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SELECTEDWORKS™

The applicability of the IS-PC-MR model on the UK economy during the crisis

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Introduction

Since the 2008 great recession, it has been a very interesting time for macroeconomics. There has been a movement to revamp how economics is taught, challenging the ability of models and mathematical equations to map agents' behaviour and the economy. This debate has inspired my interest on the applicability of economic theories. It is argued that oversimplification and generalization of assumptions make models too abstract and impractical, yet, at various points in time, models have been relatively successful in mapping out general movements in economies. As logical beings, we are constantly seeking coherence in daily occurrences and given all its drawbacks, economic models might still currently be the best solution to understanding reality. A core model of macroeconomics is the IS-PC-MR model (3EM), and having just spent a good portion of time learning the closed economy 3EM, I thought it was apt to examine if this model accurately reflects reality and its ability to analyse shocks of such magnitude.

The paper will firstly set up the 3EM, following that, it will apply the model onto the UK closed economy over 2008. This is done by analysing the Bank of England (BoE) inflation report, drawing out relevant information specific to the UK domestic economy and applying it to the model. This paper uses those reports as they are a reliable source of information and they provide the necessary data for the analysis. I will be picking up key phrases from the BoE report overview in every period and use it to explain the intuition behind the movements of the curves in the analysis and map out developments in the economy. After that, I will compare and review the proximity between the model's prediction and what actually happened, followed by drawing conclusions about the applicability of models.

IS-PC-LM Model

The 3EM is a macroeconomic model which incorporates the demand and the supply side of the economy, and the (CB) Bank's Monetary Rule at any given period.

IS

The IS curve reflects the demand side of the economy and in the closed economy and it is given as Consumption + Investment + Government Spending. The components of Consumption and Investment are negatively related to real interest rate set by the CB. Government Spending is autonomous.

PC

The Phillips Curve (PC) reflects the supply side of economy. It is generated from the wage- and price-setting (WS/PS) behaviour of the economy. As workers bargain for real wages and firms setting prices, the PC is the relation between inflation and output in the economy, where it is a feasible set of inflation and output pairs for a given rate of expected inflation.

MR

The Monetary Rule (MR) curve reflects the best-response behavior of the inflation-targeting central bank and it is the optimum combinations of output and inflation that the CB will choose subject to the PC it faces. The Bank of England aims to deliver price stability, growth and employment, i.e. keeping inflation constant at its target rate of πT and output at its max potential ye in the medium run equilibrium (MRE). The MR generates the real interest rate (Bank Rate) the CB needs to set to guide the demand side of the economy towards its target.

3EM analysis against BoE reports

Before I begin, I shall lay out the scope of my analysis. Firstly, I assumed that the UK economy is a closed economy and assumed away trade, exchange rate and the forex market. This was done not because the UK economy resembles a closed economy, but for a simplification reason. The aim of the paper was to observe the newly learnt closed-economy model in practice and thus, the UK was simply assumed to be purely domestic.

This paper analyses the UK economy specifically in 2008 because it was when the great recession was unfolding and changing interest rates was still the main tool the Bank of England (BoE) used. Other tools such as Quantitative Easing started in 2009 and thus, periods after 2008 were left out of the analysis.

The length of each period of analysis depends on "stickiness" of wages. It will be assumed that the wage-setting period has a length of three months, in line with the BoE quarterly inflation reports.

Going into period 1, "CPI inflation remained close to the 2% target in December" (BoE, Feb 2008: 5) at 2.1% and "output growth moderated to around its long-term historical average rate" (ibid). It will be assumed that the economy is at MRE point **z**, where central bank is on its target with inflation at 2% and output at ye.

Assuming the great recession only started in the beginning of 2008, the UK economy is hit by a negative demand shock in period 1. IS curve shifts from IS to IS' and given the current bank rate of 5.50%, The economy moves from point **z** to point A, with output below ye at y1'.

However, the economy is also experiencing an oil/commodity price rise. CB is away from its bliss point and forecasts next period's PC to be at PC($\pi e=\pi 1$'), at a higher inflation rate. Faced with this PC, CB would like to be on point B on its MR curve with output at y1 and inflation at $\pi 1$. In order to achieve this, CB sets r such that when corresponding to IS', it will result in a lower bank rate than the current rate. As the fall in domestic demand is forecast to be "modest" and with inflation expectations rising, the CB has to "balance conflicting risks" and reduced Bank Rate only slightly. This is reflected in its policy rate falling from 5.50% to 5.25% in its February 2008 Inflation Report.

The oil/energy price increase is analysed as a PC inflation shock instead of modeled by the change in markup, μ, of the Price-Setting curve because of BoE's believe that "inflation [will ease] back to a little above the 2% target in the medium term, as the near-term rise in energy prices drops out of the twelve-month rate" (ibid: 7). If this shock is interpreted as a supply side

disturbance, ye will change and bank's mandate (ie the MR curve) will change as well. However, this is not the case as the BoE projects the medium term output to be back to its original level. In period 2, the forecasted PC($\pi e=\pi 1'$) curve actually happens. This is reflected by an increase in inflation despite a fall in output as predicted in Feb's report, given bank rate of 5.25%. Economy is now at point B as predicted.

The analysis of the oil/commodity price increase as a PC inflation shock instead of a supply side shock in period 1 is in accordance with the economic data reflected in the May Report and is justified. The BoE backs this up by continuing to project that "declining contribution from energy and import prices, then bring inflation back to around the 2% target in the medium term" (BoE, May 2008: 5).

The negative demand shock continues to persist and demand continues to fall in period 2. The IS curve shifts leftwards from IS' to IS" and given the bank rate of 5.25%, there would be a fall in output from y1 to y2'. This corresponds to point C'.

The high oil and energy prices continue to rise sharply and this leads to the inflation shock to continue in the next period. CB forecasts next period's PC to be PC($\pi e=\pi 2'$) and faced with this PC, CB would like to be on point C with output y2 and inflation rate at point $\pi 2$. This leads to the BoE setting bank rate to be 5.00%.

In period 3, the forecasted PC($\pi e=\pi 2'$) actually happens. Economy is indeed on point C with output falling to y2 in previous period and CPI inflation up to 3.8%. Again, the modeling of the oil/energy price hike via PC inflation shock is justified as in period 2. This is backed up again by the BoE's expectation that food and energy prices will fall back in the medium term.

The negative demand shock is a persistent one and continues in period 3. IS curve continues to shift leftward from IS" to IS'" and given bank rate at 5.00%, output falls from y2 to y3, from point C to point D.

Oil/energy prices continue to rise sharply, exacerbating the inflation shock. PC continues to rise to PC($\pi e=\pi 3'$). Faced with this PC, CB's best response is to be on point D where output is at y3 and inflation at $\pi 3$. Given the high levels of inflation, despite the fall in output, CB decides to leave bank rate unchanged as its best response, guiding the economy to point D.

In period 4, the forecasted PC($\pi e=\pi 3'$) actually happens as inflation spiked up to 5.2% and output continued to fall as predicted in Aug report. Economy is on point D. Negative demand shock continues to persist with IS shifting leftward from IS'" to IS"". Given rate of 5.00%, this corresponds to a fall in output to y4' on point E'.

Oil/energy prices have fallen and similar to the previous periods, it will be interpreted with a fall in inflation expectations. PC shifts down to PC($\pi e=\pi 4'$). As inflation expectations have eased, CB is able to pursue higher output without compromising its inflation aims. CB reduced bank rate strongly by 2 percentage points to 3.00%, aiming to increase output to y4 and a lower inflation rate to $\pi 4$.

However, looking at the February 2009 inflation report, the UK economy did not behave as the 3EM predicted. Though "CPI inflation fell to 3.1% in December" (BoE, February 2009: 5), as rightly predicted from the fall in PC, "GDP **contracted** sharply in the fourth quarter of 2008" (ibid), despite a lowering of the bank rate. This deviation could possibly be explained by the UK economy experiencing "a **substantially** larger (GDP) decline than envisaged at the time of the November Report" (ibid: 6). The IS curve shifted leftward more than the BoE expected and the 'actual' IS curve is at IS''''a instead of IS''''. At bank rate of 3%, the economy is on point Ea rather than E, with output falling to y4a and inflation falling to π4a. This is now more consistent with the data of Q4 2008 as reported in the February 2009 report.

Analysis results compared against reality

As we can see, especially in the first 3 periods, the 3EM correctly modeled the general directions of inflation, output and Bank Rate and the results were somewhat congruent with the data from the BOE reports. This gives us a good intuition behind the interaction between the IS, PC and MR curves. However, complication started in period 4, especially when the crisis was reaching its zenith. In the November 2008 report, the BoE expected "output to continue to fall", yet my analysis via the models did not accurately account for this fall, but even predicted a rise in output. With extra data from February 2009 report, I attempted to correct my analysis and was slightly more successful in representing the data.

Possible reasons for differences

Some of the possible reasons for the deviation of my analysis of the 3EM and the information of the UK economy from the BoE statements will be address below.

Bank of England's uncertainties

Firstly, the BoE itself is unsure of the situation of the economy. There are lags and measurement uncertainties in collecting economic data, especially for GDP. In order to project inflation, output and accordingly set the bank rate in the next period, it is ideal that the CB has perfect information about the current situation of the economy and future developments. The model assumes that the CB is an omniscient agent, however, this is far from the case in reality. Though the BoE has rightly predicted a slowdown, they were unable to predict the extent of the slowdown. Also, there was uncertainty over the permanency of the negative demand shock. This uncertainty is clearly evident in BoE's method of projecting the future of the UK economy via fan diagrams.

The BoE also cannot truly interpret all the economic information and data they have gathered. Given the complexity of the economy and the limited ability of the Monetary Policy Committee, shocks cannot be accurately identified and explained. This is clear in the case of the energy prices shock that accompanied the negative demand shock. The BoE was unsure if firms were going to pass on the increase in import costs to higher prices, lowering wages or retrenching workers. This makes mapping

the energy price shock, as a simple inflation shock, or a supply side shock, or a combination of both, extremely difficult.

Problems with the 3EM

Firstly, some of the assumptions embedded in the 3EM are not representative of reality. (1) The 3EM assumes that agents in the demand and supply side of the economy are homogenous. However, this is not the case as every agent has different preferences and behaviours. (2) The PC is assumed to have adaptive expectations, while in reality, it tends to be a mix between rational and adaptive expectations. (3) In order for the CB to be able to have an impact on the economy, it has to be credible for the demand and supply side of the economy to react to its actions. The BoE is simply assumed to be credible.

Secondly, the 3EM fails to account for the financial sector, which played an instrumental role in 2008 great recession. The 3EM ignores "characteristics of the financial system that can create vulnerability to a financial crisis, with implications for fiscal balance" (Carlin and Soskice, 2015: xii). In order to better understand the global economy, the financial system has to be integrated into macroeconomic models. Some of such models are proposed in the textbook *Macroeconomics: Institutions, Instability, and the Financial System* by Wendy Carlin and David Soskice.

Thirdly, monetary policy in practice is far more complex than the CB setting real interest rates as the driving force to guide the economy. In practice, other factors such as asset prices, expectations and confidence, and exchange rates affect Monetary Policy (Carlin and Soskice, 2015: 479). The 3EM also assumes the Bank Rate is the only method of affecting output, but there are classical mechanisms or market clearing mechanisms that will put pressure on output. These pressures affect the economy naturally when output is in disequilibrium. In the 3EM, this is assumed away.

Another possible reason for the deviation between the projection of the BoE and reality attributable to the model is the assumption that the real rate set by the CB is the rate of credit of the economy. However, this is not the case as BoE Bank Rate and actual lending rates, such as LIBOR, were not identical. Even the BoE reports acknowledge this drawback and projects its view on output and inflation "assuming the bank rate follows market yields".

When using the 3EM, the economy is viewed as static period blocks. Economic data in every period is analysed as changes in absolute value and block shifting of IS and/or PC curves. In reality, this is hardly the case as fluid movements and constant gradual shifting is a better representation of the behaviour of the economy.

Another setback of the 3EM is that it can only analyse single shocks at a time. When multiple shocks hit the economy in reality, the 3EM cannot accurately analyse changes to inflation and output. Multiple shocks tend to come hand in hand and when these shocks affect economic variables in opposite direction, the simple 3EM is unable to discern which shock outweighs which or generate accurately the final outcome.

Limitations to my methodology

Another possible explanation for the difference between the model analysis and reality is the existence of limitations in the process of my analysis.

Firstly, I assumed that the UK economy is a closed economy. However, the UK is extremely open and globalised, it is not good representation of a closed economy. Factors such as trade, exchange rates and the forex market are needed to be accountable in order to have a more accurate interpretation of the UK economy. 14

Secondly, I assumed that the UK economy initially started at equilibrium output ye and that it has reached its max potential, ie that it is not growing anymore. Thus, I treated the slowing of output growth in the BoE statements as comparable to a fall in output. This poses 2 problems. (1) I have inaccurately used the model right from the beginning. Instead of modeling a growing economy with intrinsically non-static IS, PC and MR curves, I assumed that the economy is static at MRE for simplification. (2) The UK economy might not have been at ye at the start of 2008. The issue of deciding what exactly is "equilibrium output" limits the accuracy of my analysis.

Thirdly, when analysing the economic data from the reports onto the model, I was neither pedantic nor technical in taking into account the exact change in output, inflation and bank rate. Economic information were merely modeled as direction shifting on the 3 curves and not meticulously drawn to scale. This lack of accuracy on my part possibly allowed for a substantial margin of error for my model analysis.

Fourthly, as this paper is analysing past events, there is a possibility of hindsight bias in my modeling. I was presented with an 'end point' to work towards and that might have blinded my analysis. Instead of simulating present time economic data analysis, I might have fallen into the trap of forcing the model to fit the data.

Fifthly, there are many ways to interpret the same economic data and therefore my interpretation is neither the only nor the 'right' interpretation. Even the Monetary Policy Committee themselves are using a variation of the 3EM as a tool! An example is mapping the oil/energy price shock as a full-fledged PC inflation shock. As pointed out under the section of *BoE's uncertainty*, I do not know the extent of the shock as a temporary PC inflation shock or having deeper supply side repercussions. Others might interpret such data differently and will ultimately get very different results.

Strengths and limitations of modeling

After observing a core macroeconomic model in practice, we can now look at the strengths and limitations of modeling in economics.

Strengths

It is argued that economic models can help us understand the mechanisms of economics and in the case of the 3EM, macroeconomics. The 3EM assists us in understanding the effects of individual policies of the CB for the next periods *given* the best information we have on what has occurred in practice. As such, models help us analyse a very complex world by breaking down data into sections and add clarity to that understanding.

Limitations

On the other hand, it is argued that as the global economy is extremely complex and with economic models being extremely simple in comparison, results from modeling is inaccurate and unreliable. The unrepresentative assumptions and oversimplifications possibly make models impractical and obsolete. Many shocks and developments were bombarding the economy during the great recession and the 3EM might be too simplified to handle such developments.

Mathematics, the tenet of economic models, tends to create general equations, unnecessarily standardising economic agents and their behaviour. In such equations, parameters and variables are given values within models. However, the true values of such parameters are unknown and possible constantly changing! It is argued that economics should not be treated this way as the generalisations destroy details which are pertinent to social sciences. This is because in reality, there exists so many 15

different actors with multiple fast-moving developments happening at the same time, it is impossible to trace out what exactly is happening in the economy.

From this paper's analysis, we can see a glimpse of the workability of models. A model is analogous to a 'machine', churning out information based on the 'settings' input. Though it is obvious that it cannot exactly predict the outcome of reality per se, based on the information that is put into the machine of the model, it does however reflect quite accurately what happens and/or what can happen. Models are effective in **mapping** predictions **BUT NOT PREDICT**. This is evident in the analysis of period 4 where after the addition of the data from the February 2009 report, the model produced a closer match to reality.

Conclusion

"Essentially, all models are wrong, but some are useful" (Box, 1987: 424). Though models might be an unrepresentative reflection of reality with all its illogical assumptions and oversimplifications, models do indeed help us map out our thoughts and give structure to our analysis of economics. The key understanding of modeling, given its extreme nature of its benefits and limitations, is to be able to have balance, and to use models sensibly and wisely. We have to discern for ourselves which variables are important and prudently apply them in modeling. The fact that everyone has their own interpretation of models and parameters, the onus is on economists to explain their intuition behind their interpretations when modeling. And in turn, it is up to readers to use their own intuition to critique or accept the intuition. As according to Lars Peter Hansen (2014), "models are not exact replications to reality, (and at the) end of day, it is only some type of approximation. They are simplifications and they are not perfect. Instead of dismissing imperfect models…[he prefers] to use them in sensible ways." After all, models might be all that we have.

Bibliography

Bank of England, 2008, Inflation Report: February 2008, http://www.bankofengland.co.uk/publications/Documents/inflationreport/ir08feb.pdf, last assessed 2nd Mar 2015

Bank of England, 2008, Inflation Report: May 2008, http://www.bankofengland.co.uk/publications/Documents/inflationreport/ir08may.pdf, last assessed 2nd Mar 2015

Bank of England, 2008, Inflation Report: August 2008, http://www.bankofengland.co.uk/publications/Documents/inflationreport/ir08aug.pdf, last assessed 2nd Mar 2015

Bank of England, 2008, Inflation Report: November 2008, http://www.bankofengland.co.uk/publications/Documents/inflationreport/ir08nov.pdf, last assessed 2nd Mar 2015

Bank of England, 2009, Inflation Report: February 2009, http://www.bankofengland.co.uk/publications/Documents/inflationreport/ir09feb.pdf, last assessed 2nd Mar 2015

Box, G. E. P and Draper, N. R., 1987, Empirical Model-Building and Response Surfaces, United Kingdom: Wiley

Carlin, W., and Soskice, D., 2015, Macroeconomics: Institutions, Instability, and the Financial System, United Kingdom: Oxford University Press

Hansen, L. P., 4th Dec 2014, The Consequences of Uncertainty, speech, Sheikh Zayed Lecture Theatre, New Academic Building, London School of Economics and Political Science, United Kingdom.

Haidar, J.I., 2015, Can the Euro Survive?," The World Economy, Wiley Blackwell, vol. 38(3), pages 553-567, 03.

Haidar, J.I., 2012. "Sovereign Credit Risk in the Eurozone," World Economics, World Economics, vol. 13(1), pages 123-136, January.

Haidar, J.I., 2012. "Currency crisis transmission through international trade," Economic Modelling, vol. 29(2), pages 151-157.

Haidar, J.I., 2011. "Currency Valuation and Purchasing Power Parity," World Economics, vol. 12(3), pages 1-12, July.