

## Macro module 23 and 24 Keynesian model practice problems

### *Practice problems and illustrative test questions for the final exam*

(The attached PDF file has better formatting.)

This posting gives sample final exam problems. Other topics from the textbook are asked as well; these problems are just examples. All final exam problems are multiple choice; practice problems are not multiple choice so that the solutions can be better explained.

#### \*\* Exercise 24.1: New Keynesian model

In the new Keynesian model with sticky prices, imperfect competition, and mark-up ratios more than one, what are effects of an increase in  $M$  on

- A. The demand for goods
- B. The total net profit from sales of goods
- C. The economy wide demand for labor curve
- D. The equilibrium quantity of labor supplied
- E. The real wage rate
- F. The economy wide labor supply curve
- G. Real GDP
- H. The cyclicality of the labor supply
- I. The cyclicality of the marginal product of labor
- J. The cyclicality of the price level
- K. The cyclicality of the money supply

*Part A:* In the equilibrium business cycle model, money is neutral. An increase in the money supply increases the price level, since prices respond rapidly to equate supply and demand of goods. Even with imperfect competition, prices respond rapidly to keep the same mark-up ratios.

If prices are sticky, the price level does not adjust rapidly for an increase in the money supply. If the money supply increases, people have more money than they want to hold, so they seek to buy more goods, whose prices haven't changed. The demand for goods increases.

For simplicity, we say prices do not change with sticky prices. In truth, prices change, but they do not fully offset the greater money supply. If the money supply increases 20%, markets that are perfectly competitive show a 20% increase in nominal prices. Price stickiness may cause the price level to increase 10%, not 20%.

*Part B:* The change in total net profit depends on the mark-up ratio. Producing more goods requires more labor. Since the labor supply curve is upward sloping, using more labor means a higher real wage rate, which increases the cost of producing goods. If the mark-up ratio is 1 (as is true for perfect competition), to produce more goods and not lose money, the price must rise. If prices are sticky and do not rise, firms don't produce more goods, which decreases total net profit.

*Question:* What if the labor supply curve is backward bending? That is, the income effect is stronger than the substitution effect?

*Answer:* A backward bending supply curve implies that a higher real wage rate won't elicit more labor. This is possible for some workers: a rich lawyer may take more vacation if the real wage rate increases instead of working more. For most workers, the substitution effect dominates.

If the mark-up ratio is more than 1 (as is true for imperfect competition), firms make profits on each good sold. They produce more to meet higher demand, even if the price of the good does not rise. The total net profit from sales increases, as long as the cost of producing the additional goods is less than the sales price.

*Illustration:* Suppose the mark-up ratio is 1.200. If the demand for goods rises (the demand curve shifts to the right), firms hire more labor and produce more goods until the cost of producing the goods increases 20%. In the long run, firms maximize profits by setting prices 20% above the cost of producing the goods. As they increase nominal prices, demand declines, firms hire less labor, production declines, inflation-adjusted prices return to their original level, and the change in the money supply has no long-term effect.

*Take heed:* The models in chapters 15 and 16 that posit monetary effects on the real economy are generally short term models. In the long-run, money is neutral; it has little or no effect on long-term economic growth.

*Part C:* In the short run, capital is fixed, so firms need more labor to produce more goods. The labor demand curve has quantity on the horizontal axis and the real wage rate on the vertical axis. If firms demand more labor for a given real wage rate, the labor demand curve shifts to the right.

*Question:* What is the change in the quantity of labor demanded?

*Answer:* A one unit increase in labor increases production by  $\Delta L^d \times$  marginal product of labor (MPL). For an increase in production of  $\Delta Y$ , labor must increase by  $\Delta Y / \text{MPL}$ .

*Question:* Does this mean that total production is labor  $\times$  marginal product of labor?

*Answer:* The marginal product of labor is downward sloping, so the MPL decreases as labor increases. Total production is more than  $L^d \times$  the marginal product of labor (MPL).

*Question:* In this section, the textbook has  $Y$  and  $L^d$  varying by firm, so it uses  $Y(j)$  and  $L(j)$ . Why does the model have this extra parameter?

*Answer:* In perfect competition, all firms charge the same prices and have the same marginal product of labor. The new Keynesian model assumes markets are not perfectly competitive, so the equations depend on the characteristics of the firm.

*Question:* When do we use labor vs labor demand ( $L^d$ ) vs labor supply ( $L^s$ )?

*Answer:* To decide how many workers to hire, firms use their labor demand curve ( $L^d$ ). To decide how much labor to supply, households use their labor supply curve ( $L^s$ ). The equilibrium quantity of labor ( $L$ ) is an input to the production function and determines the amount of income.

Know Barro's comment on equation 16.3 on page 292:

Equation 16.3: 
$$\Delta L^d(j) = \Delta Y(j) / \text{MPL}(j)$$

Barro says: "The important point is that, with a fixed price  $P(j)$ , an increase in the nominal demand for money,  $M$ , leads to an expansion of the labor demand by each firm  $j$ ."

*Question:* Why does the demand curve for labor shift to the right? Why isn't this a movement along the demand curve?

*Answer:* The real wage rate for a given supply of labor has not changed. However, for any real wage rate, firms demand more labor than before, because the demand curve for this goods has shifted to the right.

- If the real wage rate decreases, firms demand more labor: this is a movement along the demand curve.
- If demand for their products increases, firms demand more labor: this is a shift of the demand curve.

*Part D:* The demand for labor equals the supply of labor in equilibrium. The demand for labor increases, so the equilibrium supply of labor increases.

*Part E:* The supply of labor depends on the real wage rate. For the supply of labor to rise, the real wage rate must rise. This is a movement along the supply curve for labor, not a shift of the curve itself.

The cyclical nature of the real wage rate differs between the new Keynesian model and price misperceptions model.

In the price misperceptions model, people work more because they think the price level has not changed even though it has. The demand for labor has not changed, so a higher labor supply means a lower real wage rate.

In the new Keynesian model, people work more because prices are sticky and the mark-up ratio is more than one. The demand for labor curve shifts to the right, and businesses want more labor to produce more goods to earn more economic profits from the high mark-up ratios. To induce people to work more, businesses have to raise the real wage rate, so the real wage rate is pro-cyclical.

*Part F:* The labor supply curve itself does not change. In Figure 16.1 on page 293, the demand curve for labor shifts to the right, but the supply curve for labor does not shift. Workers have no misperceptions about prices in the economy and the supply of capital has not changed; these are the two items that might cause a shift in the supply curve for labor.

*Part G:* The equilibrium quantity of labor increases, so more goods are produced and real GDP increases.

*Question:* This seems counter-intuitive. The microeconomics course says that free markets maximize output and optimize social welfare. Barro makes the same assumptions about free markets in the macroeconomic text. The benefit of free markets reflects the ability of prices to adjust rapidly to equate supply and demand. Now we say that sticky prices can increase real GDP.

*Answer:* The new Keynesian model works only if markets are not competitive. The market prices are too high. Firms earn monopoly profits and consumer welfare is not optimized. The increase in the nominal money supply  $M$  and the stickiness of prices causes real prices to fall toward their competitive level. Production and real GDP increase, and consumer welfare increases.

*Part H:* The labor supply is pro-cyclical: it increases in booms and decreases in recessions.

*Question:* Is this the same as in the equilibrium business cycle model?

*Answer:* In the equilibrium business cycle model, booms are caused by increases in the technology level, which shifts the demand curve for labor right by increasing the marginal product of labor. In the new Keynesian model, booms are caused by a shift of the demand curve for labor to the right by an increase in the money supply. Both shifts cause an increase in the quantity of labor supplied.

*Part I:* The cyclical nature of the marginal product of labor differs between the new Keynesian model and the equilibrium business cycle model.

*Question:* You say "the labor supply is pro-cyclical." Do you mean the labor supply curve is pro-cyclical?

*Answer:* A supply curve is not pro-cyclical or counter-cyclical. The quantity of labor supplied is pro-cyclical. The cyclical element reflects the shifts in the demand curve for labor.

In the equilibrium business cycle model, booms occur because the technology level rises. A higher technology level raises the marginal product of labor (as well as the marginal product of capital), so the marginal product of labor is pro-cyclical.

In the new Keynesian model, booms occur because the money supply increases, with no change in the technology level. Prices are sticky, so the price level does not rise, the real prices for goods decrease, and

the demand curve for goods shifts to the right. The mark-up for goods is more than one, so firms make money by selling more goods even though the price does not rise. To produce more goods, firms use more labor. Labor has decreasing marginal utility, so since the technology level has not changed, the marginal product of labor decreases. More labor means higher real GDP, so the marginal product of labor is counter-cyclical.

Empirically, the marginal product of labor is pro-cyclical. To explain why it is pro-cyclical even though the theory implies it should be counter-cyclical, Keynesian economists assume labor hoarding. Finding, hiring, and training new workers is expensive, so firms do not fire workers for mild changes in real demand. For example, insurers do not hire and fire actuaries each month as work levels change. Instead, workers are retained during recessions even though the marginal product of labor decreases. In recessions, workers have less to do, so the marginal product of labor decreases, and the marginal product of labor is pro-cyclical.

*Question:* Is this a serious critique of the model?

*Answer:* The marginal product of labor is hard to measure, and booms may have many causes, and many things affect the marginal product of labor. Understand Barro's critique, but it is hard to judge.

*Part J:* Booms are caused by increases in the money supply, so the money supply is pro-cyclical.

*Part K:* In the short run, prices are sticky, so one might think that the price level is acyclical. But sticky prices does not mean that prices don't change at all. Markets for commodities are competitive, and even in markets for complex goods, prices change somewhat. The price level is inversely correlated with the money supply, so the price level is counter-cyclical.

*Question:* Higher real GDP in the short run (when capital is fixed) implies higher labor. Does this mean that the labor supply is always pro-cyclical?

*Answer:* Not necessarily. The labor supply is pro-cyclical if the substitution effect dominates the income effect. Suppose an economy is primitive, and people work 80 hours a week just to earn enough money for food and shelter. This scenario is true for primitive agricultural societies in places with high population (so little land per capita) and poor soil and weather (so crop yields are low). With the equilibrium business cycle model, booms occur because the technology level rises. This model is especially appropriate for undeveloped countries, where better technology (better knowledge of what crops to plant) raises output.

Suppose the technology level doubles, and people have twice the income. The substitution effect is weak, since people are already working as much as they can. Few people work more than 80 hours a week even if the real wage rate rises. But the income effect is strong, because people no longer need to work all day for food and shelter. The quantity of labor supplied decreases, and the labor supply is counter-cyclical.

In modern societies, people don't work as much and most people have enough income for food and shelter even in recessions. The income effect is weak and the substitution effect is strong, so if the real wage rate increases, the labor supply increases.

See Barro *Macroeconomics* Chapter 16 Keynesian model pages 292-293

