Problem Set 4: Monetary Policy & New Keynesian Model

Monetary Policy

Exercise 1. What are the implications of a nominal anchor for stabilization policy? (Hint: consider what would happen to inflationary expectations in the future – and hence long-run interest rates – if expectations were not anchored, and the central bank increased money growth today in response to a recession).

Solution 1 (Nominal Anchors)**.** If financial markets know that the central bank is ultimately constrained in how much money it can print (e.g. agrees to fixed nominal exchange rate peg), then they will realize that any rise in money growth will be *temporary*. As a result, when the bank lowers interest rates sharply, expectations of future inflation will remain low, as will the inflation risk premium. In turn, long-run interest rates will remain low. By contrast, without a nominal anchor, the central bank would be reluctant to engage in a large monetary stimulus for fear of raising inflationary expectations, the inflation risk premium, and hence long-run interest rates.

Exercise 2. 'But the FOMC also disliked being constrained by the bond market. It hated it when the bond market built expectations about policy actions at the very next meeting into current long-term interest rates, when the Committee was uncertain whether or not it would prefer to move that soon.' (Laurence Meyer, 'Term at the FED')

Explain what Meyer is referring to here.

Solution 2 (Expectations)**.** Meyer is referring to the idea that financial markets make inferences about the trajectory of central bank actions when the central bank changes interest rates. As a result, long-run rates move on the basis of these expectations. However, these expectations will not always be correct, and this can cause problems for the central bank. To see this, suppose the central bank lowers interest rates *and* the markets infer that they will keep rates low for next year. As a result, short-run bond yields (1-5 year duration, say) will fall a lot. But if the central bank considers changing rates after, say, 6 months, they would feel under pressure to proceed in the way the markets expected them to proceed. Otherwise, the unexpected change could be destabilizing, causing relatively large rises in bond yields and declines in bond prices. Because central banks care about financial market stability, the markets can effectively 'bully' the central bank into keeping rates unchanged.

Exercise 3. The FED has claimed that it will 'mop up' all the liquidity it has created as soon as the economy starts recovering. Is this claim dynamically inconsistent?

Solution 3 (Dynamic Inconsistency)**.** The central bank has committed to removing much of the excess liquidity it has created as soon as the economy recovers. However, when the economy starts to recover after years of poor economic performance and high unemployment, the FED will come under strong political pressure *not* to contract the monetary base. In this sense the claim is possibly dynamically inconsistent (and this is the reason why many at the FED are averse to quantitative easing.) On the other hand, if the FED has sufficient independence, the claim would be dynamically *consistent*. Ultimately, the answer depends on how politically independent the FED is.

New Keynesian Model

Exercise 4. Suppose a) because of globalization, consumer demand becomes more elastic; and b) nominal wages rise. To maximize profits, how should the monopolistically competitive firm change prices in each of these cases?

Solution 4 (Optimal prices under monopolistically competitive markets)**.** More elastic consumer demand implies η is higher, so the markup $\frac{\eta}{\eta-1}$ is lower, which translates into lower prices, since the firms' optimal prices are $P_i = \frac{\eta}{\eta-1}W$. When nominal wages W rise, prices will rise, according to the formula.

Exercise 5. According to the New Keynesian model, what are the implications of procyclical marginal costs for prices over the business cycle?

Solution 5 (Marginal Costs)**.** Because price is a markup over marginal cost, procyclical marginal costs would cause prices to rise in a boom, and vice versa (assuming prices are flexible).

Exercise 6. According to the New Keynesian model, a firm's price exceeds marginal cost; i.e., $p > MC$. Explain clearly why the firm would *reduce* profits if it produced more. Would the firm be willing to produce more at a *constant* price?

Solution 6 (Profit Maximisation)**.** A profit-maximizing monopolistically competitive firm chooses the optimal price/quantity combination, say (p, q). Assume the firm is initially maximizing profits. Crucially, if a firm desires to sell more, it must change its price/quantity combination to (p', q'), where $p' < p$ and $q' > q$. But because the firm was *initially* at an optimum, this new point can't maximize profits. Namely, to sell more, the firm must reduce its prices on *all existing* goods, which ultimately causes profits to fall. Yet – and this *is* important – since price exceeds marginal cost, if the firm somehow could sell more at the *existing* price, it would (so long as marginal cost doesn't rise much).

Exercise 7. What would happen to the optimal price if unions increased wages by some proportion, γ? In a symmetric equilibrium – i.e., where all firms were the same – what would happen to the real wage?

Solution 7 (Optimal Prices)**.** Optimal prices increase to γP when nominal wages increase to γW. Therefore, the real wage remains unchanged. To see this more formally: initially each firm sets a price $P_i = \frac{\eta}{\eta-1}W$. And because it's a symmetric equilibrium (where all firms are the same), P_i simply equals the average price level P. Therefore, $P = \frac{\eta}{\eta-1}W \implies \frac{W}{P} = \frac{\eta-1}{\eta}$. If wages all increased by a factor of γ, then for each firm $P_i = \frac{\eta}{\eta-1}\gamma W \implies P = \frac{\eta}{\eta-1}\gamma W \implies \frac{W}{P} = \frac{\eta-1}{\eta}$; i.e., the real wage remains the same. Intuitively, the price-setting firms move second and raise prices sufficiently to counter the rise in nominal wages by the union. For this reason, the *real* wage remains unchanged.

Exercise 8. What would happen to a firm's markup if nominal wages increased, but its price stayed fixed?

Solution 8 (Markup)**.** Since $P_i = mW$ (where m is the markup), if the wage increases but the price remains the same, then the markup m must fall.

Exercise 9. Write down the firm's optimal pricing rule in log form. What would be the optimal price if a firm must set prices for *two* periods? What log price would it set? What would happen if productivity was expected to rise next period? What would happen if the firm cared more about this year's profits?

Solution 9 (Sticky Prices)**.** Taking logs of the optimal pricing rule, $P_i = \frac{\eta}{\eta-1}W$, the log pricing rule becomes $\log P_i = \log \frac{\eta}{\eta-1} + \log W$.[1] If a firm is setting prices today for two periods, then it would set some weighted average of optimal prices for each period. So suppose the optimal log price today is $\log P_i = \log \frac{\eta}{\eta-1} + \log W$, while the optimal log price next period is $\log P_i' = \log \frac{\eta'}{\eta'-1} + \log W'$. Then assuming no discounting (i.e., the firm cares equally about each period's profits) the firm would set a price of $.5P_i + .5P_i'$ today. By contrast, if there *was* discounting, the firm would set $(1-\gamma)P_i + \gamma P_i'$ where $0 \leq \gamma \leq 1$. If the firm cared more about today's profits, then $\gamma < .5$. Similarly, replace P_i and P_i' by $\log P_i$ and $\log P_i'$ in the linear combinations to get the optimal log prices.

Explicitly introducing productivity A, the optimal log price is $\log P_i = \log \frac{\eta}{\eta-1} + \log \frac{W}{A}$. With higher productivity next period, the optimal log price next period is $\log P_i' = \log \frac{\eta'}{\eta'-1} + \log \frac{W'}{A'}$, where $A' > A$. As a result, the price set today, $(1-\gamma)P_i + \gamma P_i'$, would be *lower*.

[1] Since logarithms are often easier to work with, we often *log-linearise* expressions this way.

Exercise 10. In a boom, suppose there is 'learning by doing', as the firm produces more; that is, the workers learn to work more efficiently as they work harder in a boom. Explain how this mechanism acts as a form of *real rigidity*, which reduces incentives of the firm to change its price. How is the power of monetary policy affected? What implications does this have for the New Keynesian model's prediction for the cyclical nature of productivity, the New Keynesian Phillips Curve and the effectiveness of monetary policy?

Solution 10 (Learning by doing)**.** The marginal cost is given by $\frac{W}{A}$, where W is the wage and A productivity. If there is 'learning by doing' in a boom, then productivity A would rise as workers became more efficient. This would tend to counter the usual rise in marginal costs arising from increases in W. As a result, from the formula, $P_i = \frac{\eta}{\eta-1}\frac{W}{A}$, there is now less upward pressure on prices in a boom. In particular, this would imply prices would not move so much in response to a rise in the money supply, which would make monetary policy more effective. The more rigid prices are, the more effective monetary policy is – or the more real variables monetary policy affects. With learning by doing, productivity would be procyclical. The coefficient on the output gap in the NKPC would be smaller.

Exercise 11. Explain how *efficiency wages* affect firms' incentives to change prices. Efficiency wages refer to the idea that, as real wages rise, workers become more efficient.

Solution 11 (Efficiency Wages)**.** This is a similar situation to above. The concept of 'efficiency wages' refers to the idea that workers work harder and become more efficient as their wages rise. In the context of the model, this would imply that productivity A would rise as W rises. In this sense, marginal costs would remain relatively stable in a boom, which would attenuate the usual upward pressure on prices that typically occurs.

Exercise 12. Multiple Choice Questions: 2012 Q11; 2011 Q10; 2010 Q4, Q6, Q7; 2009 Q9.

Solution 12 (MCQs)**.** 2012: e. 2011: a. 2010: e, a, b. 2009: c.