An Explanation (Using the ISLM Model) of How Volatility in Expectations About the Profitability of Future Investment Projects Can Make Aggregate Demand Itself Volatile.

The ISLM model is a combination of two economic models; those of interest and savings (IS), and liquidity preference and money supply (LM)[1]. To fully understand the effects of changes in the various elements of the model, it is necessary to examine the two major components in further detail.

The IS curve is derived initially from the general equation for aggregate demand. It can be quite easily proven that, in a closed economy, the total demand, *y*, is given by:

$$y = c + i + g \ ,$$

where *c*, *i* and *g* are defined as desired consumption, investment and government spending respectively. It can also be derived (but will not be here, as only the final results are relevant) that consumption is given by the equation:

$$c = a + by \ ,$$

as per J M Keynes' theory of the consumption function[2] (the two other variables are an autonomous element and the marginal propensity to consume respectively); and that investment can be defined in terms of the real rate of interest:

$$i = I_{\mathbf{0}} + h(r^m - \dot{P}^e) \ ,$$

as described by D W Jorgensen[3] (I_0 is, again, an autonomous element (the depreciation of existing capital goods, while *h* represents the sensitivity of investment to changes in the real interest rate). The derivation of income expenditure is, obviously, of higher importance here, and shall be examined in greater depth later. Finally, it can be assumed that *g* is an exogenous constant, and is fixed by an independent body.

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[1] The ISLM model was first developed by Sir John Hicks, who also named the IS and LM graphs. The IS curve shows those levels of income and interest at which investment equals savings; the LM curve shows those levels of income and interest at which money demand (which Keynes called liquidity preference) equals money supply. These definitions are expanded on in the essay.

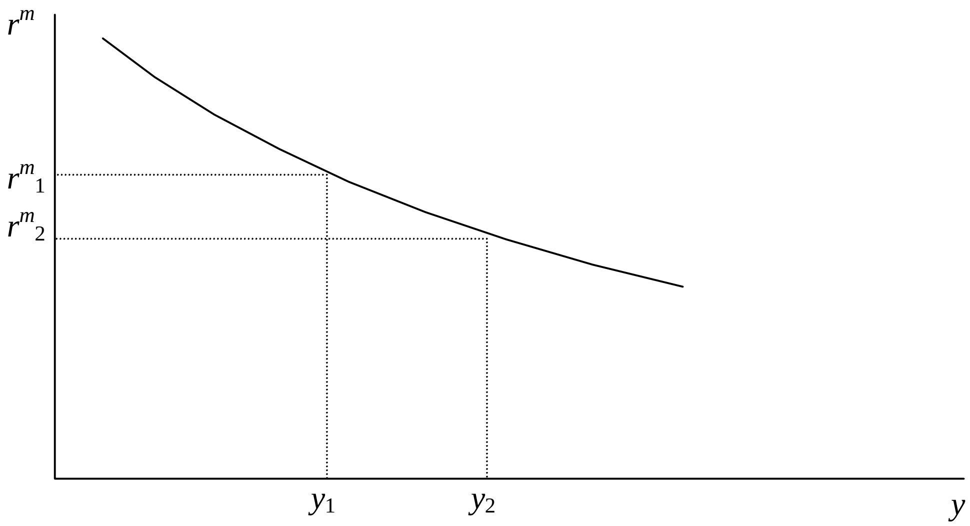
[2] See also Miller (1996)

[3] Jorgensen (1936)

By combining the above equations, and looking at the model intuitively, we can see that aggregate demand will be influenced by real income, interest rates, expected inflation, and changing levels of government expenditure. However, by noting that we assume the actual expenditure in the economy (which here is represented by the aggregate demand) is equal to both the actual income and the actual output, we may find that:

$$y = \frac{a + I_0 + g - h(r^m - \dot{P}^e)}{1 - b}.$$

This equation is said as defining the IS curve; it shows how saving (which is defined as income minus consumption) varies, in a two-sector economy, with investment expenditure. The curve itself traces out levels of income and interest rates at which the two factors mentioned are equal; that is, where injections into the economy are equal to withdrawals from the economy. This defines equilibrium, as otherwise income will either be rising or falling as households are given more than they give, or vice versa. From examination of the above equation, it can be seen that income and interest rates are negatively proportional; that is, the IS curve takes on a shape similar to the following:



This shape can be explained by considering how aggregate demand (and thus income) is built up of investment and consumption components. If we assume both government expenditure and the expected rate of interest are exogenous (and so we label the curve $IS[g_1, \dot{P}^e{}_1]$), we can examine the effects of a change in income. Consumption is considered as a 'sticky' variable – that is, it does not alter instantaneously. Therefore, any change in interest rates will, initially, only affect aggregate demand through the investment function described above (and to be discussed below). Changes in this aggregate demand (and therefore also income) will alter the consumption element over time, but by an amount less than the initial increase in income.

The direction of influences on the level of aggregate demand is obviously important here; it can be stated that a rise in interest rates will make saving more attractive than borrowing for investment, and so aggregate demand (and thus income) will fall. This can be added to the above paragraph to determine the shape of the IS curve; it is known that investment and consumption will alter in the same direction, and now it is known that a fall in interest rates leads to a rise in income. The graph drawn above follows.

To look at the other side of the ISLM model, that of supply of and demand for money, it is first necessary to define clearly some otherwise vague terms. It is fundamental, for example, to define 'money' as a form of financial asset that is readily exchangeable for goods and services; the 'demand for money' would otherwise be infinite and the following analysis would be impossible.

The demand for money, therefore, is the amount of financial assets people wish to hold in a form that does not earn interest but can be used as payment for goods. This will, it is assumed, be a finite value, as consumption demands are limited over short periods of time, and income is another limiting factor. Any other assets will be held as bonds, earning interest and increasing potential consumption in the next time period. Money demand will also be defined to be a real value; that is, changes in monetary value due to inflation will be excluded from this model.

There are two major influences on the demand for money thus defined. Aggregate real income is perhaps the most obvious, as it can quite easily be assumed that an increase in income will lead to a greater demand for consumption, and thus a greater need for money. The rate of interest on bonds is the other main factor, as can be partially seen from the definition of money demand; assets are held as either money or bonds, and anything that makes either of the options more attractive will bias the ratio in its favour. Money demand is thus negatively proportional[4] to the rate of interest. From this we can derive an equation for the nominal demand for money, m^d, in terms of income (y), the general price level (P), and the general interest rate (r^m):

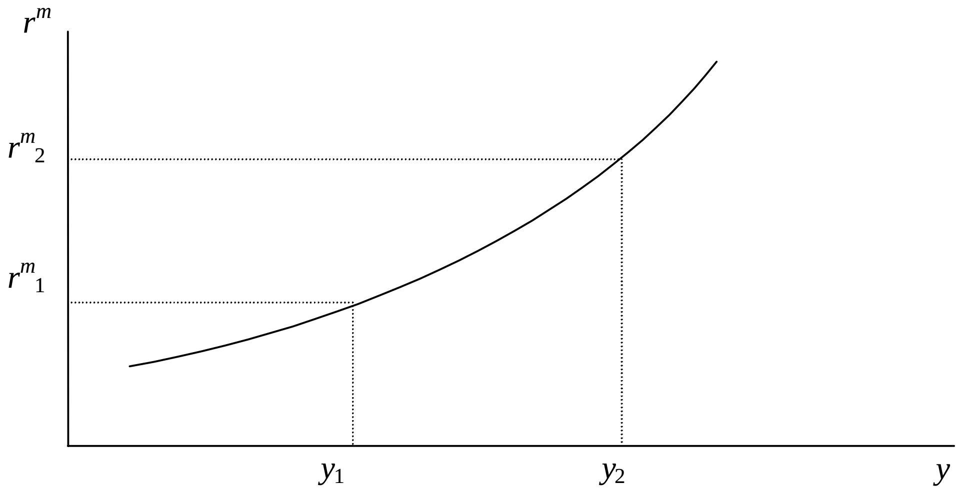
$$m^d = P(ky - lr^m),$$

where k and l are positive constants, representing the sensitivity of money demand to changes in income and interest rates respectively.

The supply of money, conversely, is very easily (and obviously) defined; it is the amount of liquid assets manufactured by the country's government and released into circulation. As this is not influenced directly by any of the variables in the ISLM model, it shall be assumed to be exogenous, and normally constant.

It is these definitions that lead to the derivation of an equation for the LM curve, and the corresponding graph:

[4] Note the use of the phrase 'negatively proportional' rather that 'inversely proportional'; the latter implies that one element varies with the inverse of the other (that is, one divided by it), while the former implies that the two vary directly, but with one of the elements made negative.

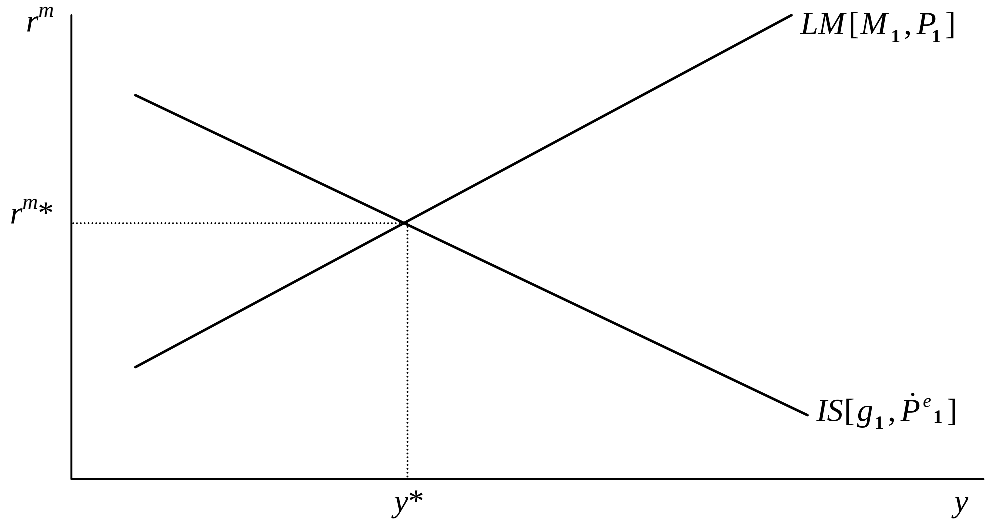


This graph is quite easily found from the equations for money demand and supply – in equilibrium, as always, supply and demand must be equal (and if they are not, there will be forces acting to make this so), and so the LM equation can be found by simply substituting an exogenous *M* (money supply) into the demand for money formula:

$$y = \frac{\overline{M}}{kP} + \frac{lr^m}{k}.$$

Again, it is necessary to assume that certain factors are constant to draw the graph from this equation, in this case *M* and *P*. The LM curve is thus written $LM[M_1, P_1]$, and further analysis may reveal that variations in money supply and price levels have the effect of purely shifting the LM curve.

Now that the IS and LM models are complete, it is possible to combine the two to find a model for aggregate demand in an economy. By definition, an economy in equilibrium will be on both the IS and LM curves, as total withdrawals will equal total injections, and money demand will equal money supply. However, because of the shapes of the functions, it can be seen that there is only one place at which this is true, and so equilibrium aggregate demand will be at a position where the IS and LM curves cross:



It can be seen that this leads to the conclusion that aggregate demand is influenced directly purely by the levels of money supply, general prices, government expenditure, and expected inflation; and these factors also determine the interest rate. This is, therefore, obviously a simplified model, but it can be shown that these four factors are the strongest influences, and so the model remains approximately valid.

The aggregate demand curve is then found, from this model, by varying the general price level and thus shifting the LM curve (to the right for a fall in prices, to the left for a rise). The shift in LM curve will vary according to the original price, and it would be observed that the aggregate demand curve evolved to be hyperbolic in shape.

In purely algebraic terms, it is possible to equate the two formulae for income (or aggregate demand), and obtain the formula:

$$y^d = \frac{a + I_0 + g + h\dot{P}^e}{1 - b + hk/l} + \frac{Mh}{P[(1-b)l + hk]},$$

which will help to look at how demand will alter following changes in the individual elements, or, more specifically, in investment.

Before any conclusions can be drawn in this area, however, it is first necessary to examine the investment function,

$$i = I_0 + h(r^m - \dot{P}^e),$$

in greater depth. It is first assumed that consumption is fixed, and so any excess income may be spent in one of two ways; on bonds (with a fixed rate of interest), or on investment. By the law of diminishing returns, the amount of gain from investment will fall with each extra unit of money invested, while the rate of return from bonds stays the same. A rational consumer will therefore invest up until the point at which bonds become a more attractive proposition, that is, where the rate of return from investment equals that of bonds. The rate of return for bonds is simply the interest rate; the rate of return on investment is found by adding the value of services gained (r_1) to the expected inflation rate ($\dot{P}^e$), and taking away the amount spent on depreciation (d).

Equating these two statements, a general formula is obtained:

$$r^m - \dot{P}^e = r_1^{\,e} - d^e;$$

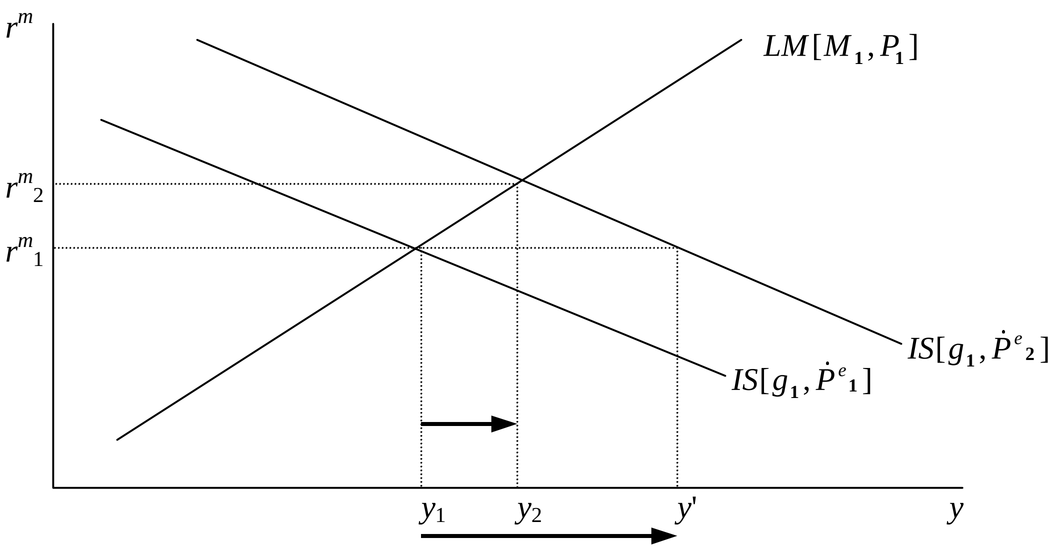
and, from this, we can see that the optimum level of investment is determined by a function of the rate of interest and the expected inflation rate. This is the point at which optimism is introduced, in that higher optimism leads to a higher expected rate of return and a lower depreciation rate, and from the formula this must all be balanced by an alteration in the expected inflation rate.

Finally, it is assumed that investment expenditure is a linear function of the real expected interest rate (that is, the interest rate minus expected inflation), and, knowing that depreciation must be included in the formula and that it will be roughly constant due to the very large stock of capital in most economies, the investment function is revealed as that described in the first part of this essay.

So, then, it is now possible to look at varying expectations in the profitability of investment projects. As mentioned above, the main (and possibly only) indicator of varying optimism in the ISLM model will be the expected rate of inflation, which in turn will vary with the values for the expected rates of return on investment, and depreciation. It is the effects of changes in this variable, therefore, that must be examined to determine how volatility in expectations affects aggregate demand.

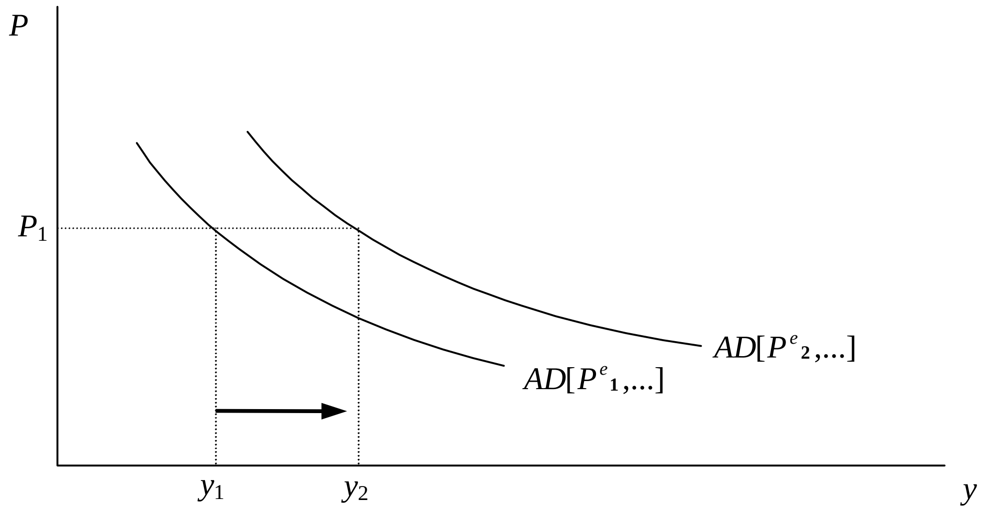
Any volatility in optimism, and therefore in expected inflation, will lead to shifts in the level of investment via the investment function described above. A fall in expected inflation will increase future values of money, and investment will become less attractive compared to bonds; the real rate of interest will have risen. From this, and by looking directly at the equation derived for the IS curve, it is possible to deduce that varying optimism will cause the IS curve to shift, to the right for increases in expected inflation, and to the left for decreases.

Transferring this to the ISLM model, we can see how shifts in the IS curve will affect the equilibrium level of aggregate demand for any given price level:



A shift in the IS curve to the right (caused, as determined, by an increase in expected inflation) will therefore result in an increase in aggregate demand, but (as can be seen on the diagram above, comparing the arrow $y_1 \rightarrow y_2$ with the arrow $y_1 \rightarrow y'$) the increase here $(y_2 - y_1)$ will not be as large as the original shift in the IS curve $(y' - y_1)$. The fraction of the original shift by which demand will increase is determined by the slope of the LM curve, which in turn represents the responsiveness of income and interest rates to changes in the money supply (a steeper curve indicates larger responses).

The amount demand (and income) will rise is, however, the same, regardless of the original position of the IS curve, for the same shift in IS. It can be deduced from this that the overall effect of the shift in IS will be to shift the entire aggregate demand curve to the right by the amount represented by the bold arrow in the last diagram:



It is, however, not the effect of a specific movement in optimism being studied here, it is the volatility of this variable. The volatility of the IS curve will be of a similar magnitude and variance, and it can be gathered from the specific case outlined above that any changes in the IS curve will lead to a smaller but proportional shift in aggregate demand. By considering this case in both directions it is possible to see that volatility in the IS curve (due to volatile expectations) will lead to a smaller degree of volatility in aggregate demand, but the volatility will still exist.

Finally, this result can be considered intuitively; it is known that investment is only one part of aggregate demand, and the other factors are more or less (and assumed to be) independent of optimism (and, especially, as defined in the title, referring to returns on investment!). Investment itself contains an autonomous element, and a multiplying factor. The expected inflation rate is, therefore, a very small proportion of the total demand in the economy, and will have less of an effect on it than on anything directly examining investment. Rises in aggregate demand will, therefore, not be as significant as rises in investment functions.

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