1. Money, Interest Rates and Investment

- We showed previously that, as an initial working hypothesis, the assumption of a fixed nominal wage appears to hold some promise. However, Keynes wanted to include investment in his model, while he also wanted to explain the determination of the interest rate. To explain the latter concern, we need to discuss some of the debate between economists, at the time Keynes was writing, about the causes of the Great Depression. The prevailing theory of the source of business cycle fluctuations at the time of the Great Depression was that they were primarily the short-term consequence of monetary instability. However, it was also the practice at the time to measure the "stance" of monetary policy by looking at interest rates. Many economists viewed "the price of money" to be the cost of borrowing on the short term money markets. If money was "tight" interest rates were high and vice versa. This contrasts with the view of the classical quantity theorists who viewed the inverse of the general price level as the "value of money". However, given that the quantity theorists argued that the connection between money and nominal prices involved long lags, it did not seem very practical to base daily monetary policy on movements in nominal prices. Furthermore, while it is quite practical to measure the nominal price of particular goods and services on a daily basis it is not possible to continuously monitor the *average* level of nominal prices. Therefore, many central banks, and in particular the Bank of England, focused on movements in interest rates to determine the current stance of monetary policy. A problem with such an operating procedure is that nominal interest rates reflect current expectations for the rate of inflation in prices in addition to real interest rates or the current real cost of credit. In particular, at the height of the Great Depression prices in the United States, were *deflating* at nearly 30% p.a. and this must surely have reduced nominal interest rates. Nevertheless, some economists argued that monetary policy could not have caused the Great Depression because nominal interest rates weren't high enough to suggest money had been very tight. This led Keynes to be interested in explaining the short run determination of nominal interest rates and also

to look for alternatives to money supply changes as a cause of business cycle fluctuations.

- It is quite natural that he should turn to exogenous fluctuations in investment as an alternative source of business fluctuations. He argued that equity markets could be characterized by periods of exogenous swings in investor confidence and that these exogenous movements in equity prices affected the ability of firms to raise funds to finance investment. Keynes talks about investment in the stock market as a game of "old maid" where everyone is concerned with the valuation other investors place on stocks and not the underlying "fundamentals". In terms of our models of a dynamic economy with capital, you might argue Keynes was implicitly suggesting equity prices can deviate from the long run perfect foresight path as investors pay more for stocks only because they expect others to pay yet more for them at a later date. Eventually, these prices are recognized as being inconsistent with the underlying fundamentals, and the period of booming investment financed by the rising stock market comes to a crashing halt.

- One apparent difficulty with his model is that if investors sell equities they could be expected to buy bonds. This would reduce interest rates, making it less costly for firms to raise funds for investment via the bond market. To close off this channel, Keynes emphasized the so-called "liquidity trap". Investors would not flee to bonds but rather to cash, and interest rates would not fall far enough to stimulate investment.

- Keynes emphasized that the demand for money was a demand for *liquidity* and that less liquid assets paying a higher rate of interest were an alternative to holding money. This "liquidity preference" theory of the demand for money enabled him to explain how movements in interest rates could affect the demand for money and in the short run lead to deviations between money supply changes and changes in nominal prices.

- The key notion behind Keynes' analysis is that an exogenous change in investment or savings requires the real interest rate to change (as in the equilibrium intertemporal resource allocation models we have been examining), but then the change in interest rates affects the demand for

money and therefore the equilibrium average level of nominal prices. Stickiness in nominal wages then prevents a rapid adjustment of the economy to changes in desired intertemporal resource allocation.

2. The Textbook IS-LM Model

- The IS-LM analysis of Hicks summarized Keynes' arguments on the interaction between monetary and real phenomena in the presence of fixed nominal wages and exogenous shocks to investment. It is this version of Keynes' model which became the standard expository device for the "Keynesian model".

- To get an idea of the way the IS-LM model works, we shall, for the moment, ignore the labor market (even though this was a centerpiece of Keynes' own analysis). We replace the assumption of fixed nominal wages by one of fixed nominal prices. In the short run, equilibrium in the demand and supply of goods and in the demand and supply of money jointly determine the two endogenous variables – real output and the nominal interest rate (= real interest rate in the presence of fixed prices).

- The demand for goods consists of a demand for consumption and a demand for investment goods. Again we shall ignore some of the detail of Keynes' analysis by not distinguishing between "investment goods" and "consumption goods" but merely talk about aggregate output as a homogeneous good. Equilibrium in the goods market requires that

$$y = c + i \tag{1}$$

  where, y = the level of output, c = consumption and i = investment.

- Households are assumed to decide on their level of consumption and savings by allocating their current income on the basis of current interest rates:

$$c = f(r, y) \tag{2}$$

(this contrasts with the real business cycle and growth models where consumption depends on *wealth* rather than current *income*. This issue will be discussed in more detail later.)

- Keynes postulates as a "fundamental psychological law" that the elasticity of consumption with respect to income is less than 1 so that, as income increases, consumption increases less than proportionately:

$$\frac{y}{f}\frac{\partial f}{\partial y} < 1 \tag{3}$$

We shall also assume that substitution effects dominate on average so that increases in r increase savings and so reduce consumption.

- Having determined their level of savings, households then allocate those savings between money and interest paying assets on the grounds that:
(i) higher income increases the demand for money for transaction purposes, as in the classical quantity theory of money
(ii) higher nominal (*and real with* p *fixed*) interest rates reduce the demand for money.
This leads to the money demand function:

$$\frac{M}{p} = L(r, y) \tag{4}$$

with $L_r < 0$ and $L_y > 0$.

- Investment is determined by firms and depends positively on the current level of output and negatively on the current nominal rate of interest. In addition, Keynes argued that the desire to invest was unstable and much governed by "whims" and "herd instincts". We can represent this by an exogenous shift parameter α in the investment function:

$$i = g(r, y, \alpha) \tag{5}$$

- The product market equilibrium condition leads to a relationship between y and r called the IS curve:

$$y = f(r, y) + g(r, y, \alpha) \tag{6}$$

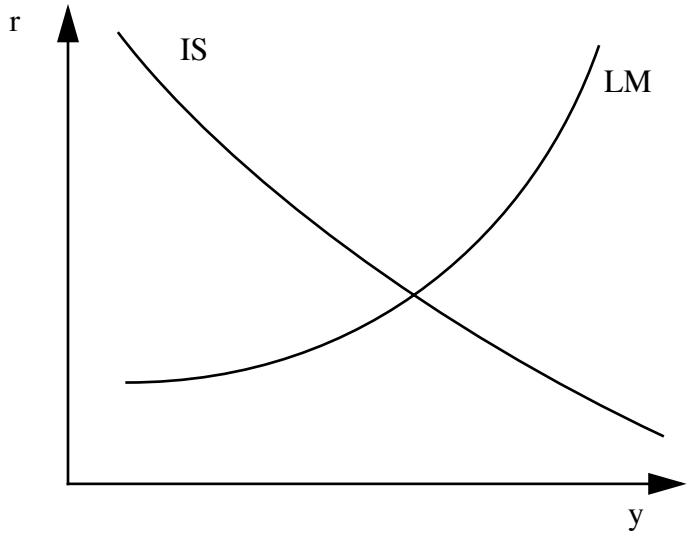
Totally differentiate this equilibrium condition to find

$$1 = \frac{\partial f}{\partial r}\frac{dr}{dy} + \frac{\partial f}{\partial y} + \frac{\partial g}{\partial r}\frac{dr}{dy} + \frac{\partial g}{\partial y} \tag{7}$$

which can be rearranged to yield

$$\frac{dr}{dy} = \frac{1 - \frac{\partial f}{\partial y} - \frac{\partial g}{\partial y}}{\frac{\partial f}{\partial r} + \frac{\partial g}{\partial r}} \tag{8}$$

- Then the assumptions on f and g imply the denominator of this derivative is negative. Also, it is usually assumed that the "marginal propensity to consume" out of income plus the marginal effect of higher output on investment are less than 1. In that case the IS curve will be negatively sloped in the (y, r) plane.



- Equilibrium in the supply and demand for money with M and p exogenously given also leads to a relationship between y and r called the LM curve:

$$L(r, y) = (M/p)^* \tag{9}$$

Totally differentiating this equilibrium condition (9) we find

$$\frac{\partial L}{\partial r}\frac{dr}{dy} + \frac{\partial L}{\partial y} = 0 \tag{10}$$

so that

$$\frac{dr}{dy} = -\frac{\partial L}{\partial y} \Big/ \frac{\partial L}{\partial r} \tag{11}$$

which is positively sloped in the (y, r) plane.

3. Comparative Statics

- We can use the IS-LM diagram to study the effects of changes in some of the exogenous variables. Consider first an increase in the money supply M. This will shift the LM curve to the right and leave the IS curve unaffected. Output y will increase, so there will be pro-cyclical movements in M which corresponds to our observations. However, r moves counter-cyclically and there is considerable doubt whether this corresponds with the evidence. Our observation of the data suggested r tended to be relatively high as the economy went into a downturn but then tended to decline along with output as the recession got under way. Similarly, low interest rates tended to precede periods of rapid output growth but then rise along with GNP at business cycle peaks.

- An increase in the shift variable α will move the IS curve to the right and leave the LM curve unaffected. The result will be a pro-cyclical movement in both y and r, which is usually thought to be more consistent with the evidence (although as we noted above, the correlation between

movements in interest rates and output is weak). To explain the pro-cyclical movement in M we could add the assumption that the monetary authorities "accommodate" the expansion - with higher interest rates following the investment boom, the authorities expand the money supply. So long as this expansion in the money supply is not too large, interest rates can still rise overall. In this scenario, the causality will run from interest rates to money supply changes rather than money supply being the exogenous driving factor.[1]

- We can also examine the effects of changes in exogenous variables using algebra. Collect the equilibrium conditions together to get

$$y = f(r, y) + g(r, y, \alpha) \tag{12}$$

$$L(r, y) = (M/p)^* \tag{13}$$

Now totally differentiate (12) and (13) with respect to α to get the matrix equation:

$$\begin{bmatrix} 1 - f_y - g_y & -f_r - g_r \\ L_y & L_r \end{bmatrix} \begin{bmatrix} \frac{dy}{d\alpha} \\ \frac{dr}{d\alpha} \end{bmatrix} = \begin{bmatrix} g_\alpha \\ 0 \end{bmatrix} \tag{14}$$

The determinant is given by

$$\Delta = (1-f_y-g_y)L_r + (f_r+g_r)L_y < 0 \tag{15}$$

and the solutions for the derivatives by

[1] This idea of accommodating money supply expansions has difficulty explaining a *lead* of money supply growth over movements in output, but some economists doubt whether this corresponds with the facts. The idea that money supply changes are endogenous accommodating movements would also have difficulty accounting for the evidence of a link between money and output provided by Hume and other economists writing before there was a central bank. The idea of reverse causation from output movements to changes in the money supply has recently regained popularity in the works of the real business cycle theorists.

$$\frac{dy}{d\alpha} = \frac{g_\alpha L_r}{\Delta} > 0 \tag{16}$$

$$\frac{dr}{d\alpha} = -\frac{g_\alpha L_y}{\Delta} > 0 \tag{17}$$

as we noted by examining the IS-LM diagram. Also we have:

$$\frac{dc}{d\alpha} = f_y \frac{dy}{d\alpha} + f_r \frac{dr}{d\alpha} \tag{18}$$

and (18) is greater than zero if $|f_y| > |f_r|$ and $|L_r| > |L_y|$ as we shall assume. Also,

$$\frac{di}{d\alpha} = \frac{d}{d\alpha}(y - c) = (1 - f_y)\frac{dy}{d\alpha} - f_r \frac{dr}{d\alpha} > 0 \tag{19}$$

so that consumption and investment both move pro-cyclically in response to an α shock. Furthermore,

$$\frac{d}{d\alpha}(i/y) = y^{-2}\left(y\frac{di}{d\alpha} - i\frac{dy}{d\alpha}\right) = y^{-2}[y(1 - f_y) - i]\frac{dy}{d\alpha} - y^{-1} f_r \frac{dr}{d\alpha} \tag{20}$$

But

$$y(1 - f_y) - i = c - y f_y = c\left[1 - \frac{y}{c}\frac{\partial f}{\partial y}\right] > 0 \tag{21}$$

The final inequality in (21) follows from Keynes' "fundamental psychological law". Thus the investment-output *ratio* moves pro-cyclically in response to α shocks as appears to be the case in practice.