Fletcher School of Law and Diplomacy, Tufts University

4. Simultaneous Goods and Financial Markets Equilibrium in the Short Run: The IS-LM Model

E212 Macroeconomics

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Aggregate Demand and Fluctuations in Output and the Interest Rate

Having looked at the market for goods and services and the determination output, and financial markets and the determination of the nominal interest rate, in isolation, we shall now look at the interactions between these two markets. We shall focus on the simultaneous short run determination of fluctuations in output (and implicitly employment) and the interest rate.

We shall, as in the basic keynesian model, assume that in the short-run the price level is predetermined as the adjustment of the prices of goods and services in very gradual.

This assumption, of a fixed price level in the short run, , because of slow price adjustment, is the basis of the Keynesian approach to macroeconomics and aggregate fluctuations.

However, unlike the prices of goods and services, which are assumed to adjust slowly, it is assumed that financial prices, such as bond prices and interest rates, adjust immediately so as to equilibrate domestic financial markets.

Aggregate Demand and the Simultaneous Determination of Output and the Interest Rate

Short-run equilibrium of a closed economy takes place at the level of output (GDP) and the interest rate where, for a given price level, two conditions are simultaneously met:

1. The market for goods and services is in equilibrium, in the sense that the aggregate demand for goods and services is equal to aggregate output. What adjusts to equilibrate the market for goods and services in the short run is not the level of prices, but output (and implicitly employment).
2. Domestic financial markets are in equilibrium, in the sense that aggregate money demand is equal to the money supply. What adjusts to equilibrate domestic financial markets depends on the policy instrument used by the central bank. If the central bank controls the money supply, then what adjusts is the interest rate. If the central bank, as is more realistic, controls interest rates, then what adjusts to equilibrate financial markets is the money supply.

In the short-run, real output and the nominal interest rate are thus determined so as to simultaneously satisfy these equilibrium conditions in the market for goods and services and in financial markets.

Investment, Sales and the Interest Rate

In the basic model of the keynesian cross, investment was assumed to be autonomous, i.e an exogenous variable. This assumption was made for simplicity. Investment is in fact far from constant and depends primarily on two factors:

1. *The level of sales*. Consider a firm facing an increase in sales and needing to increase production. To do so, it may need to buy additional machines or build an additional plant. In other words, it needs to invest. A firm facing a decline in sales will feel no such need and will not spend anything on investment.
2. *The interest rate*. Consider a firm deciding whether or not to buy a new machine. Suppose that to buy the new machine, the firm must borrow. The higher the interest rate, the less attractive it is to borrow and buy the machine. At a high enough interest rate, the additional profits from using the new machine will not cover interest payments, and the new machine will not be worth buying.

Note that, for the moment, and to keep things simple, we make two simplifying assumption. First, we assume that all firms can borrow at the same interest rate—namely, the interest rate on bonds. In fact, many firms borrow from banks, possibly at a different rate. We also leave aside the distinction between the nominal interest rate—the interest rate in terms of dollars—and the real interest rate—the interest rate in terms of real goods.

To capture these two effects, we write the investment relation as follows:

$$I=I(Y,i)$$
$$(+\ -)$$

This states that investment I depends positively on production Y and negatively on the interest rate i.

The Short Run Equilibrium Condition in the Market for Goods and Services with Endogenous Investment

Aggregate Domestic Expenditure

$$D=C+I+G$$

The Consumption Function

$$C=C(Y-T)$$

$$(\ +\ )$$

The Investment Function

$$I=I(Y,i)$$

$$(+\ -)$$

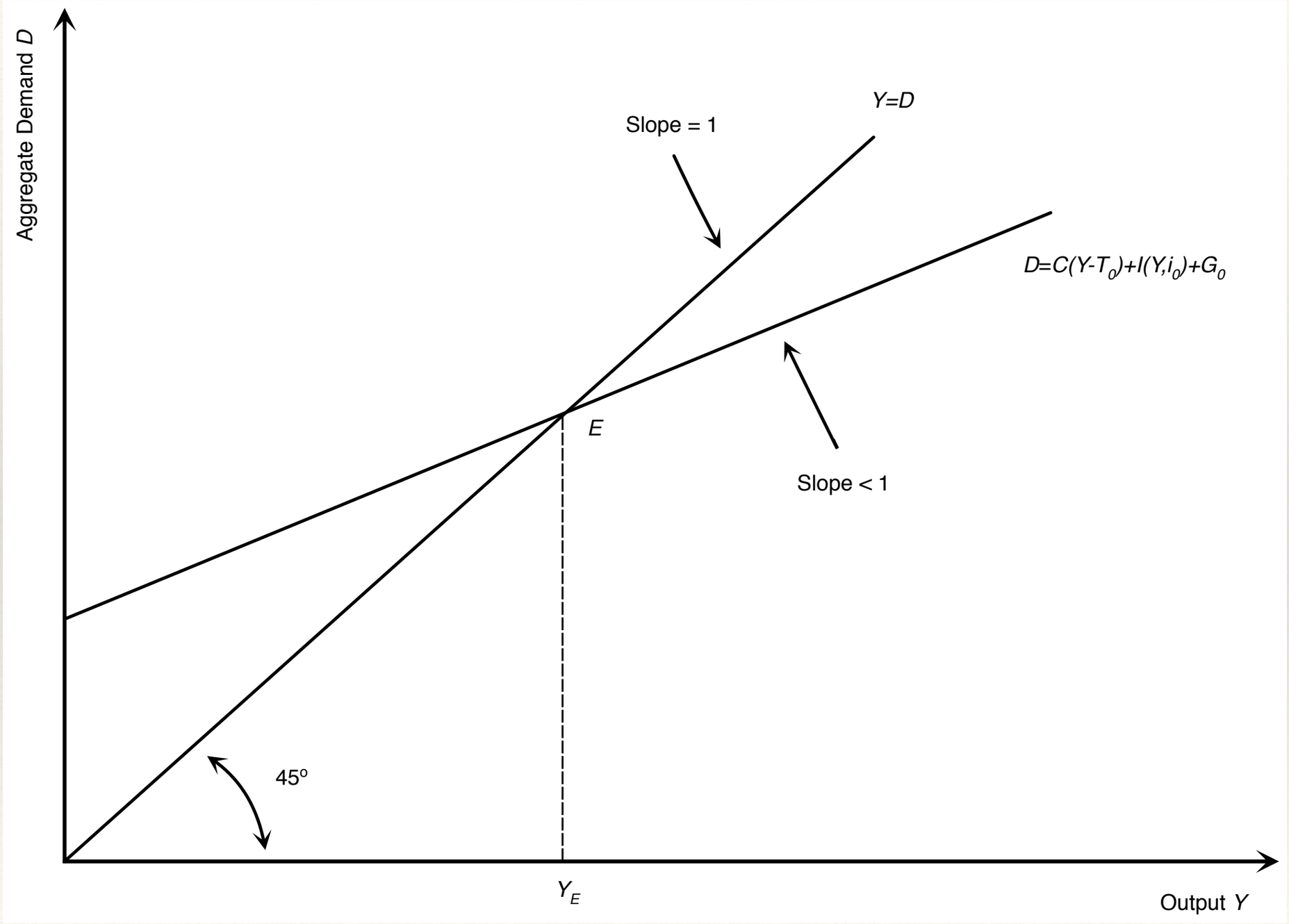
Government Purchases and Taxes (net of transfers)

$$G=G_0,\ T=T_0$$

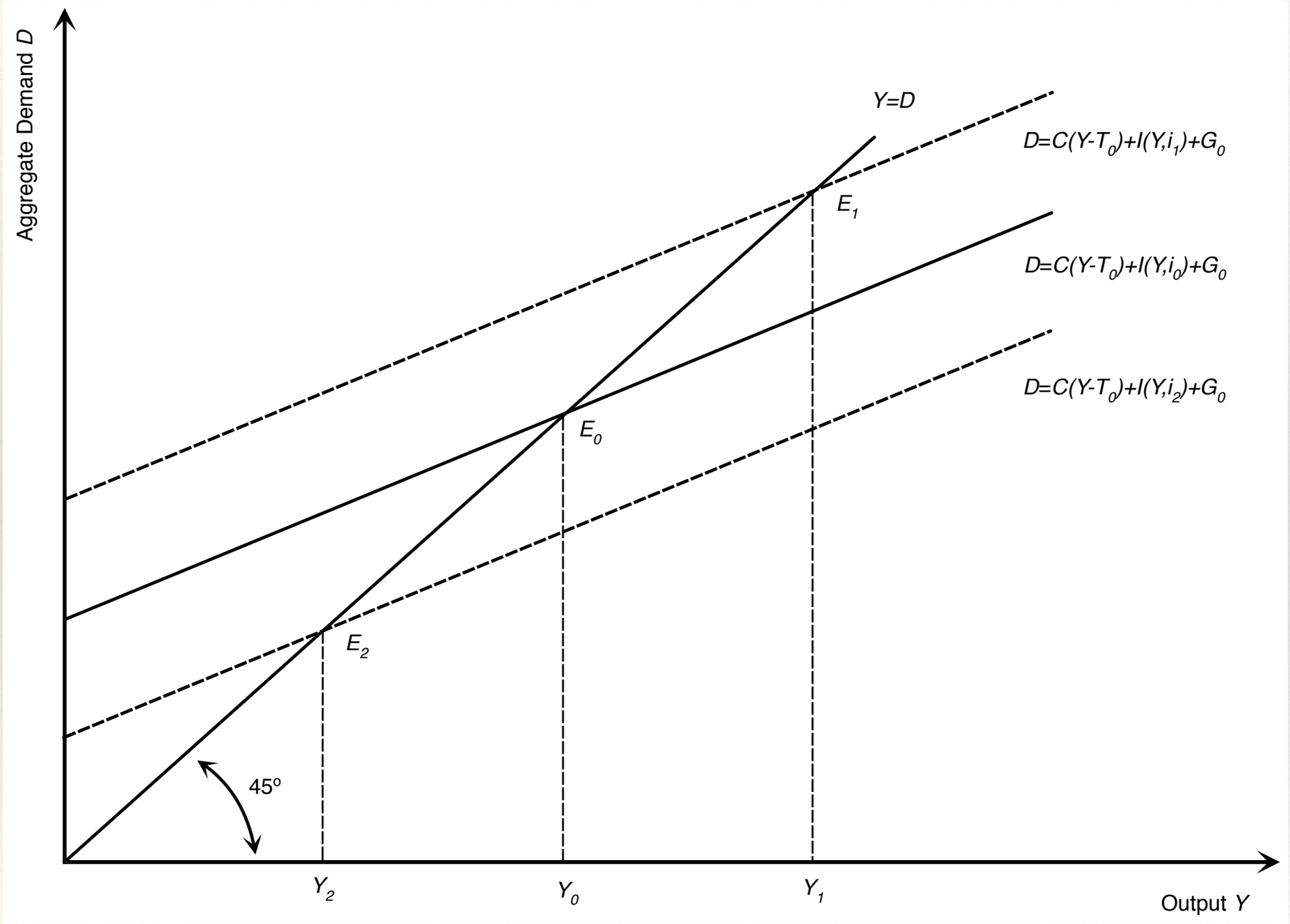
Equilibrium in the Market for Goods and Services

$$Y=D=C+I+G=C(Y-T_0)+I(Y,i)+G_0$$

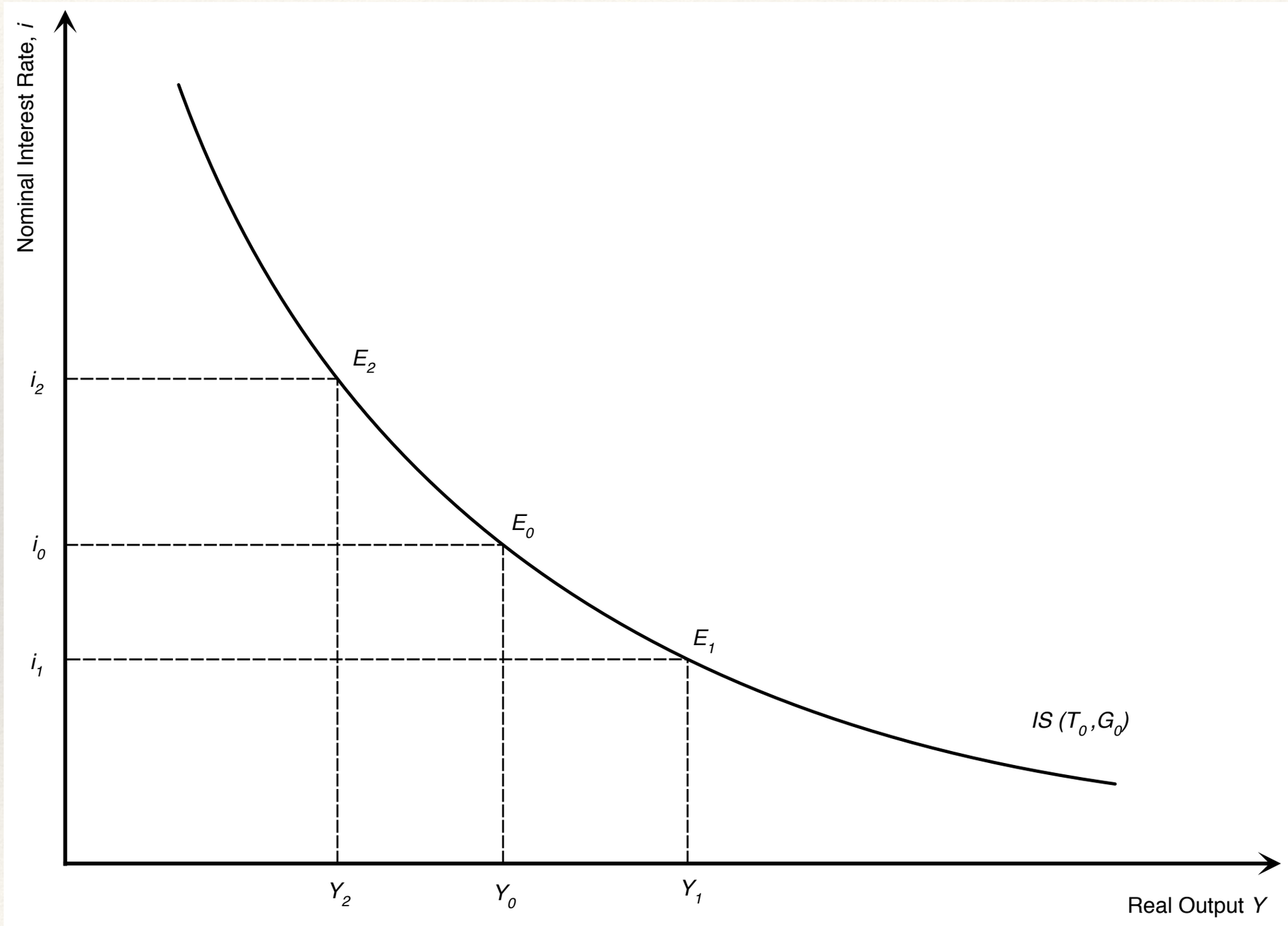
Aggregate Demand and the Short Determination of AggregateOutput



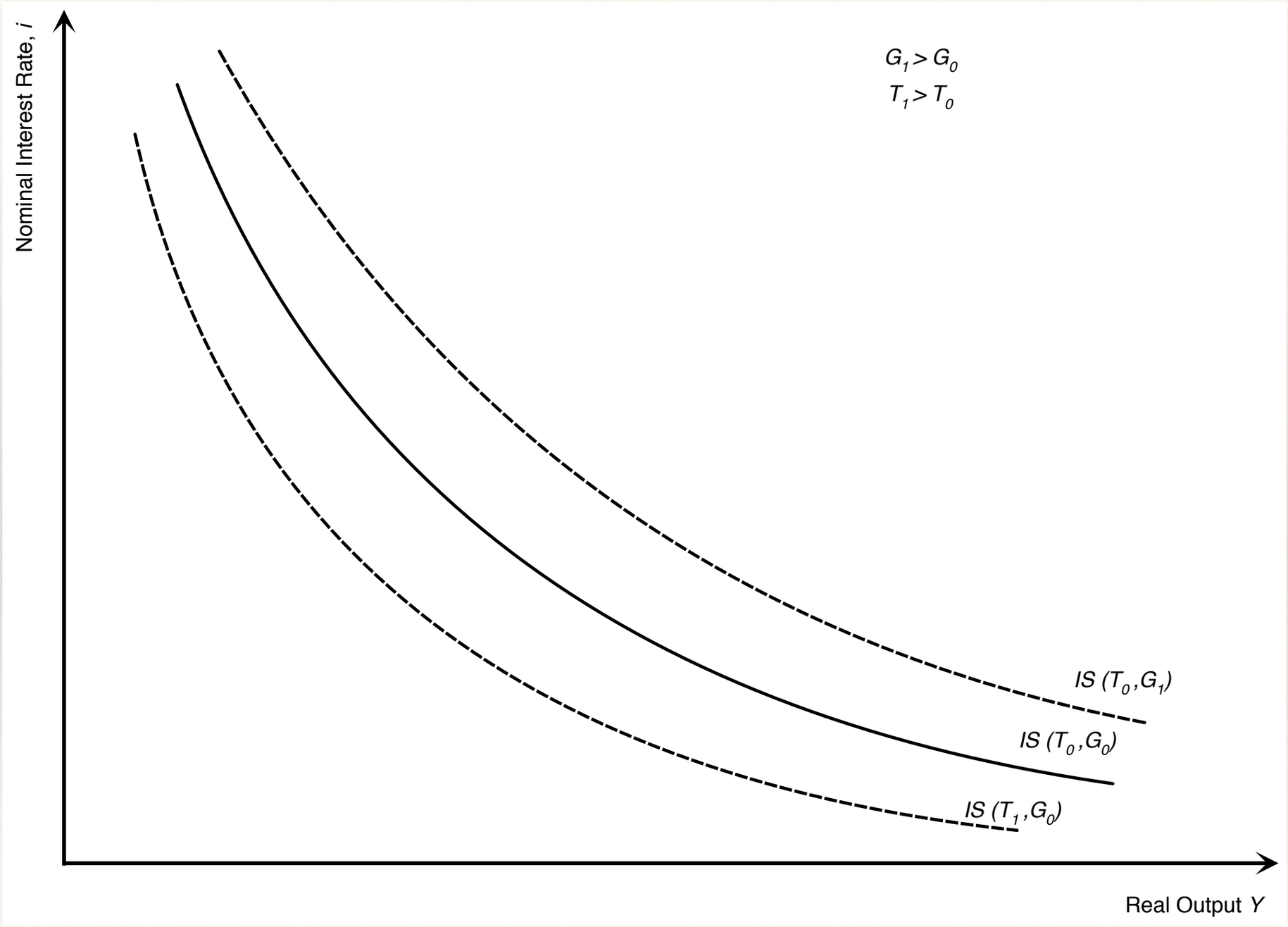
Changes in the Nominal Interest Rate, Investment, and Shifts in Aggregate Demand and Real Output



Real Output and the Nominal Interest Rate
The Product Market Equilibrium Condition, or *IS* Curve



An Increase in Public Expenditure (or in Taxes) and Shifts in the Product Market Equilibrium Condition



Short Run Equilibrium in a Closed Economy

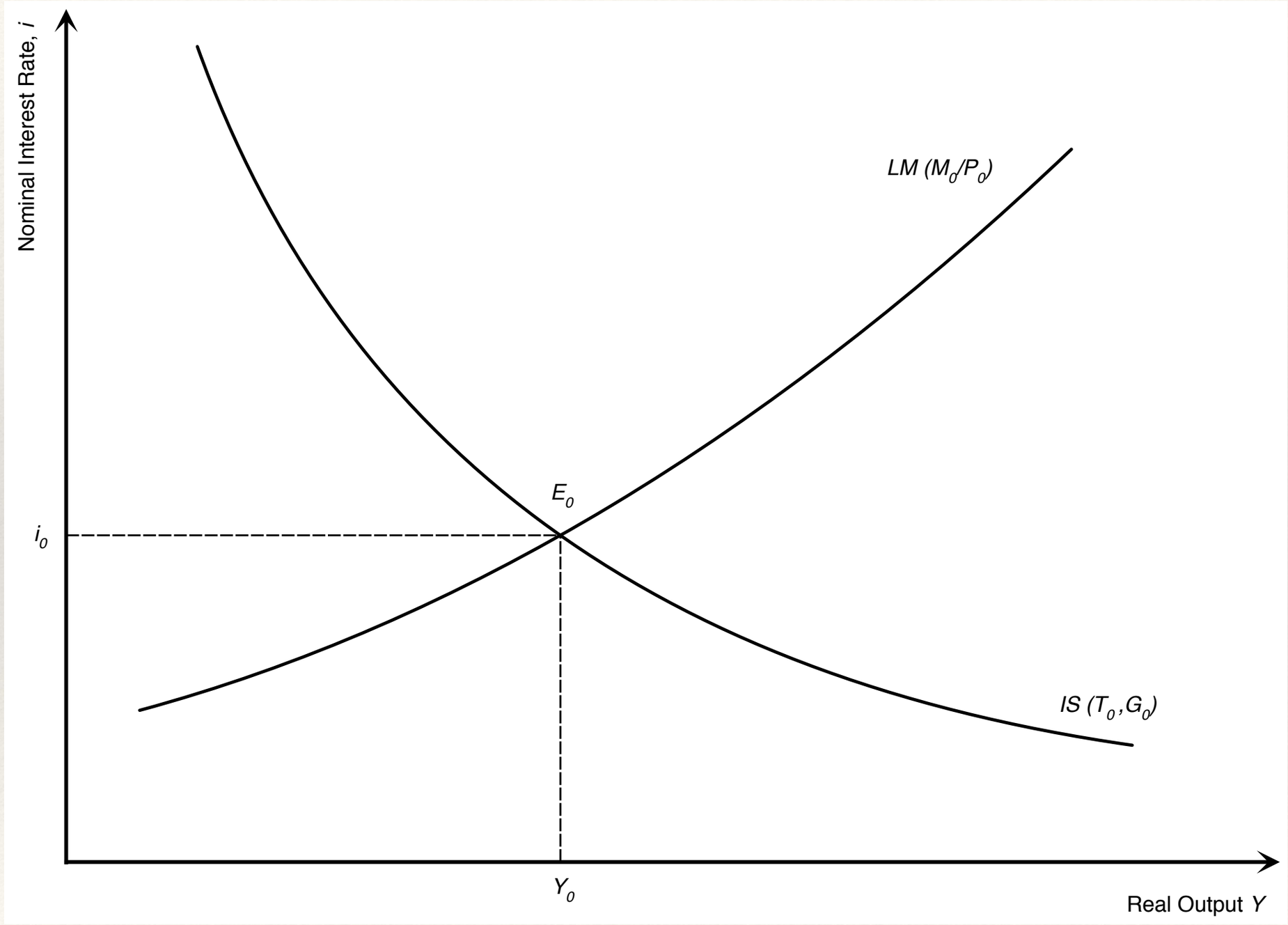
Short Run Equilibrium in the Output Market

$$Y=C(Y-T)+I(Y,i)+G$$

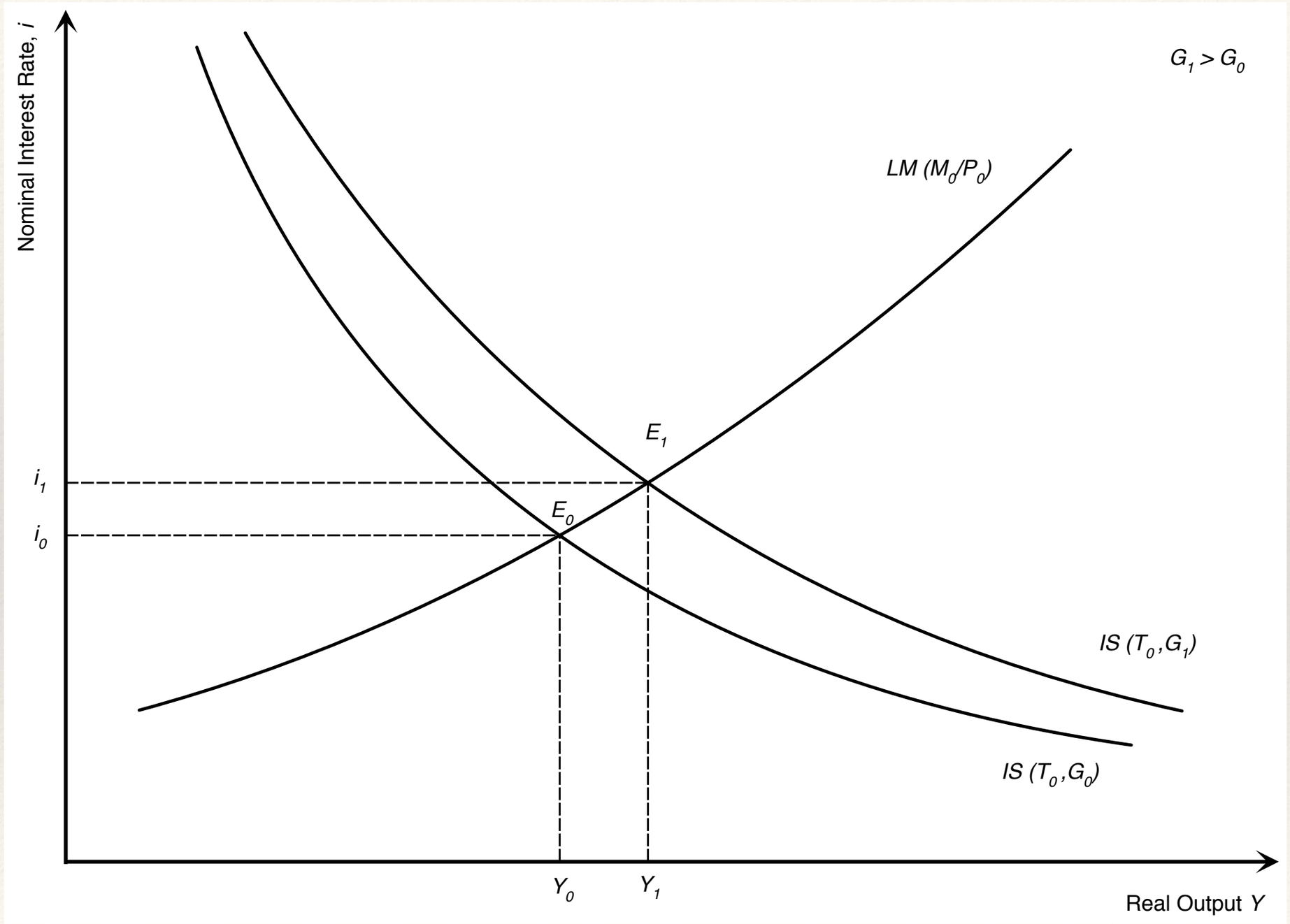
Short Run Equilibrium in Financial Markets

$$M/P=L(Y,i)$$

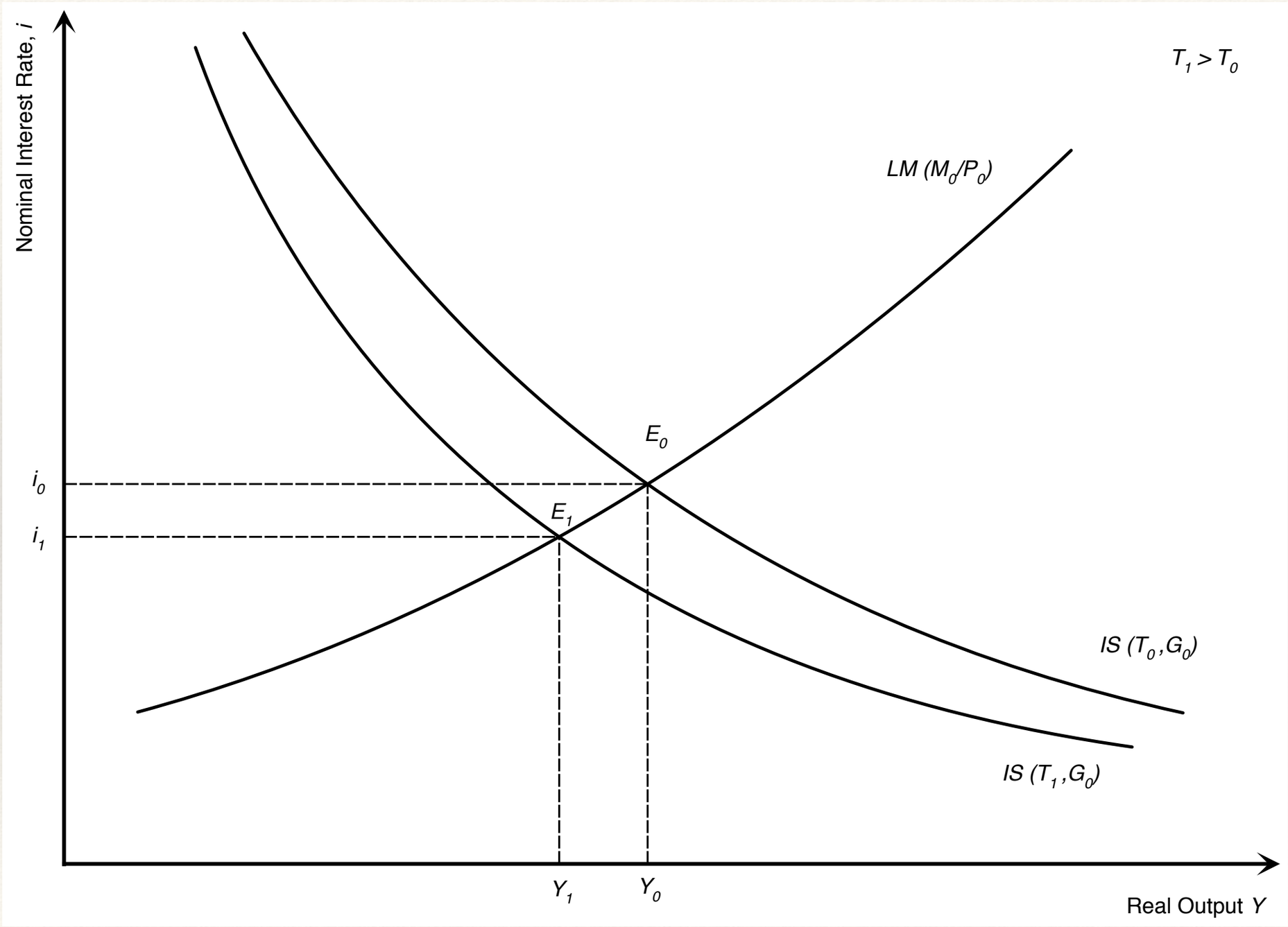
Short Run Equilibrium in a Closed Economy
Aggregate Output and the Interest Rate



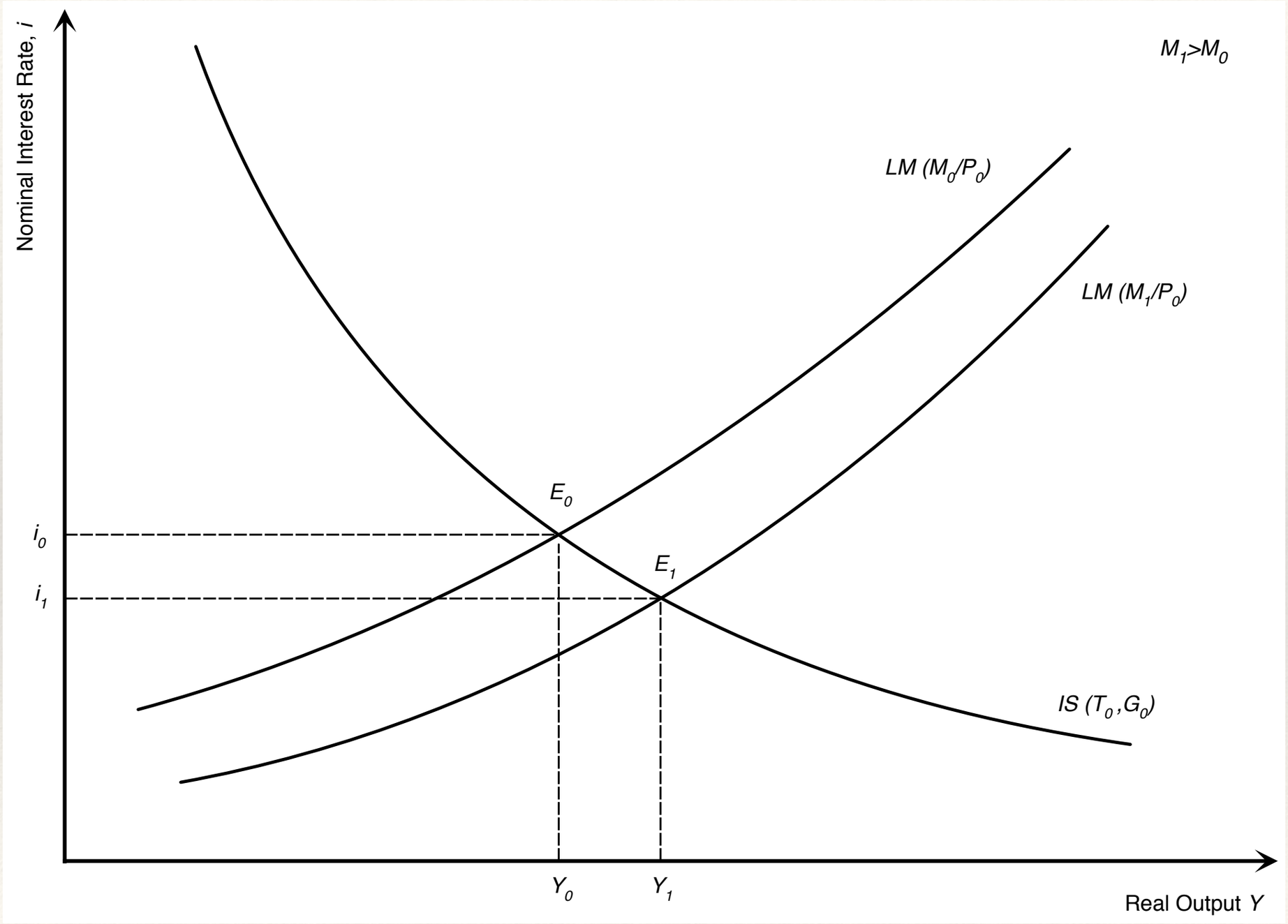
The Short Run Effects of an Increase in Government Purchases



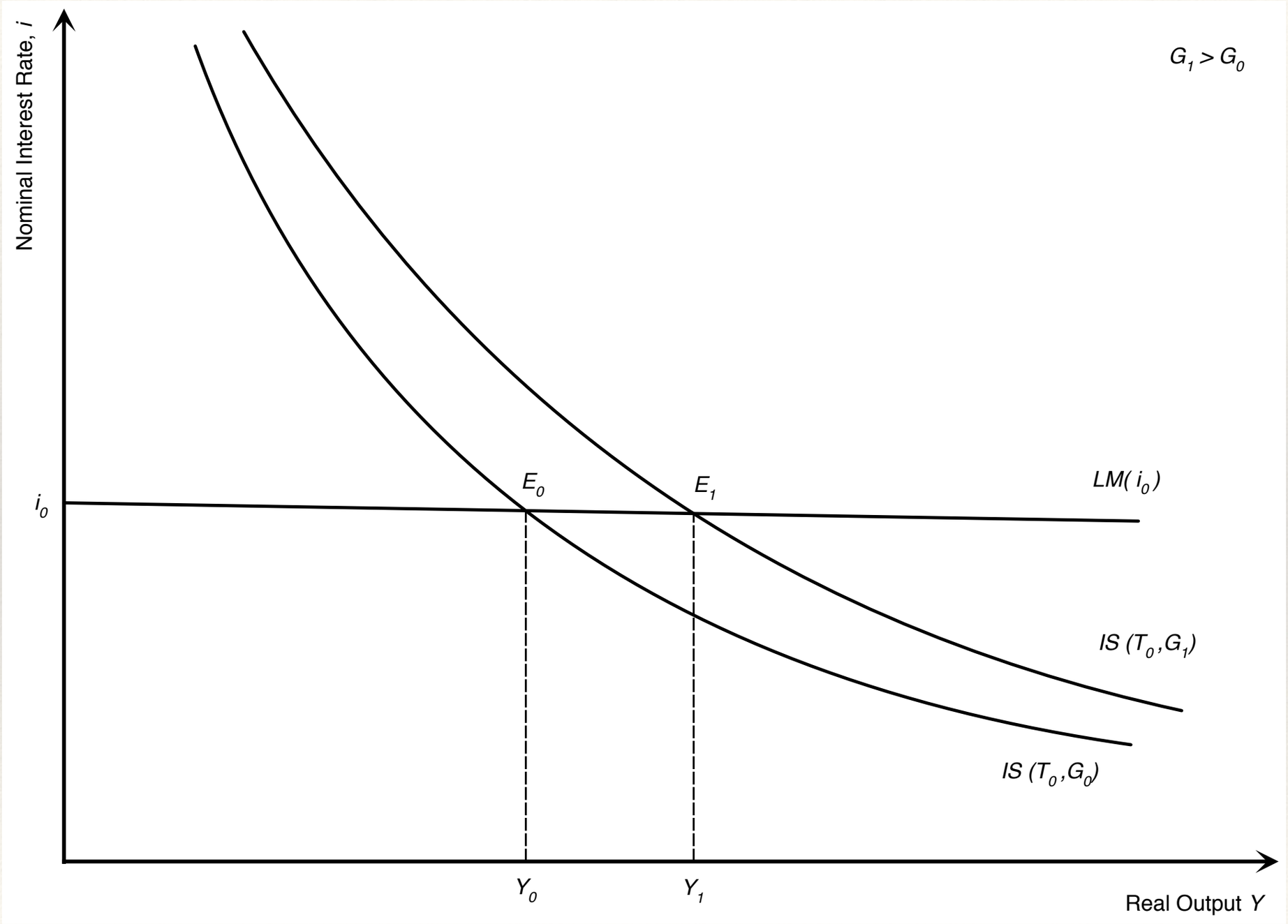
The Short Run Effects of an Increase in Taxes



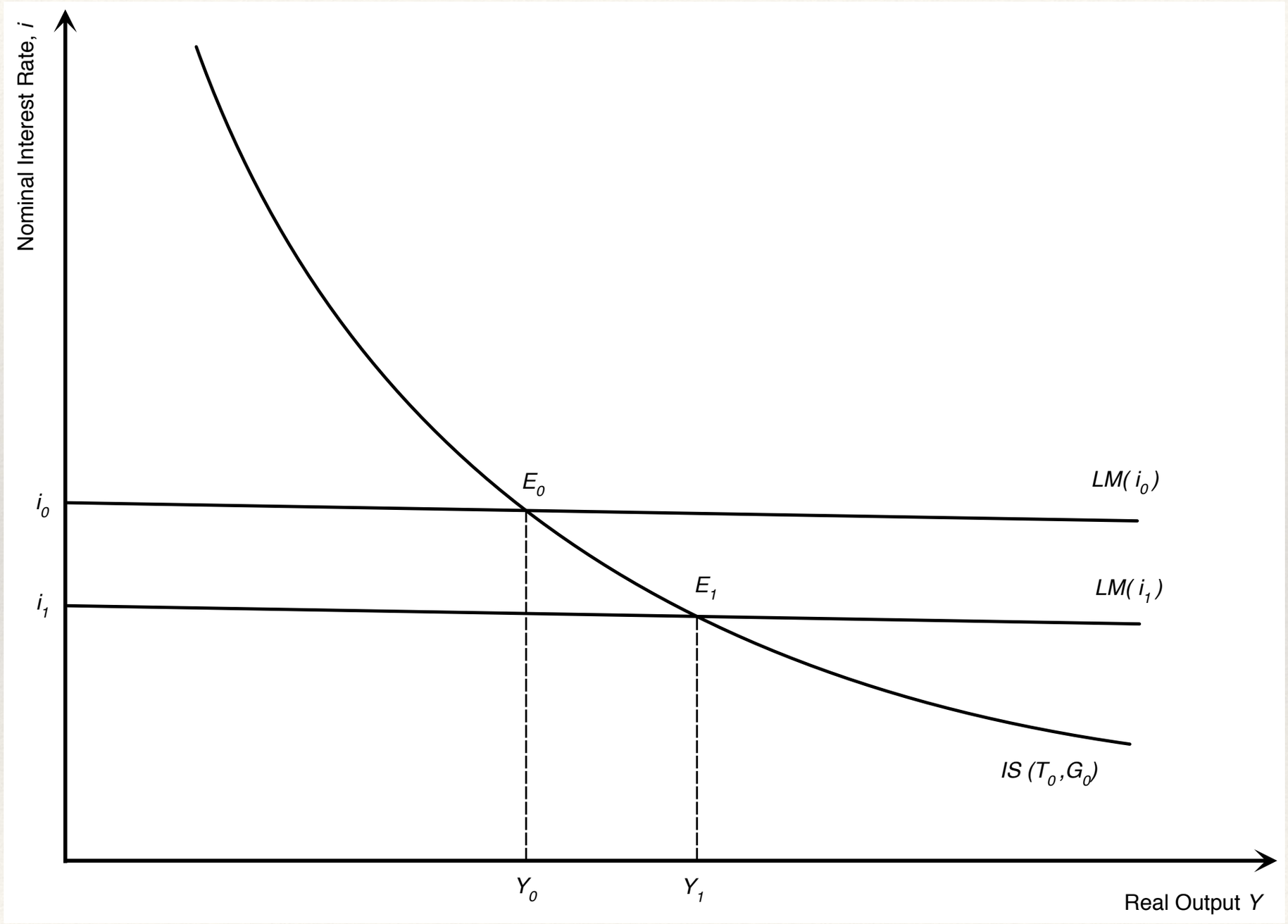
The Short Run Effects of an Increase in the Money Supply



Interest Rate Pegging and the Effects of a Fiscal Expansion



A Reduction of the Interest Rate under Pegging



Interest Rate Pegging versus an Interest Rate Rule

We have described short run macroeconomic equilibrium under two assumptions about the behavior of the central bank.

In the first case, we assumed that the central bank fixes the money supply at a given level, say M_0, and the interest rate and output adjust to equate money demand with the given money supply, and output demand with output supply.

In the second case, interest rate pegging, we have assumed that the central bank chooses the interest rate, say i_0, and then allows the money supply to adjust so as to achieve the interest rate it has chosen.

The second assumption is closer to what modern central banks, including the Fed, typically do. They typically think about the interest rate they want to achieve, and then adjust the money supply so as to achieve their interest rate targets.

However, the interest rate targets of central bank are not fixed. They tend to change, depending on the state of the economy. In other words, interest rates are set according to *rules*. If aggregate demand and income are low, central banks tend to reduce interest rates, and as aggregate demand and income rises, they tend to raise interest rates. This kind of rule can be written as,

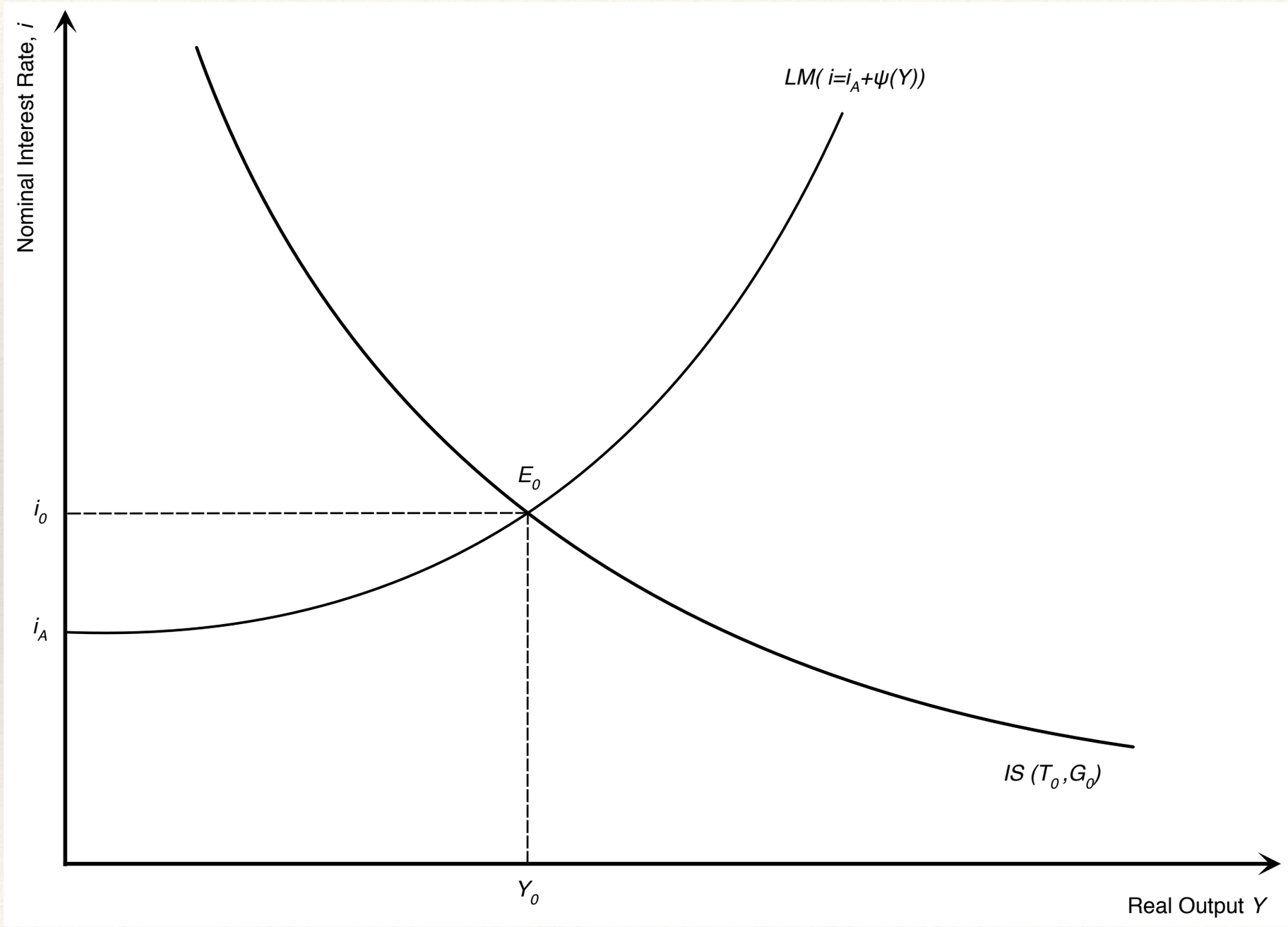
$$i=i_0+\psi(Y)$$

where $\psi(Y)$ is a positive function of output.

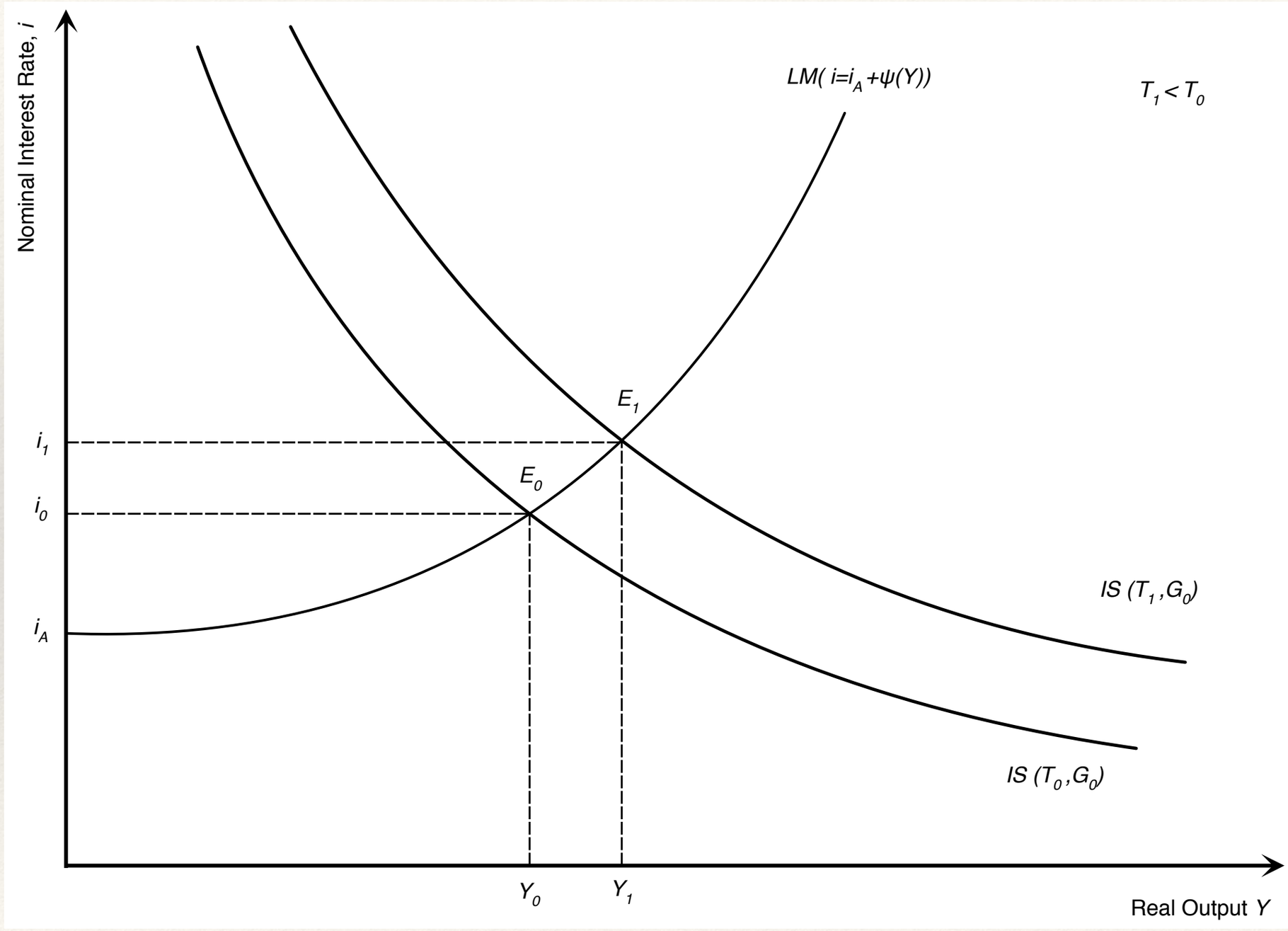
Equilibrium in the money market in such a case is then not determined by the interest rate adjusting to equate money demand with the money supply, as determined by the central bank, but by the money supply adjusting so as to be equal with money demand, at the nominal interest rate determined by the central bank.

When the Central Bank controls the nominal interest rate following an interest rate rule, the *LM* curve is upward sloping, and an increase in real income brings about an increase in the nominal interest rate. Such a case can be depicted diagrammatically in a fashion similar to the previous ones.

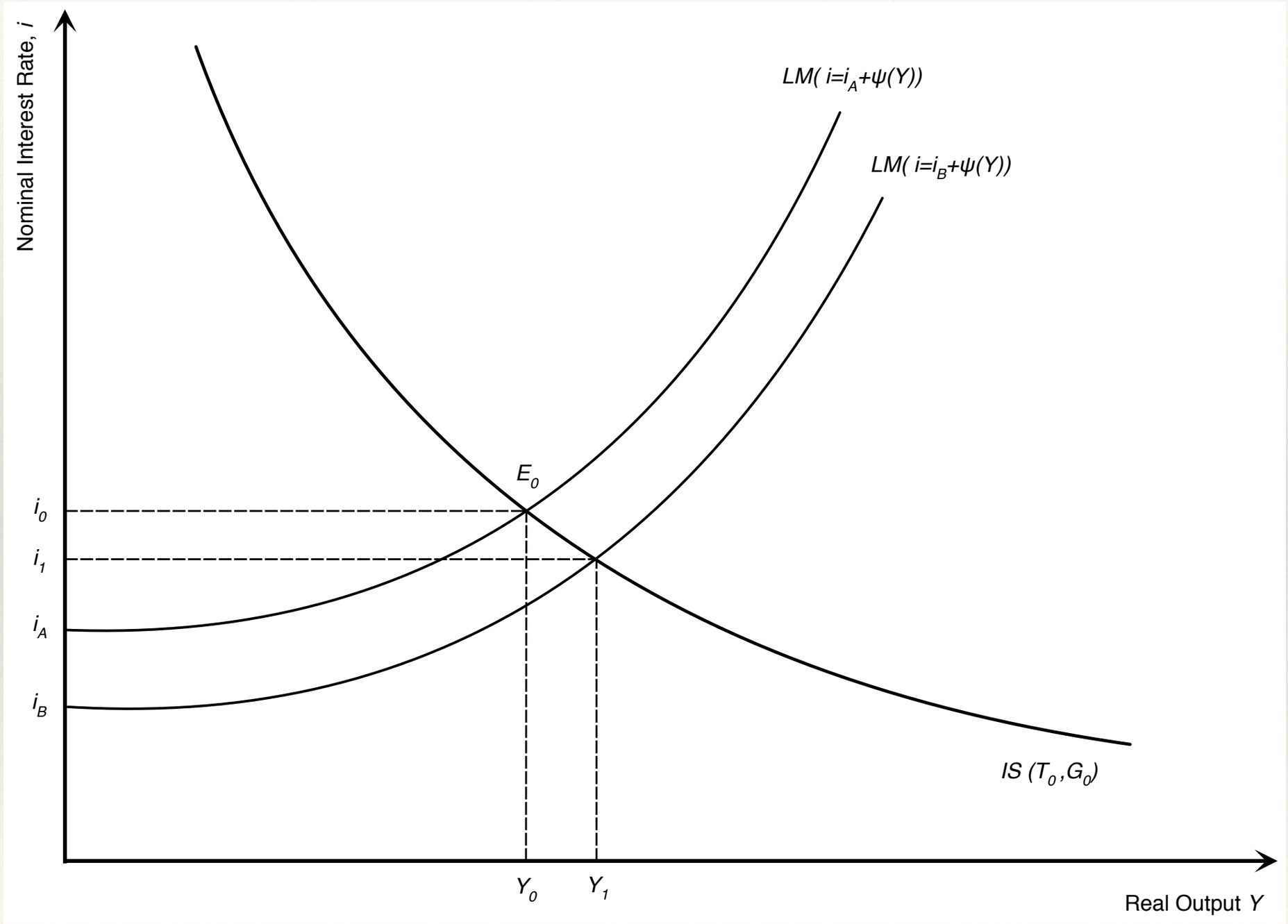
Interest Rate Pegging versus an Interest Rate Rule



The Effects of a Fiscal Expansion under an Interest Rate Rule



A Reduction of the Interest Rate under an Interest Rate Rule



Conclusions about Short Run Macroeconomic Equilibrium in a Closed Economy

Short-run equilibrium in a closed economy is determined at the level of output and the interest rate where two conditions are met,

1. The market for goods and services is in equilibrium, in the sense that aggregate demand equals aggregate supply,

   The product market remains in equilibrium through adjustments in output (aggregate supply) to the level of aggregate demand, as determined by consumption, investment and government purchases.

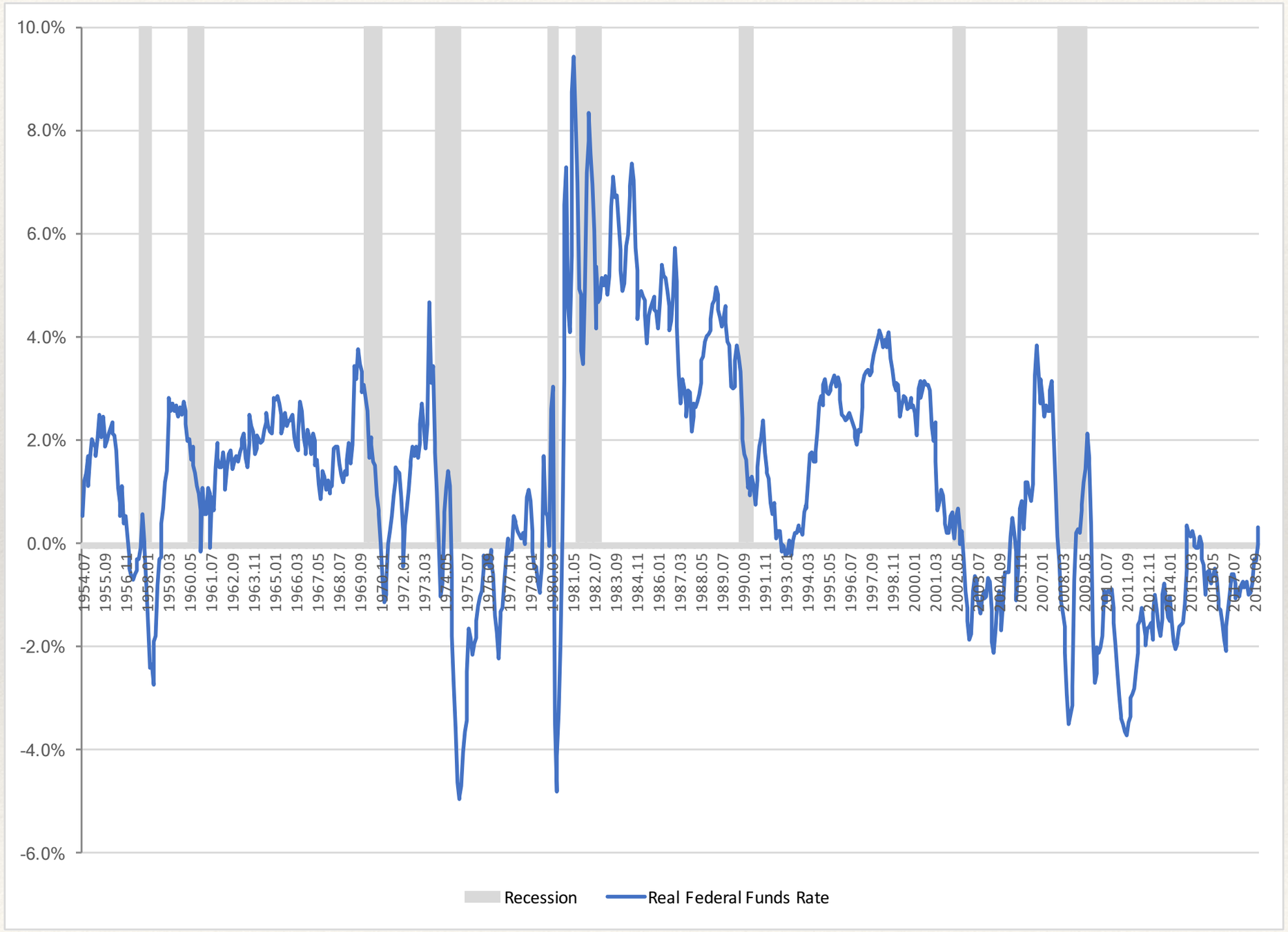
   2. The domestic money market is in equilibrium, in the sense that the demand for money equals the supply of money by the central bank.

   When the central bank controls the money supply, the money market remains in equilibrium through adjustments in the nominal interest rate. When the central bank controls nominal interest rates, the money market remains in equilibrium through endogenous adjustments in the money supply.

Conclusions about the Short Run Effects of Fiscal and Monetary Policy on Output and the Interest Rate

1. When the central bank controls the money supply, or follows an interest rate rule, according to which the interest rate depends positively on output, a fiscal expansion (increase in government purchases or reduction in taxes) causes a short run increase of both the nominal interest rate and real output.
2. A monetary expansion (increase in the money supply) results in a short run reduction of the nominal interest rate and an increase in real output.
3. We have looked so far at fiscal policy and monetary policy in isolation. Our purpose was to show how each worked. In practice, the two are often used together. The combination of monetary and fiscal policies is known as the *monetary–fiscal policy mix*, or simply the *policy mix*. The policy mix can be either a expansionary monetary and fiscal policy, or an expansionary monetary policy and a contractionary fiscal policy, or a contractionary monetary policy and an expansionary fiscal policy, or a contractionary monetary and fiscal policy.
4. If the central bank pegs the nominal interest rate, a fiscal expansion (increase in government purchases or reduction in taxes) causes a larger short run increase of real output, as the nominal interest rate remains constant. Thus, under interest rate pegging, a fiscal expansion ends up as a combination of a fiscal and a monetary expansion.

Fed Policy and Post War US Recessions



What is the Right Policy Mix?

Sometimes, the right mix is to use fiscal and monetary policy in the same direction.

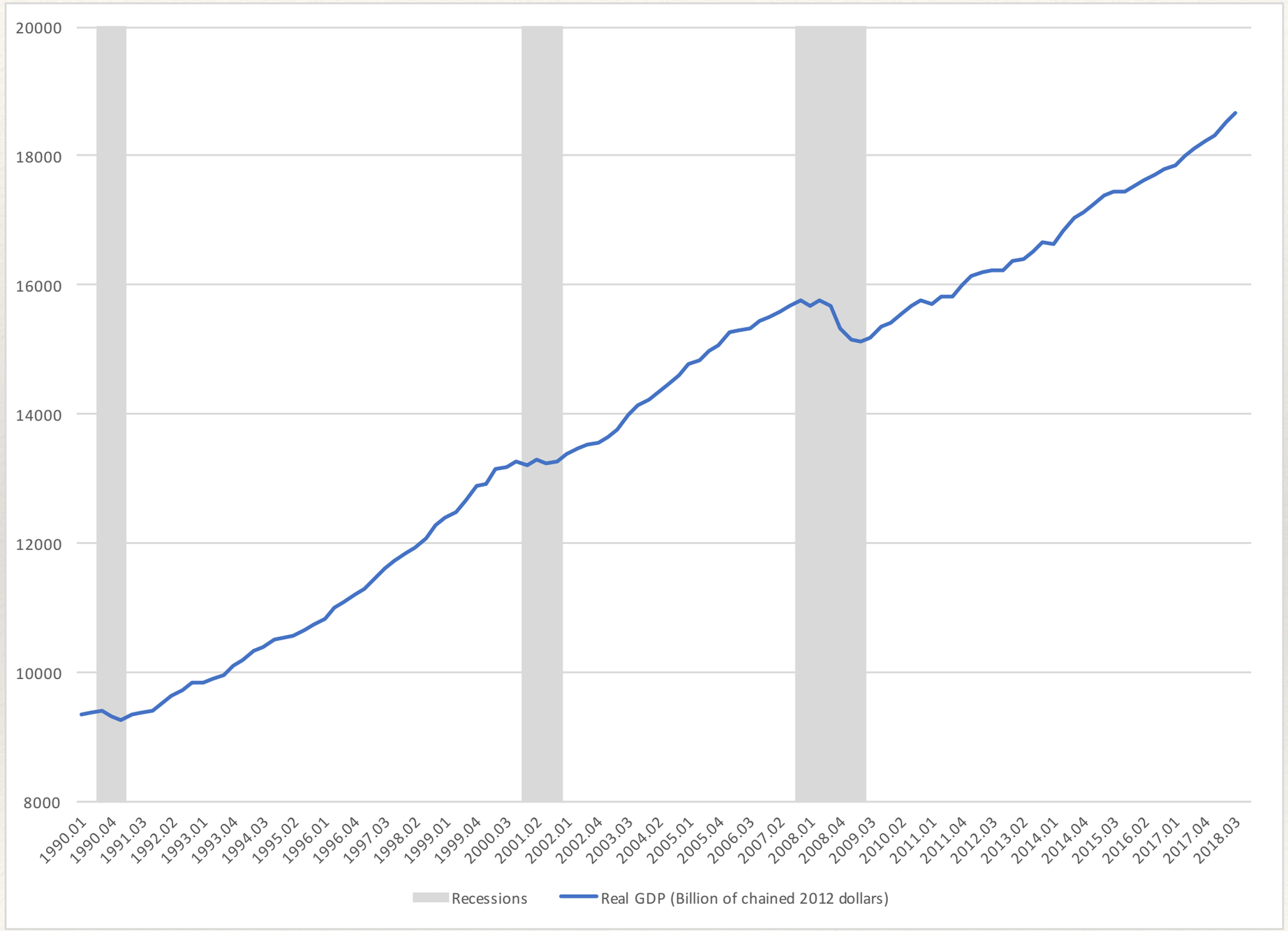
This was the case for example during the recessions of 2001 and 2007-09 in the United States, where both an expansionary monetary and an expansionary fiscal policy were used to fight the recession.

Sometimes, the right mix is to use the two policies in opposite directions, for example, combining a fiscal contraction with a monetary expansion.

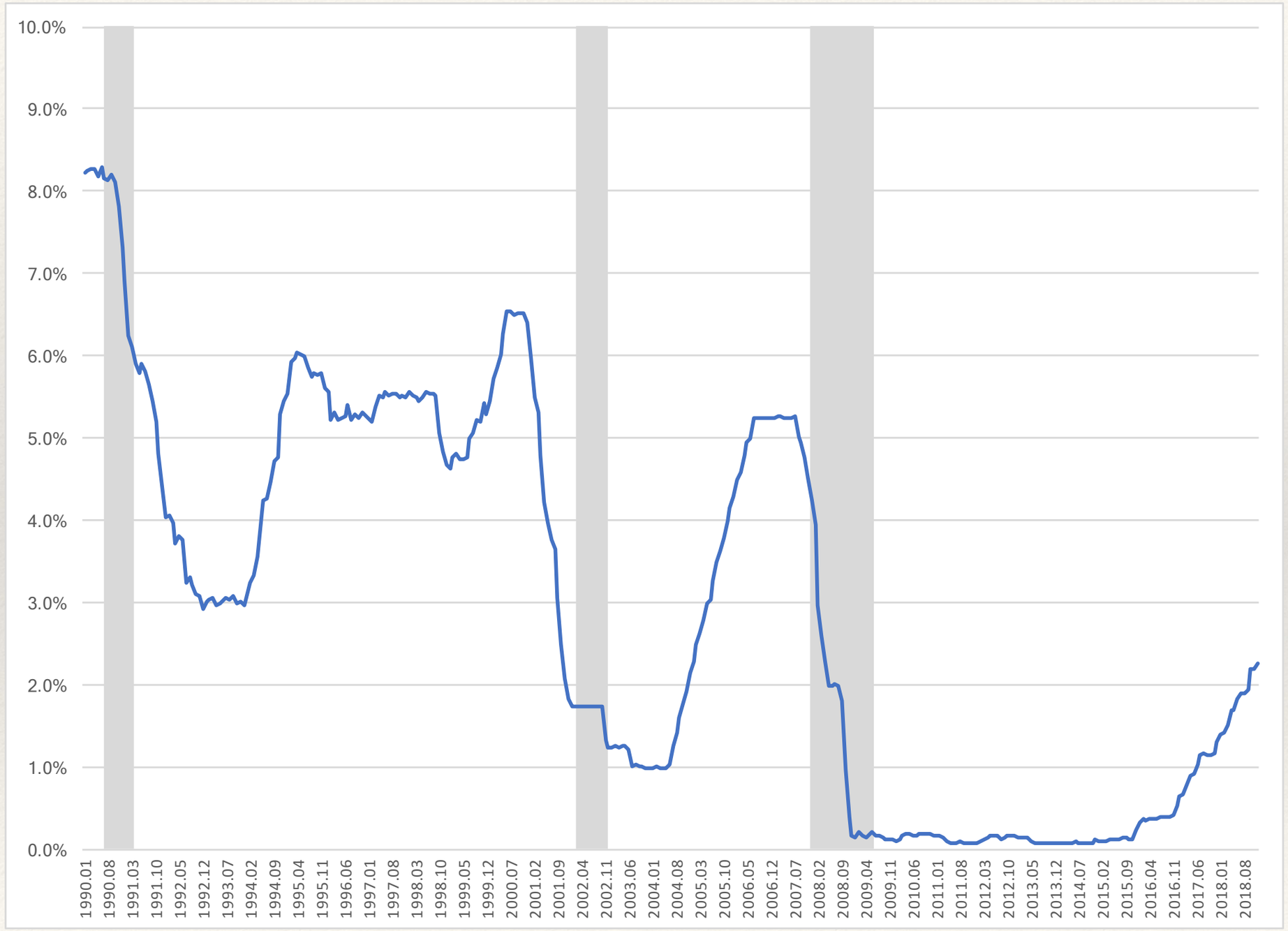
This was the case in the early 1990s in the United States. When Bill Clinton was elected President in 1992, one of his priorities was to reduce the budget deficit, using a combination of cuts in spending and increases in taxes. Clinton was worried, however, that, by itself, such a fiscal contraction would lead to a decrease in demand and trigger another recession. The strategy chosen was to combine a fiscal contraction (so as to get rid of the deficit) with a monetary expansion (to make sure that demand and output remained high). This was carried out by Bill Clinton (who was in charge of fiscal policy) and Fed Chairman Alan Greenspan (who was in charge of monetary policy). The result of this strategy—and a bit of economic luck—was a steady reduction of the budget deficit (which turned into a budget surplus at the end of the 1990s) and a steady increase in output throughout the rest of the decade.

The current policy mix in the USA seems to be a neutral monetary policy, as the Fed has indicated that it will not continue to increase interest rates, and an expansionary fiscal policy, as President Trump has enacted a tax cut and intends to increase government spending for infrastructure investment.

US Recessions since 1990



The Effective Federal Funds Rate and US Recessions since 1990



The Dynamic Response of Output to Changes in Monetary and Fiscal Policy

So far we have ignored *dynamics*. For example, when looking at the effects of a fiscal or a monetary expansion, we made it look as if the economy moved instantaneously from one equilibrium position to another. This is clearly not realistic. The adjustment of output clearly takes time. To capture this time dimension, we need to introduce *dynamics*.

Introducing dynamics formally would be technically demanding. But, we can describe the basic mechanisms in words.

- Consumers are likely to take some time to adjust their consumption following a change in disposable income.
- Firms are likely to take some time to adjust investment spending following a change in their sales.
- Consumers and firms are likely to take some time to adjust residential and business investment spending following a change in the interest rate.
- Firms are likely to take some time to adjust production following a change in their sales.

So, in response to an fall in taxes, it takes some time for consumption spending to respond to the increase in disposable income, some more time for production to increase in response to the increase in consumption spending, yet more time for investment to increase in response to higher sales, for consumption to increase in response to the increase in disposable income, and so on.

In response to a monetary contraction, it takes some time for investment spending to respond to the increase in the interest rate, some more time for production to decrease in response to the decrease in demand, yet more time for consumption and investment to decrease in response to the induced change in output, and so on.

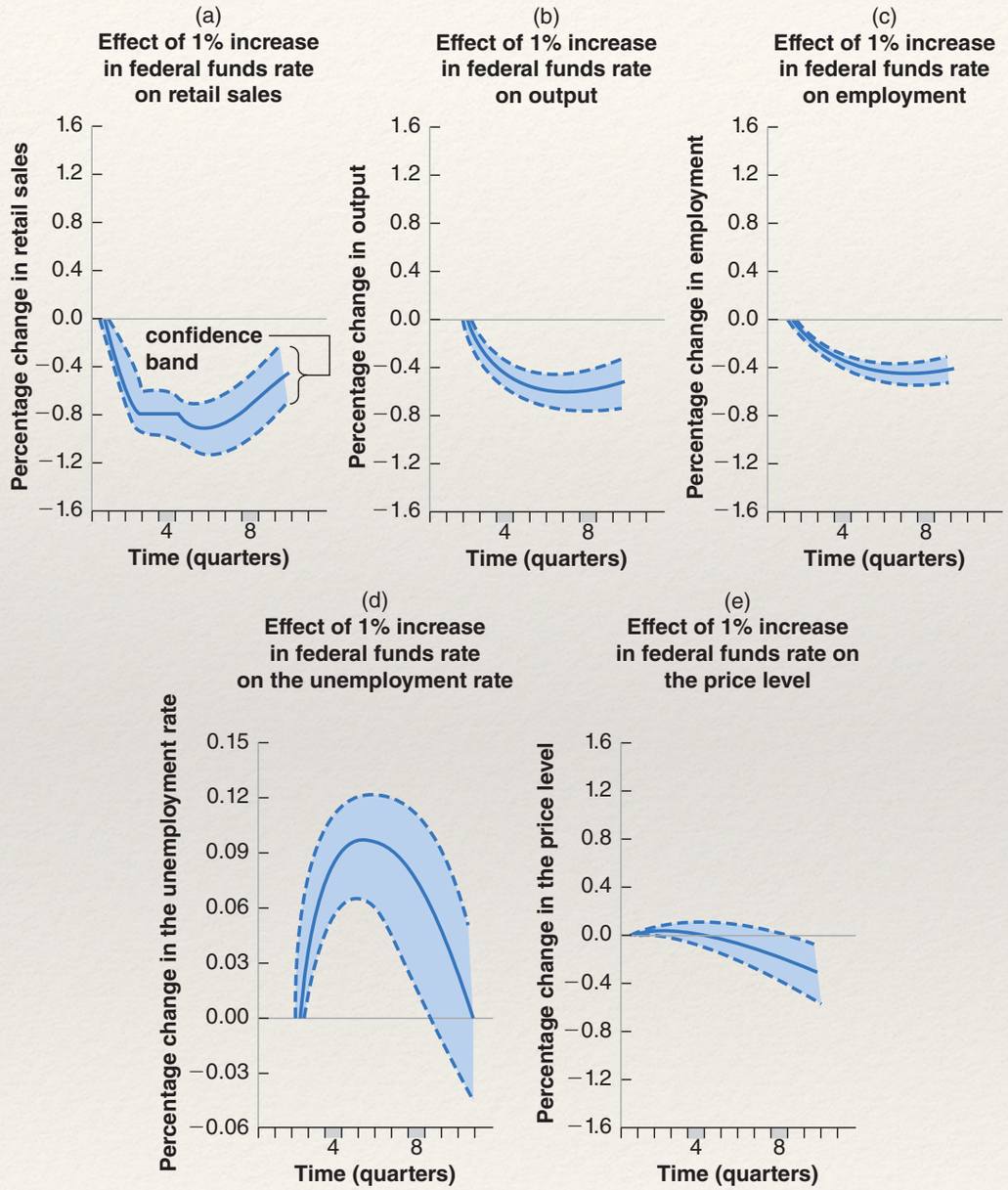
The IS LM Model, the Adjustment Process and the US Economy

Describing the adjustment process implied by all sources of dynamics precisely is obviously complicated. But the basic implication is straightforward: Time is needed for output to adjust to changes in fiscal and monetary policy. How much time? This question can be answered by looking at the data and using econometrics.

Using such a dynamic econometric model by Christiano, Eichenbaum and Evans (1996), we can look at the effects of a decision by the Fed to increase the *federal funds rate* by 1%. This is the main interest rate instrument of the Fed. We shall trace the typical effects of such an increase on a number of macroeconomic variables.

The adjustment is described with the help of the following figure, which depicts the dynamic adjustment of sales, output, employment, unemployment and the price level, following an increase in the federal funds rate by 1%.

Dynamic Effects of a 1% Increase in the Federal Funds Rate



Dynamic Effects of a 1% Increase in the Federal Funds Rate

We can see that an increase in the federal funds rate of 1% leads to a decline in retail sales. The largest decrease in retail sales, - 0.9%, is achieved after five quarters.

Lower sales lead to lower output. In response to the decrease in sales, firms cut production, but by less than the decrease in sales. Put another way, firms accumulate inventories for some time. The adjustment of production is smoother and slower than the adjustment of sales. The largest decrease, -0.7%, is reached after eight quarters. In other words, monetary policy works, but it works with *long lags*. It takes nearly two years for monetary policy to have its full effect on production.

Lower output leads to lower employment: As firms cut production, they also cut employment. As with output, the decline in employment is slow and steady, reaching −0.5% after eight quarters. The decline in employment is reflected in an increase in the unemployment rate.

One can also look at the behavior of the price level. Recall that one of the assumptions of the *IS–LM* model is that the price level is given, and so it does not change in response to changes in demand. This assumption is not a bad approximation of reality in the short run. The price level is nearly unchanged for the first six quarters or so. Only after the first six quarters does the price level appear to decline. This gives us a strong hint as to why the *IS–LM* model becomes less reliable as we look at the medium run: In the medium run, we can no longer assume that the price level is given, and movements in the price level become important.

However, overall, the *IS-LM* model does not fare too badly in the short run.