the 1980s shifted the economy's IS curve to the right.

The Federal Reserve responded to this outward shift in the IS curve by raising real interest rates. It sought in the first half of the 1980s to ensure that the success it had achieved in reducing inflation did not unravel. The Federal Reserve feared that a rapid return of real GDP to potential GDP would put upward pressure on inflation once more.

Hence the rise in real interest rates to make sure that the large Reagan-era fiscal expansion did not have too large an effect.



As inflation remained low throughout the mid and late 1980s, Federal Reserve policymakers gained confidence. They became increasingly optimistic that higher real GDP levels relative to potential would not reignite inflation. Between 1985 and 1980

successive step-by-step reductions in real interest rates carried the U.S. economy back to full employment, and carried it down and to the right along the IS curve.

The 1990s [to be updated every year within editions...]

The principal maker of economic policy since the late 1980s has been Federal Reserve Chair Alan Greenspan—appointed and reappointed by three successive presidents, Reagan, Bush, and Clinton. Federal Reserve Chair Alan Greenspan also is somewhat of a paradox: a Federal Reserve Chair whom all trust to be a ferocious inflation fighter, yet one who—in the policies that he has chosen—has frequently seemed willing to risk higher inflation in order to achieve higher economic growth, or to avoid a recession.

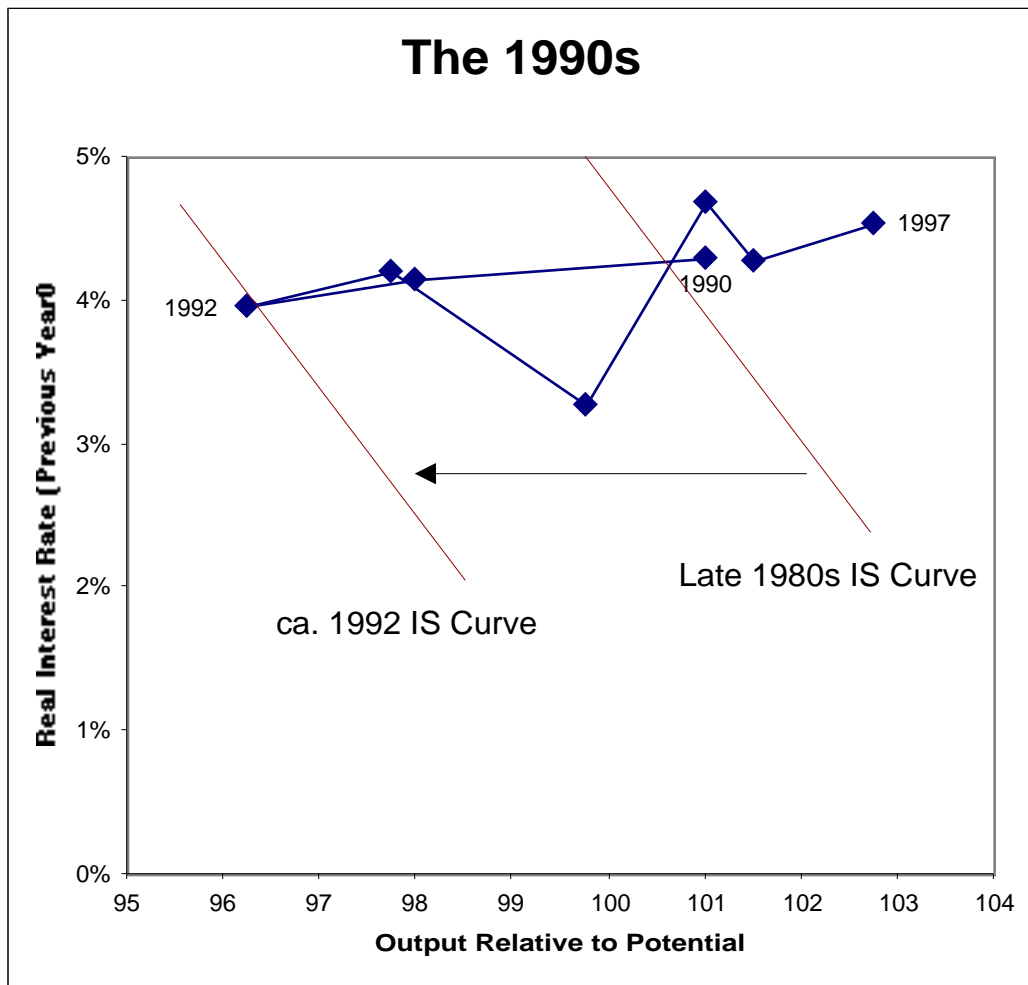
Immediately after taking office Alan Greenspan faced a challenge: the sudden stock market crash of October, 1987. How large an effect would this crash have on aggregate demand? What would it do to investment spending? How much of a leftward shift in the IS curve would be generated by the sudden change in investors' expectations about the future that triggered the stock market crash? No one knew. If the crash turned out to be the harbinger of a large leftward shift in the IS curve, then an unchanging monetary policy would lead to a significant recession. So the Alan Greenspan-led FOMC lowered interest rates and expanded the monetary base, hoping that this shift in monetary policy would offset any leftward shift in the IS curve, and avoid a recession.

In point of fact, the stock market crash of 1987 had next to no effect on investment spending or aggregate demand. Economists have still not come up with a convincing story for why its effects were so small. The two years after 1987 saw higher output relative to potential, and lower unemployment rates. The years between 1987 and 1990 did not see real interest rates rising--as they usually do in the latter stages of an expansion--but real interest rates that were stable or falling.

As the unemployment rate fell, inflation accelerated. The economy moved up and to the left along the Phillips curve. 1988 and 1989 saw inflation move up from three percent to four percent. The Federal Reserve found that it had successfully avoided any chance of a (big) recession in 1988 in the aftermath of the stock market crash, but only at the price of letting inflation rise above four percent per year. In the second half of 1990 there came a sudden leftward shift in the IS curve: the Iraqi invasion of Kuwait served as a trigger for

firms to reduce investment, as they waited to see whether the world economy was about to experience another long-run upward spike in oil prices. The U.S. economy slid into recession at the end of 1990. The Federal Reserve, worried about the upward creep in inflation in the late 1980s, took no steps to reduce real interest rates as the economy slid into recession.

FiThe Recession of 1990-1992



Legend: A sharp inward shift in the IS curve triggered a recession at the beginning of the 1990s.

During the recession inflation fell to two and a half percent. Unemployment rose to a peak of 7.6 percent—in the late spring of 1992, just in time to be salient for the 1992 presidential election. Recovery began in mid-1992.

Soon thereafter Federal Reserve Chair Alan Greenspan made another decision to risk higher inflation in order to accomplish other goals. 1993 saw Greenspan signal that if Congress and the president took significant steps to reduce the budget deficit, then the Federal Reserve would try as best as it could to maintain lower interest rates--a shift in the policy mix that would keep the target level of production and employment unchanged, but that with lower interest rates would promise higher investment and faster productivity growth: an "investment-led recovery."

This time the gamble turned out extremely well. As fiscal policy tightened in 1994 and beyond, interest rates remained significantly lower than they had been in the 1980s even though output recovered to potential. Moreover, this time there was no significant acceleration of inflation, even though by the end of the decade of the 1990s unemployment had fallen to the lowest level in a generation.