IS-LM: An Update

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Abstract

IS-LM is the model which every undergraduate economics student is taught in their intermediate macro course, because it is very intuitive and at once explanatory. However, the more one reads, the more one realizes that it has been critiqued for anything from excluding basic Keynesian principles, to Pasinetti's Timing problem, and the model is no longer considered useful by academics for theory or representative of the economy. There is however a lot to be taken from this model yet, and by making it dynamic and consistent with the real operation of an economy the models one can get a very powerful and useful result. On top of which, this dynamic model can be taught to undergraduates with the simple exposition of the original IS-LM model. This is facilitated by removing the generalized assumptions about money market functioning and foresight. Rather expectations based on past events (not necessarily rational), and a second future interest rate, as Keynes had in his general theory, are introduced. Further, specific institutional characteristics for the UK are imposed on the model. So the stock market and the Bank of England are included, leading to changes in money demand and substituting a fixed money supply function with an unlimited supply at a given interest rate, leading to an upwards sloping Ms (according to the workings of the central bank). The net effect of this is the conversion of the LM curve into a Flow constraint, and by allowing agents to 'remember' past events, it is shown that information dating back 12 months, influence choices in the economy, to a large extent. By making the model country specific (and removing institutionally incorrect assumptions), the model becomes not only *dynamic* but the economy becomes *cyclical*, as the IS and LM curves *pivot* in response to institutional and agent choices, creating a business cycle endogenously.

Why use IS-LM?

The discipline of economics may present a unified face to the world, but underneath this mask, there is a vast diversity in how questions of economic policy and economics itself are approached. What is most often found is that orthodox economics is criticized for being overly idealized and so abstract from reality, that it explains and predicts little of the world we live in – often defended on the basis of doing positive economics. Heterodox economics (as wide a definition as that may be), is then counter-accused of not being able to come up with a consistent set of models and theories to explain the workings of an economy – generally defended on the basis of real complexities.

The IS-LM system is generally the first 'complete' economic theory presented to students, because of its simple and intuitive exposition of a complicated argument. It allows a few theoretical positions (monetarist, neo-classical and 'Keynesian') to be highlighted through the slopes of the curves within a very orthodox and simple framework.

It is the aim of this paper to update the static IS-LM textbook framework[1], and change it into a dynamic model which, despite it simple exposition will give new insights both into the economy and theory. It will show how the economy, and its responses, changes over time, and how policy affects the economy differently. This will be achieved while keeping the results as intuitive and simple to understand as in the traditional static model.

By re-introducing some of Keynes' 'forgotten' principles and making actual institutions and empirical data endogenous to the IS-LM system can lead to outcomes which are both original and relevant (despite the abstract nature of the frame). As will be shown, multiple schools of thought naturally appear in the model, as its dynamics carries us through scenarios which various schools propose, but none unify.

The model is initially updated by bridging two gaps Hicks left between himself and Keynes in the original Paper on IS-LM models (Hicks 1937). This means removing Hicks' assumption of zero elasticity of expectations, and re-introducing a second 'rate of interest' into the model. This is achieved by including the London Stock Exchange into the money demand function, thereby changing the liquidity preference schedule. And

[1] By this is meant the Hicks-Hansen version of the model, which dominate textbook expositions.

then looking at investment models to try and determine how an aggregate of firms make investment decisions. The often discussed problem of simultaneous stock -and flow equilibrium is dealt with, by specifying the duration of periods and through a method for showing how planned investment and savings are decided, using observed and unobserved variables, to determine equilibrium.

This in turn will show that the IS and LM curves *shift* as a result of policy and *pivot* as a result of changing expectations *simultaneously* throughout the business cycle. This can in turn be used to show how Monetarist, 'Keynesian' and Neo-Classical IS-LM depictions can be brought together, while highlighting some of the Post-Keynesian theories, which can be seen in this exposition. Further it should also be able to demonstrate how IS-LM analysis can be used for showing the state of the economy at a given time, and thereby identify which type of policies will be better for promoting growth and stability, and further how the economy will respond to policies and changes in expectations.

The assumptions left from the original which have not been changed are that this is a short run model, in the sense that capital is fixed in every period, while depreciation is not included, and labor is treated as homogenous[2].

1. Redrafting IS-LM background

It is expectations and institutions which lay the foundations for this re-drafting of the IS-LM model. A main point of Keynes' general theory was expectations of the future both in the money markets and real markets, and its effect on output. This is one of the great omissions from the IS-LM framework, and it has been criticized by multiple sources which are summed up by Robert Brazelton:

> The IS-LM formulation developed into what Richard Chase (1975) refers to as the "United States variant of Keynes" and what Joan Robinson calls "bastard Keynesianism" (1971 p.70)… Furthermore, macroeconomists using the IS-LM

[2] I assume that the reader has knowledge of the IS-LM system, but for a full exposition see Mitra-Kahn (2004) for both technical details and it history. The slope variables are repeated here: The slope of the IS curve is the marginal propensity to save over the interest sensitivity of investment, and the slope of the LM curve is the interest rate sensitivity of money demand over the income sensitivity of money demand.
IS slope: $\frac{\partial r}{\partial Y} = \frac{-(1-c)}{i}$ Lm slope: $\frac{\partial r}{\partial Y} = \frac{c_1}{c_2}$

> model often assume that the schedules are constant, or else they assume "zero elasticity of expectations" (Brazelton 1980: 260)

This argument, and the omission of a second interest rate from the IS-LM framework[3], validates the oft repeated point that the IS-LM model is not a 'true' representation of Keynes' economy. The problem has always been to incorporate something as intangible as expectations, and then aggregate them into a total, which can be of statistical use and easily explained in a model, while simultaneously introducing a second interest rate.

1.1 Country specific modeling

One thing needs to be made clear; every economy is different from the next. There is no reason to believe that all economies will respond to the same changes the same way. This is the reason economists undertake econometric testing across nations to apply general theories to individual cases. A different approach is taken here, where I will try to create a model for a particular economy first, and then attempt to tease a few general statements out of it at the end only.

This paper is modeled on the British Economy and seeks to apply British institutional, structural and expectation standards as a result.

According to macro economic accounting there are three ways of measuring Gross Domestic Product (Y). Using the income approach, we know that all the income made in the economy, sums up to Y. From this we can infer that a positive change in Y will be equivalent to a general income rise. Individual household changes will depend on the distribution of income.

For the UK, the statistical implication is that the Real Household Disposable Income (Y_d) is directly comparable to Y [4]. The key is that people are aware of differences in income gains across the economy, and recognize these as a fact of life.

[3] In Keynes General Theory (1937), the liquidity preference schedule depends on the current interest rate and a future expected rate, this second rate has been eliminated in the Hicks-Hansen IS-LM framework.
[4] This is shown clearly by the Office for National Statistics [ONS] (2003) in the blue book; page 20 in particular.

Households and thereby consumers are able to observe Y_d at the start of any given period, as the variable is in their control. Assuming households are trying to optimize their welfare, we would assume that they want as much information as possible, but due to the timing of statistical releases, and the lack of clairvoyance of the average person, it is impossible for them to know such variables as aggregate money demand or Y unless data is released by the Bank of England (BoE) or the Office for National Statistics (ONS). They could base their spending plan on only Y_d, but that would make for very poorly informed opinion, and we can justifiably say that households will try to form some sort of idea of how the economy is doing, but to do this, expectations must be formed.

1.2 Money Supply

Assuming the classical vertical money supply curve is unrealistic for the UK for two reasons. Firstly the BoE does not operate a fixed money quantity target. Secondly they cannot control the monetary base of the economy, due to such factors as stock market creation of wealth and commercial banks being able to create money by lending on electronic balances. So assuming the money supply to be exogenously set by the Bank is in the words of an anonymous BoE employee.

> Every economist assumes the Bank of England can set a quantity of money to supply, every person who ever worked for the bank, knows we cannot.

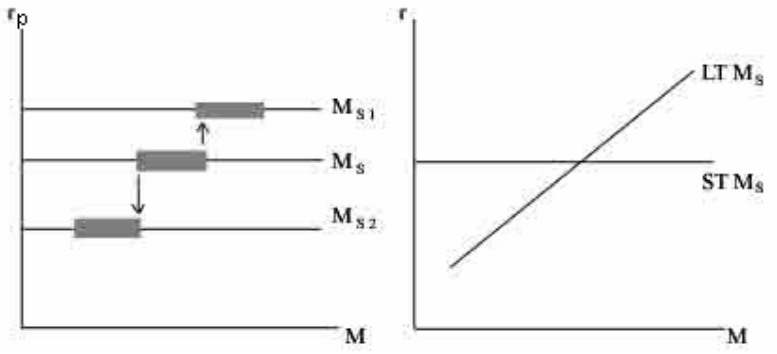
Similarly, one of Hicks' original justifications for the horizontal LM slope was that

> there is a maximum to the level of income which can possibly be financed with a given amount of money. (Hicks 1937: 154)

But if we have a look at the actual workings of this economy, we find that this picture is not just inadequate, it is wrong. Money in the UK is supplied by the central bank, which is the monopoly supplier of currency, and has been independent since 1997. The Bank has to reach certain targets set by the government, but also before its independence it operated in much the same way, although under stricter government control. At current, the bank will supply *any amount* of money that is demanded by the economy at a given interest rate. The UK money economy suffers from a chronic shortage of liquidity (BoE 2002), and money is released every morning, and sometimes in the afternoon by the BoE

unto the money markets. When the Bank of England deems money demand (M_d) (an observable variable to them) too high at a given repo-rate (r_p) (the rate at which it lends to the money market), it will increase r_p shifting M_S to $M_{S\,1}$ in figure 1, in order to restrain money demand. Conversely, should money demand be deemed to low at a given rate (i.e. to the left of the gray box on M_S), the Bank will lower r_p shifting M_S to $M_{S\,2}$ to sustain the chronic shortage of liquidity. The bank changes this repo-rate on a daily basis, and then the BoE's Monetary Policy Committee (MPC) meets once a month to set the overall interest rate (r).

Figure 1: Money Supply and the Bank of England



Based on BoE (2002).

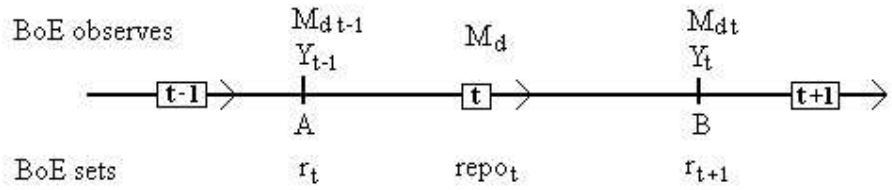
The repo-rate is a direct result of daily money demand, and the ensuing monthly interest rate setting by the bank, is a result of the money demand they have observed over the last period and their expectation of the level of money demand in the next period. This gives rise to a horizontal short run money supply, while the long term money supply should slope upwards, as higher rates will be enforced when observed money demand rises over time. Thus, interest rate setting at time *A*, depends on the last periods real money demand observed (and thus repo rate set) by the BoE, plus their expected money demand for the next period.

$$r_A = f\,[\, M_{d\,t-1} + E(M_{d\,t+1})\,] \qquad (1)$$

Another way of illustrating this is over a timeline where it is evident that the bank, when setting r_t, can only observe the previous periods growth in Y and M_d, as their values for the next period are still to be determined. The BoE sets r in a *single instance* event, but

changes the repo-rate to respond to daily money demand changes, *during* the time interval (t) between each rate setting,

Figure 2: Bank of England timeline for decisions and their basis



1.2.1 Expectations of the interest rate

The interest rate serves a dual purpose, firstly it sets the price of borrowing and lending with the central bank, which in turn means it is carried through to consumers and firms' interest rates. As such it works as an incentive device for investment and saving.

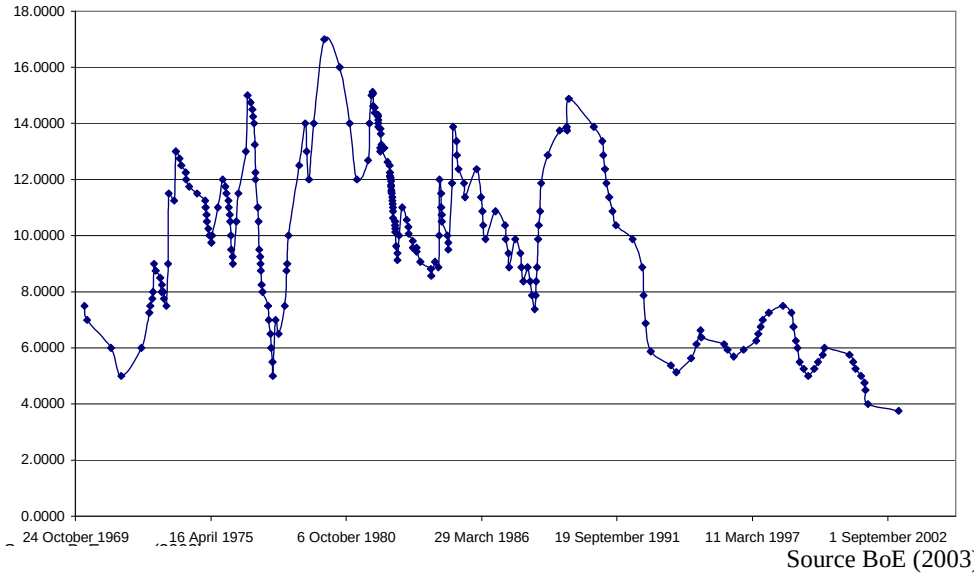
Secondly it indicates how well the BoE thinks the economy will be doing, as the BoE's rate setting is a response to past trends in M_d, and *expected* changes in M_d, so the bank is signaling where in the business cycle it thinks the economy can be found. We must recall that consumers (and firms) cannot observe aggregate money demand, and are as such dependent on the Bank of England's estimations of the variable.

All agents can observe any change in the interest rate after the MPC meet. No matter the outcome of the MPC meeting, stock markets, currency markets and consumers will have made certain expectations of the next rate change, and they will know how to interpret this well publicized variable.

Even if agents' predictions are incorrect, due to some lack of information, they are able to respond to unexpected changes, through their own decision making over the next period. The reason why it is possible for agents to interpret the banks decision is that there is a simple pattern to the BoE rate settings, and further, their immediate reasons are also well publicized. The monetary policy of the bank can be summarized by looking at rate changes over the last 30 years, and a pattern emerges. Directly after a boom period has ended, the interest rate is dropped, through many changes in a short amount of time. However, when the bottom of a slump is reached, the interest rate stops changing, and as the economy slowly recuperates, interest rate increases are implemented with longer time

gaps, until a boom period is again experienced, where the rates will vary around a general mean for a particular boom, before it is dropped again.

Figure 3: UK Interest Rates



Source BoE (2003)

If over the last quarter, the bank has undertaken many rate reductions, it can be interpreted as a sign that money demand is falling, and one could on past experience expect the rate to fall soon again, as the economy, as considered by the BoE, is headed for some sort of contraction. Oppositely, few rate increases over the last quarter, would signal that the economy is picking up again. And a general tendency to vary around a mean of zero change in the last quarter would indicate that the Bank thinks that money demand is growing at a stable rate[5], and the economy is doing well. This provides a useful signaling device Rsig, given as the number (n) of rate changes ($r\Delta$), times the change in the rate over the quarter ($r_t - r_{t-1}$), summarized in formulae (1). Rsig is an expression of the changing money demand over the last period and the Banks expectations of the future, and provides consumers and firms with an impression of the BoE's opinion of the overall economy.

$$R_{SIG} = (n \bullet r\Delta)\,(r_t - r_{t-1}) \qquad (2)$$

[5] This paper will use quarterly data for all of its data analysis, as savings ratio figures are only available quarterly, and to build a method to show how the interest rate signals may be quantified with Rsig.

1.3 Money Demand

Money Demand is still treated as a downwards sloping function against interest rates, and it still incorporates the three reasons Keynes gave for money demand, namely transactionary, precautionary –and speculative demand.

The money demand of the IS-LM model consists of the liquidity market[6] and the bond market, which clears through Walras law in the Hicks-Hansen model. The liquidity market clears because in the traditional model the money supply is fixed and demand adjusts accordingly, automatically clearing the market. This assumption as I have shown is not appropriate for thinking about the UK liquidity market, although in this re-appraisal the market also clears, but because any demand is met by unlimited supply at a given repo-rate.

In the bond market, people are supposed to demand and supply bonds in expectation of changes in the interest rate and if they expect the interest rate to increase, agents will sell bonds to avoid a capital loss (and thus increase money supply). Given that this money does not filter into the other two reasons for demand (precautionary and transactionary), there is an internal inconsistency as pointed out by Fonseca and Ussher (2002). The bond market is *assumed* to clear because of Walras law, and as a result the whole money demand-supply system clears. This is despite the fact that the increased money supply resulting from higher interest expectations will mean the downward sloping money demand intersects at a lower interest rate in the original Hicks-Hansen model. So in a sense, expectations are not a part of the money demand relationships in the model.

This assumption is not satisfactory, and even though bond market changes can be viewed as an expectation change, we have no way of estimating from which point in time people started expecting the rates would change. Even if we could, through measuring changes in sales volumes and their respective timing, it would be a statistical nightmare.

There is however, another market in the UK economy, which is more liquid, is able to create income and wealth, and responds to expectations: The London Stock Exchange (LSE). If the public expects there to be an increase in the interest rate I in a near future, it

[6] Traditionally this is called the ‘money market’ but to avoid confusions between this and the *actual* money market, where the BoE deals with banks and institutions, I use the term ‘liquidity market’.

is generally accepted that the stock markets will not respond to the interest rate change once it takes place, but it will start rising the moment the expectation is encountered, so that once interest rates change, the market is adjusted for this.

This can be considered as the balancing tool for the bond market, and it also has its own effect on money demand. As expectations change, people will demand more or less money in order to invest in the stock market, in a positive relationship. So the clearing condition for the money markets becomes:

$$(M_D - M_S) + (B_D - B_S) + (S_D - S_S) = 0 \qquad (3)$$

Still assuming Walras Law is convenient, but not as essential as it was under the Hicks-Hansen model.

It should be noted that the introduction of a fourth market into the IS-LM structure has been shown to be possible, granted it is based on interest rates, and a flex-price market.

> It may indeed be useful to show that there is, in principle, no difficulty in introducing a second flex-price market – or for that matter, introducing several. It could be useful, even for macroeconomic purposes, to introduce a second flex-price market. (Hicks 1980 p. 144)

Not only does the Stock market fulfill these criteria, it also conveys an aggregate of expectations in the economy.

1.4 The London Stock Exchange

The LSE, will in this paper be treated as the FTSE All-share index, which incorporates about 98% of market capitalization in the UK, so all future references to rises in share price, are rises on an aggregate level of the FTSE All-Share index – which measures the performance of all the shares traded on the LSE, taking into consideration new flotation of companies and price changes.

1.4.1 Interest rates and the LSE

Economic theory tells us that the stock market responds to expectations of changes in the interest rates, and therefore changes accordingly. This is the key to understanding the first aspect of the stock markets role. We know from the money supply function that repo rates and interest rates will be raised if the Bank of England deems money demand as being *too high*. The reason for an expected tighter monetary policy is therefore that public demand for money has gone up in the last period. So in explaining stock markets, one theory is that in this period, given that money has to be spent somewhere, profit expectations of firms increase. This will bring about the increase in stock market value – as Tobin's Q tells us that stock market valuation is based on expected profits.

A tricky point evolves from this conclusion: If the monetary power is not capable of enforcing the expected interest rate increase in time, the increased transactionary money demand from the first period which will involve an increase in real profit, will evolve into a speculative money demand in the second period, as people switch from bond holding to share holding, to make a net capital gain. This may lead to a situation in the second period where $(B_D-B_S) + (S_D-S_S) = 0$, thereby exerting no extra pressure on M_d, meaning that while the bank may not increase rates, the stock markets will continue rising, and a bubble could be in the making.

This is a side track to the discussion, but offers one reasonable account of how financial market bubbles may be instigated, but granted the BoE has the independence and will to enact policy; the effect of these bubbles can be limited. In conclusion the stock market does not respond to the interest rate per se, it responds to expected changes in the interest rates, and indirectly through changes in expected profitability.

The LSE also functions as an interest rate, both to consumers and firms. Consumers may invest in the stock market, removing their money from circulation (leakage) to receive "interest" on their portfolio. This could be due to an expected interest rate change; the opinion that the BoE is under-estimating the economy, and there are better returns to be had, or that firms have been profitable and will pay out higher dividends or their stocks may appreciate. Similarly, firms wishing to raise capital, can go to the capital markets rather than the banks, and will be more encouraged to do this in a booming market, as

capitalization may be higher, and speedier. So we have a short term rate set by the Bank of England and a long term rate, set by the LSE which depends on expectations.

1.4.2 Expectations and the LSE

Stock market valuations are, according to Tobin's Q, an expression of expected profits. Furthermore changes in the stock market are easily observed by consumers and firms. These two facts carry implications, and helps shape expectations both in companies and with consumers. If the stock market does well, it should be because financial investors believe that future profits will be higher, and the reason for any real change in aggregate profits will be that sales and thereby consumption has gone up. Companies respond to both of these, and even though there is no real gain from share appreciation to the company balance sheets, it brings confidence, and a will to increase investment, in order to gain a higher share of the expected future increases in consumption. Secondly id sales (and profits) are rising, this is a variable firms observe immediately and this would also lead to optimism and possibly investment. One is reminded of Minsky's analysis of investment behavior, which blends in very well with this particular aspect of the analysis.

Consumers can use the stock market to save some of their income, and are likely to do so, if expected returns are higher than the returns on interest rates, i.e. if they are expecting the economy to perform well. A rise in the market will create wealth with current share holders, and the expectation of further rises, will encourage current spending by share holders, as they feel richer, and further it will increase demand for shares traded. It is not realistic in the UK, to claim that a substantial proportion of the population have a large part of their wealth in the stock market, so a direct spending link is unlikely to be as strong as in countries where populations keep a large proportion of wealth in shares[7]. However, given that there is asymmetric information in the economy, and the LSE is an indicator of how firms are expected to be doing, and what the BoE will do in future (which is a response to money demand changes) we can use this as an aggregate expectation measure for firms and consumers, as future profits guarantees workplaces, and this implies an expectation by the workers that jobs are safe, and wages are assured for the foreseeable future at least.

[7] As in the USA.

So the rising stock market becomes a self fulfilling prophecy, as consumers increase spending now, because of their expectations of a safe future, and companies starts increasing investment spending, in expectation of rising profits, which are guaranteed by the current increase in spending. A requirement is of course that Y (the actual profits and wages) grows as a result of this increase in real investment and consumption, and thereby household income increases, leading to a positive cycle. The same can be said for the opposite case, where negative expectations will contract current spending, and start a negative cycle.

1.5 IS-LM and time

The IS-LM model has taken much critique for its handling of timing issues, both in regards to how long a period within the model should last and the timing of different stock and flow decisions within the model, these concerns can be dealt with as follows:

1.5.1 The "Short Term"

The IS-LM model, as first introduced by Hicks, was a short term model. Given Keynes' Statement that *"in the long term we are all dead"*, it becomes very simple to see the logic of having short term Keynesian models. The differences between the models were the length of this short period.

> Keynes' (he said) was a 'short-period', a term with connotations from Marshall; we shall not go far wrong if we think of it as a year. Mine was an 'ultra-short-period'; I called it a week (Hicks 1980: 141)

This timeframe was chosen to allow for propensities and expectations to be reflected in the opening of the markets – which Hicks only allowed to open on a Monday. This limitation was subjected onto his own model by keeping expectations exogenous, just like Keynes had done…

> Expectations of the future would have an effect, but no assumptions of "rational expectations". Expectations in our models were strictly exogenous. (Hicks 1980: 140)

As for the claim that Keynes did not incorporate expectations into his model, the less said, the better, for it is a clear critique by Richard Kahn (1984) of the IS-LM model, that by excluding the time element, it does *not* incorporate such *Keynesian* doctrines as

expectations, speculation and uncertainty. Hicks reverts back to Keynes' "year", after reviewing the problem of the series of events that Pasinetti (1974) so clearly displayed as a weakness of the model. Pasinetti noted that the LM curve was a stock constraint, whereas the IS curve was subject to a flow constraint. So he argued that financial portfolio decisions would lead to the setting of an interest rate, which in turn would lead to changes in Y, I and expectations, which again would lead to a change in the bond / money portfolio, making a simultaneous equilibrium an impossible solution.

Faced with this problem, Hicks could only extend the time period of the model, in order to allow planned investment and saving to equal, as suppliers adjusted their plans to expectations in order to incorporate this series of events.

> If one is to make sense of the IS-LM model, while paying proper attention to time, one must, I think, insist on two things: (1) that the period in question is a relatively long period, a "year" rather than a "week"; and (2) that, because the behavior of the economy over that "year" is to be determined by propensities, and such like data, it must be assumed to be, in an appropriate sense, in equilibrium (Hicks 1980: 147-8)

Rather than revert to a long term model, I would like to view the time element in the economy as circuits, rather than as continuous functions, but for this to hold all markets must be flow markets. Further, in this analysis, we would be looking at a circuit of expectations as well.

1.5.2 Stock and Flow equilibrium

To deal with this part of the rejection of the Hicks-Hansen IS-LM model, we need to weed out the assumptions that lay grounds to them, the first problem is that IS is treated as a flow equilibrium while LM is understood as a stock equilibrium.

In this update, companies still plan investment, and consumers still plan saving, but they base these plans on expectations of the future, which are represented by the stock market, and the signals they receive from the interest rate. So they decide at the beginning of a period, and change during a period – i.e. flow equilibrium.

The trick is the LM curve. The LM curve according to Keynes and Hicks is a stock variable, and should be treated as a balance sheet quantity, as the quantity of money is fixed at any given point, a valid argument under the gold standard. This no longer holds however, as the stock market and private banks are able to create money independently of the central bank, and there is no metal restriction on the quantity of money. In addition, the central bank provides the market with an *unlimited* supply of money at the (daily changing) repo rate. This means that the short term money quantity changes often over time and even the long term money supply function will shift as a result of policy changes.

The money demand function changes across the period, according to the same expectations as the IS curve. Further, the signals that are given out by interest rate policy will be influenced by the changing expectations over the period. So at the end of a period, the next interest rate is set, with the knowledge of the actual investment and savings in the economy over the previous time period. So the LM function is a *flow* equilibrium when one includes the institutional changes that have occurred since the model was invented.

Both the IS and LM curves are now flow equilibria, and they can therefore be compared simultaneously at any given time. This solves the second of Hicks' requirement that the economy should be in 'equilibrium' at all times, and also solves Pasinetti's timing problem.

Whether expectations were correct or not, is a different matter. What we know is that at the start of any period, general information on the state of the economy is being conveyed to the public through the interest rate, and expectations start again. This way we have a connection from one period to the next. Now the question is, how long should a short term expectation circuit in the UK be? The optimal term would most probably be the four week interval from the moment after the Monetary Policy Committee announces the next period's interest rates, until they announce it again. Assuming they do not have a crisis meeting (another signal, and another set of expectations). However as mentioned earlier, the statistical analysis in this paper is based on quarterly data. This will mean that the results are not wholly conclusive in defining all expectations at any given time, but

should give a good estimation of how consumers and firms perceive the state of the economy each quarter, and how this influences output.

As a result of the two flow equilibria, the year long interval suggested by Hicks, is not a very suitable time frame, as the system is in constant re-adjustment, and changes in plans and timed responses are accounted for within the model.

A note should be added here, about the term equilibrium, which also discouraged Hicks. Equilibrium is the simple mechanism at which demand meets supply, nothing further. It does not guarantee full employment, nor does it mean some optimal production. It is a function of producers and consumers ability to produce and purchase the amount of goods they expect to be able to afford in order to maximize profits and utility. As such, equilibrium needs not be sought after in an open market, for it will be established. This was a problem for Hicks, who did not find much use for a model, which did not exclude equilibrium. However Hicks' original model included full employment whereas the later Hicks-Hansen versions do not.

A recession is therefore an equilibrium position in the IS-LM framework, albeit a poor one. Equilibrium does not guarantee a high growth rate, or higher aggregate utility. Seeing that 'equilibrium' in this model is not some optimal stage, it becomes important to construct policies that will give the best growth rate according to the state of the economy.

2. The Parameters

The IS and LM curves are still the same mathematically as they were in the Hicks-Hansen model, and so the slope parameters are also the same as before. However in contradiction to Poole (1970) it will be demonstrated that the parameters change in a systematic way, and should *not* be treated as "random variables".

2.1 Marginal Propensity to Save

The marginal propensity to save (MPS) is the opposite number to the marginal propensity to consume (MPC). What is not consumed is saved. What is interesting is the interpretation of Keynes' view of this variable. As we know, Keynes was concerned with the short run, and as a result he is often quoted as saying that "The propensity to consume is a fairly stable function" (1936: 96).

The meaning of this statement has often been interpreted as saying the marginal Propensity to Consume (MPC) should be a fixed variable, and it should not vary very much over time. As a result, the MPS would not change either [MPS = 1-MPC]. Much study has gone into this, and for example Ackley (1971) wrote in his textbook that the MPC in the United States has had a fairly constant mean of 0.92 over a period of 35 years, from 1935 to 1970. To say the least, a period of 35 years is a long term analysis, and even these results were ambiguous, but for the short term, the conclusion was:

> No simple lag function appears to improve the explanation of short run consumer behavior (Ackley 1971: 256)

Ackley found no convincing explanation for the change in short term consumption by lagging income, and using current wealth did not explain short term consumption decisions. But the MPC and MPS does change in the short term – so what did Keynes mean? Given that we know he was referring to the short term. The answer can be found in a letter from Keynes to R.F. Harrod, dated the 30th August 1936, and is reproduced in full in the "*collected writings of Keynes*" Vol. XIV, and in Vol. VII

> When income increases, the gap between income and consumption will increase – a conclusion of vast importance to my own thinking, but not apparently, expressed just like that, to anyone else's (Keynes 1973: XV).

This is the key to interpreting Keynes first statement, and seems to have been overlooked. Keynes is aware of a change in the MPC in the short term, and he notes that it is not an erratic function (like his unstable investment), but it is a stable function related to income[8].

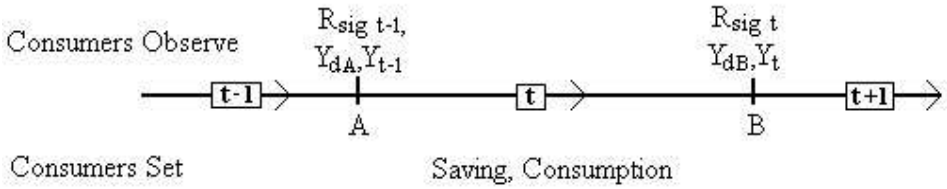
2.1.1 A changing MPS

We know that consumers are able to observe Y_d at point A ($Y_{d\,A}$), but not the aggregate Y_t, and therefore do not know where in the distribution they lie. In order to make a decision on how much to save and consume in the current economic period they need to form expectations of Y_t. This can be done by combining their own expectations (FTSE

[8] An interpretation of Keynes' individual observation is given in section 3.2

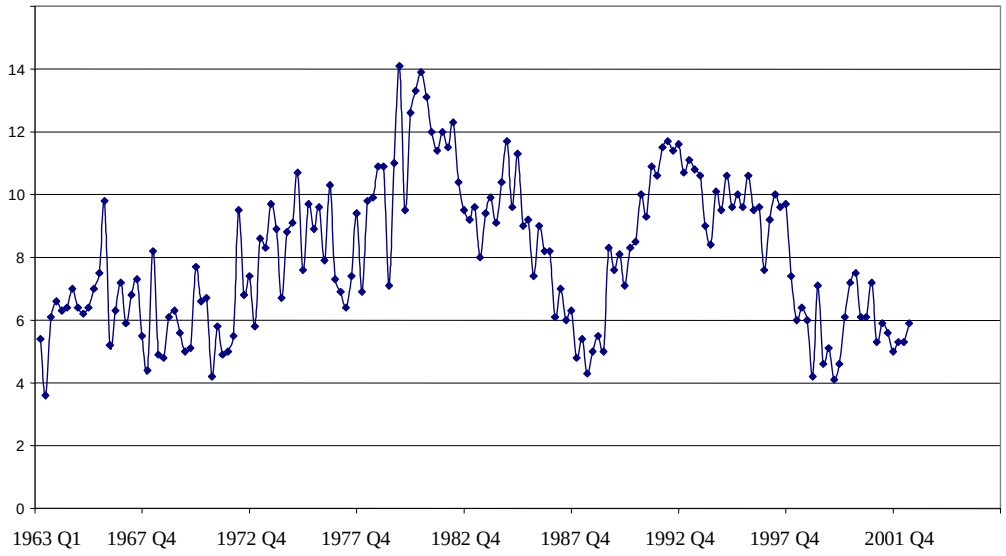
change as they occur over the period), with the Bank of England's signal of expectations (Rsig set at start), and the observed values of Y for the past periods. This is in accordance with the previous sections, and lends credibility to Ackleys conclusions about consumption decisions in the short term not being determined by wealth. These decisions are rather based on expectations and observations of recent performance. Consumption and savings decisions are taken *during* the period, illustrated here with a timeline, that show what initial plans are based on, and how they may change over a period.

Figure 4: Consumers timeline for decisions and their basis



Given this, we need to demonstrate that the proportion of income saved, does actually change over the short term. Using the Office for National Statistics (ONS) measure for the savings ratio in the UK economy, it is evident that the MPS does indeed change in the short run.

Figure 5: UK Savings Ratio, quarterly, Q1 1963 – Q3 2003



Source: ONS (2004)

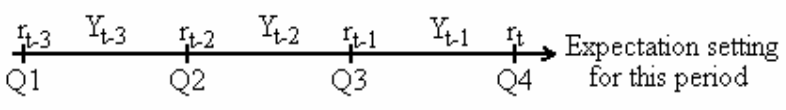
Taking our function further, we know that the absolute value of savings and consumption will rely on the actual Y_d value, but the proportion of the income spent will depend on the other three variables. Ergo, we should be able to show that marginal propensity to save is a function of: BoE expectations and signals in the past; observed change in Y (and thereby Y_d) in the past; and variation in the stock market (FTSE) over the period:

$$MPS = f (Rsig_{t-n}, Y_{t-n}, FTSE_t) \qquad (4)$$

In order to accept or reject this hypothesis, we have to investigate if the different variables cause a change in the MPS or whether the MPS is indeed randomly generated. To do this, percentage change in gross domestic product in chained volume measures, for the UK, being seasonally adjusted, was used to represent Y change. The Rsig equation as given in section 4.2.1 [$R_{SIG} = (n \bullet r\Delta)\ (\ r_t - r_{t-1})$] was calculated using interest rate information for the UK economy, and the FTSE percentage change, was calculated using FTSE all-share index figures[9].

Following this, cross-correlograms were calculated for each variable to decide on suitable lags to be incorporated into the model. Three lags were chosen for GDP change, and four lags for interest rate changes and Rsig, thus covering three quarters backwards. This pattern is illustrated below; where consumers use the last 12 months information form expectations. For good measure, the effect of a normal rate change (in percentages) was included as a comparison to Rsig, and the FTSE change (3 lags) was included to see if there was any lagged effect, or whether it was only a current period effect.

Figure 6: hindsight for expectations



[9] For data sources, data calculation methods and summary of results see Appendix I, All statistical work was performed in Intercooled Stata.

Table 1: Testing the H_0: that the variable x does not Granger-cause saving rate changes:

$X_{(lags)}$	$Rsig_{(4)}$	Rate $change_{(4)}$	GDP $change_{(3)}$	FTSE $change_{(3)}$
χ^2	13.45	12.07	8.85	4.01
Prob> χ^2	0.0093	0.0169	0.0314	0.2606

One can reject the hypothesis that Rsig over the last four observations does not granger-cause MPS change, both for the 5% and 1% significance levels. The interest rate change can also be rejected to not granger cause savings rate changes in the 5% level but not in the 1% level, and the same goes for GDP change.

In summary, the past four observations of quarterly rate changes are less useful in predicting savings rate decisions in this quarter than the Rsig estimator. Rsig for the last four observations and the GDP change over the last three observed periods Granger causes a change in the rate of savings. Running normal regressions on the variables, gives us a negative relationship between Y_{t-n}; $Rsig_{t-n}$ and the change in the savings rate. Meaning people increase savings if past experience and official opinion is negative.

For the change in the FTSE the case is different, as predicted, the past experiences of the FTSE has none or little Granger-causal effect upon the change in MPS, rather it should have a direct effect on savings in this period. The problem is best shown by simple observation. Given that the MPS change is based on the lagged effect of Y change and Rsig, it is hard to create a directly regressable relationship for the FTSE change and MPS change alone. Also we must recall that the FTSE changes observably daily, and peoples reaction is expected to be quick. None-the-less we can observe the pattern quarterly, especially if we observe periods where Rsig and $Rsig_{t-1}$ are zero, allowing the FTSE to be the main influence on MPS[10].

What becomes evident is that as the stock market rises in a period without BoE expectations, consumers tend to reduce their level of savings, and vice versa. The level of the change will depend on the values of lags in Rsig and GDP change, but the pattern is easy to follow. Higher stock market leads to more current consumption, as public expectations for the future are positive.

[10] See appendix II –, for an example of the difficulty in estimating FTSE quarterly and discerning its effect on MPS.

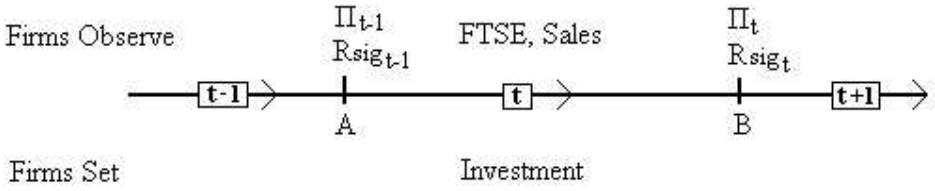
2.2 Interest sensitivity of investment (i_1)

The direct effect the interest rate has on investment is a dubious relationship. Chirinko (1993) looks into multiple investment models, and tries to discern whether there is in fact a deciding factor for investment choice, after going through expectations, liquidity availability, the interest rate, and many other variables he concludes:

> While there is clearly no uniformity in the results and the role of shocks remains to be assessed, it appears to the author that on balance, the response of investment to price variables tends to be small and unimportant relative to quantity variables (Chirinko 1993: 1906)

What this tells us is that investment decisions by firms may depend on many other things than just the interest rate, in particular that of the business cycle, and the potential for profits and sales in the future. Further we know that firms can observe net profits (Π) for the previous period, and will know sales as the period carries on. This information is available only to them, and they also observe all the publicly available data when it is released.

Figure 7: Firms timeline for decisions and their basis



We are concerned here with how investment responds to interest rate changes, so we must find a way to estimate whether the traditional schedule of the Marginal efficiency capital schedule, holds constant in different circumstances. If it does, i_1 (the IS slope formula's denominator) will not change over time. However, if firms are optimizing and can interpret Rsig, while observing own profits and the expected profits (FTSE) over the period, then it would make sense if Rsig (and rates) had less of an effect on investment if expected profits were low, and the expectations of the bank had more of an effect when expected profits are high. The reasoning being that firms and consumers will know when spending is low, and so sales figures and stock markets fall, but only the BoE knows if a stock market fall or rise is reflected in the actual money demand, so the firm must rely on

its interpretation of the central banks behavior. Regressing interest rate change (and Rsig) with respect to changes in investment, depending on the change in the FTSE over the period, should indicate whether i_1 changes systematically, randomly or not.[11]

Table 2: Interest rates effect on investment during different times of expectations

	FTSE increase > +5%	+5%> FTSE inc. >0%	0%> FTSE inc.
Rate r^2	**0.3123**	0.0758	0.0653
Rsig r^2	0.2444	**0.1238**	0.0223

The r^2 values are as predicted by Chirinko not particularly impressive, but the trend is clear. At higher expected profits, firms respond more to the interest rate, than in any other time. But as expected profits fall, so the relationship degenerates, as firms look to the Rsig (which still has quite a high significance, and its r^2 trumps the rate change), but do not respond to the rate change like before. Lastly at negative FTSE periods, the variation in investment change as explained by interest change is even lower. So as companies expect worse times, i_1 falls.

2.3 IS summary.

One can see from the above that as the economy tends towards a boom, or rather if consumers or firms expects Y to expand due to policy or other reasons, the IS curve will not only shift right (if expanded by policy), it will *pivot* either before the policy is enacted in expectation, or after it has been observed, if it was unexpected. An inverse relationship between MPS and i_1 has been shown to exist. Such that in the case of an expected expansion, MPS will fall, and i_1 will increase, making the IS curve more shallow in as optimism grows, and vice versa in times of low expectations.

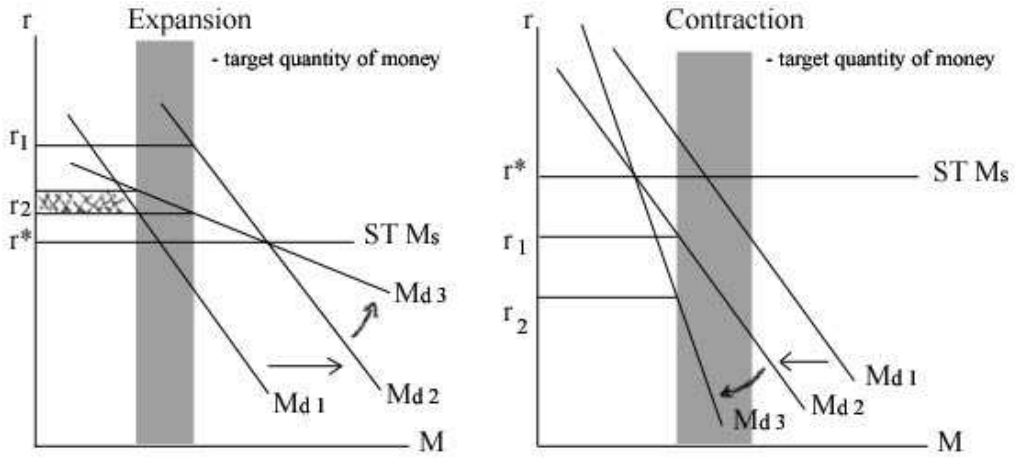
3.1 Interest Sensitivity of Money Demand (c_1)

Money demand in this model is a function of interest rates and income. As such, money demand has not changed from the Hicks-Hansen formulation; the difference in this updated IS-LM representation is that money demand should respond differently to interest rate changes, as expectations and real variables change. This has already been illustrated for firms, and this illustration coupled with the BoE monetary policy rules, will illustrate how the economy's money demand reacts as a whole to interest rate changes.

[11] Full statistical output can be found in Appendix III.

As the real economy grows, money demand grows (transactionary demand), creating an expansion of the money demand. As the BoE tries to keep the money supplied within a certain band, it will increase first the repo-rate and then the interest rate in order to keep inflation in check, as this is the *policy rule*. For firms, the response to the interest rate change is amplified, as profit expectations guide investment. For consumers the assumption is the same, if MPS decreases in boom or recovery times, the MPC must rise, and given that consumers are unable to observe real M_d they must rely more and more on the Rsig variable, to interpret the state of the economy. The point is further backed up by the BoE pattern of monetary policy, where recovery and boom times are associated with small and few interest changes in order to sustain the current money stock. From this we can infer that as money demand increases, the M_d function pivots around itself, making itself flatter, and allowing r to influence it more. So on the diagram, M_d expands to M_d2, which in a static framework would lead to r_1 to maintain the money stock, but as M_d2 pivots to M_d3, the necessary rate increase can be found at r_2 which is a significantly lower change than going to r_1 (i.e. c_1, the LM nominator increases). Oppositely, we can observe the banks pattern of behavior following booms, and into recessions, where many interest rate cuts are needed, in order to keep the target band of money in place. As such the logic goes that firms are unwilling to borrow in times of low expected profits, and consumers being risk averse to an extent will save more in recessions. i.e. c_1 falls.

Figure 8: Pivoting money demand as a result of BoE behavior



3.2 Income Sensitivity of Money Demand (c_2)

As shown in section 2.1.1, the marginal propensity to consume, does not depend on a current wealth factor, or some sort of lagged income effect. Rather, it is an effect of future expectations of income. If consumers feel they will have more money to spend in the next period, or they expect Y (which they cannot observe) to be high then they are willing to increase spending in the current period regardless of a current fall in Y_d.

However, in recessions, or times of poor expectations, consumers care less about Rsig (BoE opinion), as an increase in the interest rate will only occur, once the bank observes a positive change in money demand, and so all rate changes until then, will not improve expectations. Given that past Y is also low, consumers can only turn to the observable values they have left, in real disposable income, and the stock markets. Recalling Keynes statement from 2.1, he observed that during the great depression, as income increased, the gap between income and consumption actually rose. This would be true for the first period, as $Y_{d\,t}$ has little effect on current spending until time $t+1$, when consumers are aware of where in the distribution of income they may lie, and what the aggregate Y is. Then they would start spending as expectations are going up, while savings have increased as a result of the last period's prudence. This means investment will rise (I=S). So we have shown that money demand responds more to Y_d. in a recession, (i.e. c_2, the IS denominator rises as expectations fall).

3.3 LM summary

Poole (1970) tried solving the instrument problem for a central bank, and concluded that in a dynamic model, the better policy would depend on the size of the parameters of the LM curve. With the above conclusion, we can show that the LM curve will rotate systematically as the economy traverses the business cycle, with a high c_1 and low c_2 (steep LM) in booms and expected growth periods. While low c_1 and high c_2 (flat LM) values can be associated with recessions. We can thereby use Poole's conclusion that in the former scenario, a central bank will do better by targeting the money stock. This leads on to Friedman (1968), who gave us the notion of setting a monetary target, when LM was steep, and IS shallow. All three together, supplies the theoretical backdrop for having monetary policy, the choice of monetary policy instrument, and the economic climate in which it is most beneficial to perform monetary policy, simultaneously in one framework.

3.4 The private sector

One last point to be made is that of private sector investment. Keynes found this to be an unstable sector and recommended government intervention; the monetarists used to view this as a stable sector, and encouraged supply side policies. One must now consider how firms respond to different expectations and thereby places in the business cycle.

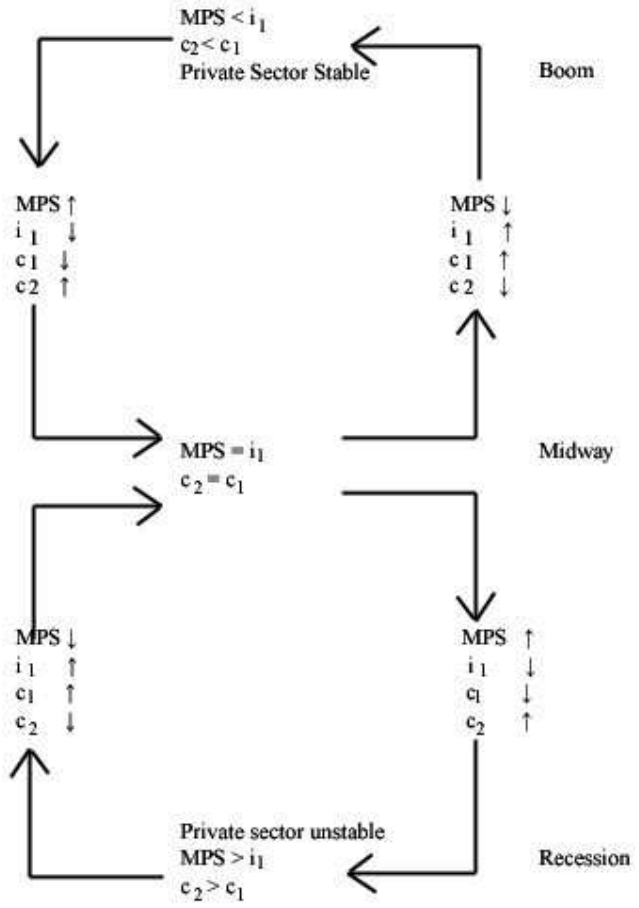
During recessions, which heavily influenced Keynes, I showed that investment responded only very slightly to interest rate changes, and investment would be a lot less forthcoming, creating an unreliable private sector. On the other side of the spectrum is the monetarist stance, which is heavily influenced by the 60's boom period, where this paper agrees that firms respond very much to the interest rate during good expectations. Furthermore the private sector, expecting profits, will be more than happy to undertake investment, and is perfectly able to sustain itself, given enough liquidity. If we look at this through the IS and LM summaries, we can demonstrate why these differences in opinion about the stability of the private sector came to be, and it is possible to unite the two schools of thought.

4. Conclusion

The combined slope variable effect on the IS-LM model above can be best displayed in an eight figure circular flow, where expectations change over time, and across the business cycle. This will then give us a guide as to how the economy looked at any given time in the past, and an image of how expectations and the economy look right now. Policy can then be implemented according to either Keynesian, Neo-Keynesian or Monetarist principles within the IS-LM framework, to ensure the most efficient policy outcome.

Figure 9 illustrates a simple way to keep track of expectation movements across the business cycle, and to estimate the slopes of the IS and LM curves. It is useful as a quick point of reference to see which way the parameters move under different circumstances.

Figure 9: Graphical representation of the cycle of the IS-LM curves



Graphically it should be possible to 'catch' the economy on the way down from a boom at the midway point, but in order to do this; expectations need to be changed to restore faith in the economy. This might be done by using both monetary and fiscal policy simultaneously. But whether this would generate the wanted result within the IS-LM schedule as curves pivot is questionable. This illustration is a different way of representing *table 3* and *figure 10* (on the next page) which may be more familiar to the IS-LM student.

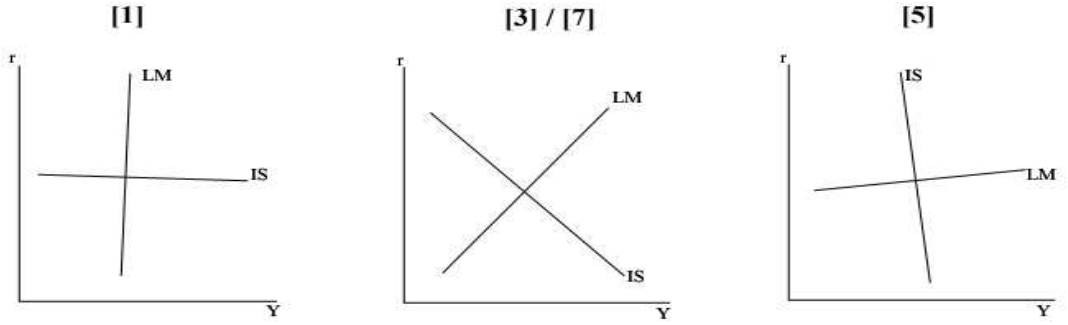
4.1 The IS-LM effect

These changes in the slope variables mean that the IS-LM schedule is *constantly* changing. Although this analysis only takes on the empirics quarterly, we can still show the relative values of the parameters and thereby estimate the IS-LM curves at different past, present and future times.

Table 3: Summary of IS-LM relative slope values

	Parameters				Slope of	
	MPS	**i_1**	**c_1**	**c_2**	**IS**	**LM**
1 Boom	low	high	high	low	flat	steep
3/7 Midway	medium	medium	medium	medium	one	one
5 Recession	high	low	low	high	steep	flat

Figure 10: IS-LM depictions of Table 3



Fiscal or monetary policy will not only shift the IS and LM curves to achieve new equilibria, but the curves will also pivot, to reflect changing expectations from different groups, thereby impacting on the outcome of any policy change considerably.

For example, a fiscal expansion, will shift IS right, and lower the MPS as consumers expect higher incomes. Therefore M_d increases, making IS flatter, and as M_d pivots, the interest rate needed to maintain the BoE monetary target (which is the better instrument in this case) falls. This is reflected in the IS-LM schedule as the increase in output, has cost less in interest rate terms as LM has pivoted to a more horizontal position, but has also moved rightwards, expanding Y, more than the static IS-LM model would predict.

The diagrams are a clear reminder of the different schools of thought, and it makes sense that Keynes' recession background, and Friedman's boom background, should come to show. Granted, these are the extreme values of the slope variables, but they are so, to illustrate the point.

4.2 Further uses for an updated IS-LM model

From this we can derive multiple new ways of looking at policy decisions, as we are faced with the question of expectations within the framework. This analysis was based on the institutional background of the UK, and was statistically backed up by this, but it would be fair to say that the same model of behavior and institutions apply to most modern economies in the world today. As such this extension of the static Hicks-Hansen model is useful for seeing how consumers and producers react to expected and unexpected policy changes. One could argue that if policy was expected on the aggregate then the IS and/or LM curve may pivot before it shifts, leaving a time lag wherein monetary policy may have an effect on real output, or not, according to theoretical doctrine. Or oppositely, unexpected policy would shift, and then pivot in the next period. In effect the further analysis offered by the model strengthens the framework to such a degree, that it has become a much bigger model, even though it still has a simple façade.

We can derive from this analysis that monetary expansion in a recession, which we can now identify as being a very Keynesian moment within the model, will be very costly in terms of interest rate reductions, and thereby inflationary pressures, backing up the argument for active fiscal policy rather than monetary policy. A good case example would be the Japanese economy, which attempted monetary revival for the better part of a decade. This model demonstrates in a simple way why output did not increase.

In the same way, fiscal expansions during boom periods are more or less redundant, as all they will do is increase money demand to such an extent that borrowing and private investment will be restricted, because firms respond to rate changes, which is very much in accordance with Friedman and the monetarist view[12].

These IS-LM equilibria, and policy responses, are clearly visible within the framework, while still incorporating concepts like the multiplier, and a possibility for expanding the framework to include the Balance of Payment and the government as a tax / benefit institution. We have a dynamic IS-LM model, which unifies a host of theoretical and policy advice in one go.

[12] One of the key macro variables the updated IS-LM has sidestepped is that of inflation, but as the BoE targets this within the M_s Function in real life, and in this model, it is to some degree inherent in the framework.

With this updated framework, the IS-LM analysis has most certainly been given a new lease of life as not just a 'classroom gadget' but as an analytical tool for the state of the economy, and as a policy decision tool, in deciding instruments and predicting expected outcomes of different policies in the economy, at different times. But the key is, that the IS-LM framework, in its updated form, is still one of the simplest representations of the economy one can produce, while the updated framework is much more powerful, in helping us understand the workings of an economy.

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GDP Conversions by: Hakim Douah, GDP Analyst, Tel: 0207 533 5934.
NRJS: HN: Households saving ratio: CP SA
ABMI: Gross Domestic Product: chained volume measures: Seasonally adjusted
NPEL: Gross Fixed Capital Formation: Business Investment: CVM SA: £m

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