IS-LM With Credit Markets

and Inflation Targeting

– a suggestion for undergraduate macroeconomics –

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Economics as introduced to undergraduate students tends to discourage many from pursuing a major. One problem is the unfortunate combination in our macroeconomic models of scientifically necessary rigor and far-reaching abstraction from the real world. Recent contributions have improved real world relevance of the IS-LM model framework by introducing imperfect asset substitutability and inflation targeting as a monetary policy goal. This paper suggests a method for bringing these contributions together within monetary equilibrium that enhances explanatory power and connects these results with related empirical findings. It is shown that the strength of the transmission mechanism from monetary policy to real sector activity depend on overall economic activity.

Standard, IS-LM models as used in undergraduate macroeconomics commonly lack ability to acknowledge the role of credit market in modern economies. This shortcoming contributes to the lack of realism of which economics is sometimes

[1] The author is grateful for comments from Roy J Rotheim.

criticized. Recent contributions have sought model development and improved explanation of monetary policy in two different ways. The first of these introduces imperfect asset substitutability by addition of credit markets (Brunner and Meltzer 1972, 1988; Bernanke and Blinder 1988, 1992; Bernanke and Gertler 1993). Empirical evidence supports development of the IS-LM model framework in this direction (Kashyap, Stein and Wilcox 1993; Loungani and Rush 1995).

The second line of contribution to model reform is by Romer (2000), who seeks a more accurate explanation of monetary transmission mechanisms. He proposes a complete reform of monetary equilibrium to account for actual central bank policy.

This paper suggests a unification of Romer's contribution with the imperfect asset substitutability contribution. Section 1 introduces asset substitutability, section 2 presents Romer's alternative to the LM function and part 3 brings the two approaches together in one model.

Asset substitutability

In its standard setting, the IS-LM framework assumes that all debt instruments are perfect substitutes on one single bond market "which is then conveniently suppressed by Walras' Law" (Bernanke and Blinder, 1988, 435). A common approach to breaking up this perfect substitutability is adding an imperfectly

substitutable asset to the two-asset model. Brunner and Meltzer (1972) add a loan market to the real sector, which determines the rate of interest that brings the real sector to equilibrium[2]. This type of model shows how monetary control policy "achieves better results in response to credit market shocks than a strategy of interest control" (Brunner and Meltzer 1988, p. 447)[3].

Bernanke and Blinder (1988) also introduce imperfect substitutability by locating the credit market to the IS function. Again, the three-asset model comes with two interest rates, one for bonds and one for credit. It is assumed that the latter usually is a positive function of the former (p. 436, note 4). Bernanke and Blinder (1992) further elaborate the transmission mechanism, reporting that tighter monetary policy transmits to the asset portfolios of commercial banks, causing supply of loans to fall.

Adding a possibility for firms to choose capital structure, Kashyap, Stern and Wilcox (1993) find evidence of a transmission mechanism from monetary policy to credit supply and output even when interest rates are controlled for, verifying the predictive power of the Commercial Paper-Treasury Bills spread:

> If tight money eventually has an output effect, this effect will have been forecast by the movement in the CP-bills spread. (Kashyap et al. 1993, 79)

[2] We assume a standard set of functions in the real sector: consumption is only income dependent, private investment is only interest dependent and there is no accelerator. Part 3 discusses potential model expansions in this framework.
[3] Meltzer (1995) shows how similar results can be achieved under strict monetarist conditions.

Bernanke and Gertler (1993) support this finding, concluding that "tight money constrains bank lending and forces firms into the commercial paper market" (p. 270).

The asset substitutability contributions have in common: a) introduction of imperfect asset substitutability by means of a loan market; b) location of the loan market in real sector equilibrium; and c) introduction of a loan rate of interest that explicitly or implicitly depends positively on the bond rate of interest.

Monetary policy and monetary equilibrium

Romer (2000) suggests a radical reform of monetary equilibrium in order to open the model to modern monetary policy analysis. When discussing the abilities and limitations of the IS-LM model,

> one cannot discuss whether a model is "good" without knowing what issues it is intended to address. (Romer 2000, 151)

For theory, the IS-LM model was designed to explain the dichotomy between real and monetary activity. In terms of policy, the model was not primarily designed to account for inflation and policy aimed at curbing it. Inflation plays a

more prominent role in economies today than when the original model was formulated. Therefore it is fair to challenge the theoretical foundation of monetary equilibrium in the IS-LM model that constitutes its policy potential. One of the controversial model choices of the IS-LM framework is its exclusion of complete and immediate price adjustment to a shock (Romer 2000, 152). Compared to a case of perfect price flexibility, this model choice leaves room for real monetary expansion until the price level has gradually and fully adjusted. While providing an appealing policy explanation vehicle, the LM curve's use of the price level rather than the rate of inflation also restricts the model in terms of accounting for inflation effects as well as inflation policy.

This excludes the possibility for central banks to target inflation rather than money supply. Since most central banks exercise inflation targeting by targeting the real interest rate, empirical validity demands reform of the way in which the IS-LM model represents monetary equilibrium (Romer 2002, 154-156).

Romer defines a Monetary Policy, MP, function instead of the LM function. The foremost property of the MP function is that it is strictly horizontal. While acknowledging the theoretical advancement reported by Romer, we will not use the MP concept here. This article seeks to merge two suggested reforms to monetary equilibrium in the IS-LM model, and therefore the demand for communicative simplicity calls for use of the LM label.

In addition, to further preserve model simplicity we maintain Romer's explicit assumption – which the other contributors implicitly share – of money supply as being high-powered money. Introduction of a more advanced money supply function, such as credit money along the lines of Moore (1988) adds model complexity without sufficiently enhancing model explanatory power.

Model development

While adding a credit market takes the IS-LM model closer to reality, locating it to the real sector forces us to introduce two new model features to support it. The first feature is a link from monetary equilibrium, specifically the money supply, to real sector equilibrium, specifically the credit market. This link, which constitutes the transmission mechanism of monetary policy, is not developed by the asset substitutability approach. Technically, this transmission mechanism links the bond interest rate to the credit interest rate. However, with the credit market located within the real sector it is not immediately clear how that bridge works. Imperfect asset substitutability means that portfolio managers make portfolio choices based on preferences between lending to the private sector and the government. It is not immediately clear how this portfolio management can take place when the credit market is not part of the monetary equilibrium: if the loan rate of interest is to be open to monetary policy, then there must be a direct

relation between monetary policy moves by the central bank and portfolio choices by commercial banks. Locating the credit market to the IS function implies that credit supply decisions are independent of banks' portfolio decisions.

A second model feature implied by real sector location of the credit market is that real sector equilibrium in the interest-income space is qualitatively different from monetary equilibrium in the same space. The interest rate that clears the real sector is the credit interest rate, whereas the monetary sector is cleared by the bond rate of interest. A link between the two interest rates is part of the transmission mechanism described above. Although such a transmission mechanism can be properly defined and put to work in the model, it appears more obvious that a workable transmission mechanism is more easily defined if the credit market is located closer to the monetary policy instrument, which – following Romer – is the real rate of interest.

When the loan market is located in the monetary equilibrium its supply side becomes part of the asset portfolio of commercial banks. Credit supply choices are made together with choices on investment in government bonds. Asset substitutability is the portfolio manager's perception of heterogeneity in investments on the bond market and on the credit market. Portfolio management

decisions therefore also become the vehicles that carry the transmission mechanism from monetary policy to real sector activity[4].

The qualitative difference between loans and bonds from which portfolio decisions are made can conveniently be described in terms of the difference between two tiers of loans. Banks classify borrowers as either 1st tier customers or 2nd tier customers and distinguish between them in terms of risk. Lending to 1st tier customers exposes banks to the same risk as lending to the government, which means that 1st tier loans are perfect substitutes with government bonds. Therefore, to compensate for the higher risk in 2nd tier lending, commercial banks supply 2nd tier credit at an interest rate $r_{L2}>r_{L1}=r_B$.

The bond rate of interest, r_B, is the policy instrument used by the central bank. Under constant monetary policy and constant credit demand, variations in the loan rates of interest are caused only by changes in credit rating. Credit rating, in turn, is a function of aggregate income: when income grows more households qualify for 1st tier loans. Let r* be the *weighted average loan rate of interest*, such that, all other things given, a rise (fall) in the ratio of households that qualify for 1st tier loans raises (lowers) r*. *k* is a constant and *z* is lender's risk aversion preference, $z = z\left(\underset{-}{Y}\right)$[5]. This gives us supply of loans as a function of loan demand:

[4] We disregard the possibility of investments on the stock market. For the time being we also disregard investments on a corporate bond market.

[5] Since banks never supply credit under zero risk, $z > 0$ holds strictly.

(1) $r^* = k^z(L_D)$

Being risk neutral, households do not demand loans based on their credit rating, but based on the price they are offered and their income. We can therefore aggregate loan demand in to one function:

(2) $L_D = l(\underset{+}{Y}; \underset{-}{r^*})$

Credit demand is an aggregate at r*, and therefore r* is also the interest rate at which the real sector reaches equilibrium. r* is partly a function of r_B, and therefore central bank policy affects real sector equilibrium through the bottom of the loan interest rate spectrum.

The transmission mechanism of monetary policy

Assume a rise in Y. A shift outward in credit demand is followed by a rise in credit supply along the supply function. At given r_B the rise in demand pulls the rate of interest upward at a decreasing rate. The decreasing interest rate pressure on the private sector translates into an accelerating rise in investments. The LM function flattens out.

If, on the other hand, the rise in Y conveys increased inflation, the central bank responds with marking up r_B enough to preserve a constant real interest rate. When the bond rate of interest increases, commercial banks reduce 1st tier lending until $r_B=r_{L1}$ is restored. This slows down lending in the 1st tier, and since the lower risk loan segment is increasingly important as a market for risk capital, the power of the central bank to affect real sector activity grows with *Y*. Since the rise in r_B is in effect for all *Y*, this is equivalent to a shift upward in the LM function and a slowdown in expansion of *Y*. In absence of intervention by the central bank the increase in Y will, theoretically, accelerate at an ever higher speed, driven by credit.

Suppose instead that *Y* is falling. Households are now increasingly categorized as 2nd tier buyers on the credit market. To reduce risk commercial banks therefore seek shelter in 1st tier lending or – since that market is shrinking with falling Y – government bonds. So long as inflation is unchanged and the central bank therefore holds the interest rate unchanged r* will fall in proportion to the reallocation of credit supply from the 1st tier to the 2nd tier and the fall in credit demand. Eventually, only 1st tier borrowers among private firms will have the opportunity to re-finance their debt or finance new investment. The IS function shifts inward along the increasingly steeper LM curve[6].

[6] If at some point banks withdraw completely from second-tier lending, credit supply collapses into first-tier supply at the bond rate of interest. Realistically, however, this only happens in a deep depression; during a regular business cycle banks will still be willing to expose themselves to

It is reasonable to expect falling inflation in a recession. As a response, the central bank cuts r_B which – in symmetry with the aforementioned increase – causes the LM curve to shift downward. The effect depends on the transmission of monetary policy action through the credit market, a mechanism that is represented by $r_{L1}=r_B$ and the weight of r_{L1} in r*.While the former always holds, the latter is weakened in a recession due to stronger risk aversion preference among banks.

A cut in r_B allows firms with existing 1st tier credit to refinance and thereby improve their performance in the midst of a recession. Thus, through its positive effect on private investment, the r_B cut slows down the fall in *Y* and helps the economy stabilize in the recession. However, it is important to notice that if the recession makes banks turn sufficiently prudent, the moderating effect of the r_B cut will be thwarted.

These two examples illustrate how the central bank can moderate business cycle swings. In the expansion case there is a risk for excessive credit expansion as commercial banks re-classify nearly all of its customers as 1st tier. In the case of contraction the rate cut slows down the fall in Y (so long as, again, credit re-categorization does not work in the opposite direction). But can an inflation-targeting central bank take the lead and pull the economy out of a recession? The European Central Bank does, e.g., not have the same directive as the Federal

some second-tier lending in order to preserve their market presence. An unchanged bond rate of interest will therefore not serve as an absolute interest rate floor.

Reserve to promote recovery in a recession. Does this mean that the ECB in practice is deprived of an efficient policy tool?

Suppose an economy is at unemployment equilibrium. Inflation is stable so the central bank has no price-caused reason to intervene. To stimulate the economy, the central bank cuts r_B which causes r* to fall via a reduction in r_{L1}. However, because of the strong risk aversion preference held by commercial banks, a large number of borrowers do not meet 1st tier credit requirements. The weight of r_{L1}.is small which severely weakens the transmission mechanism for monetary policy. Thus, while inflation targeting can moderate a recession, it cannot be expected to produce any significant results in terms of active demand stimulus.

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