

Modules 9 and 10: Equilibrium business cycle model

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; some practice problems are not multiple choice so that the solutions can be better explained.

**** Exercise 10.1: Cyclicalities**

Barro discusses the cyclicalities of each macroeconomic variable.

- A. What is the difference between trend, seasonality, and cyclicalities?
- B. What does pro-cyclical mean?
- C. What does anti-cyclical mean?
- D. What does a-cyclical mean?
- E. Why is cyclicalities so important for Barro's textbook?

Part A: Trend is a long-term, linear progression. Population growth is a trend: it stays about the same each year for more than a few years. Population growth is now slowing in many countries: the trend is slowing to a lower level, but it is still a trend.

Seasonality is systematic changes during the year, from holiday shopping, vacations, or weather patterns. The real demand for money is seasonal, since it is higher in November and December when households need money for holiday shopping, and low in January and February, when the weather is cold and few holidays draw consumers to stores.

Cyclicalities measures the correlation of a macroeconomic variable with real GDP (business cycles).

Part B: Pro-cyclical means that the macroeconomic variable is positively correlated with real GDP. Investment is one of the most pro-cyclical variables: in prosperous years, when real GDP is above its trend, investment is very high; in recessions, when real GDP is below its trend, investment is very low.

Part C: Anti-cyclical means that the macroeconomic variable is negatively correlated with real GDP. The unemployment rate is anti-cyclical: when real GDP is above its trend in prosperous years, unemployment is low; when real GDP is below its trend in recessions, unemployment is high.

Jacob: What does *above its trend* and *below its trend* mean?

Rachel: Suppose the long-term trend in real GDP is +10% per annum, starting at 100 in 20X0. If real GDP is 105 in 20X1 instead of 110, it is below its trend, even though it has increased from 20X0.

Part D: A-cyclical means that the macroeconomic variable is not correlated with real GDP. The inflation rate is a-cyclical: it reflects the growth in the money supply, not real GDP.

Part B: Each macroeconomic model implies certain types of cyclicalities. If the model predictions do not agree with empirical observation, the model may not be correct.

Jacob: The equilibrium business cycle model assumes that shifts in the technology level *A* cause recessions and prosperity. Why not examine whether these shifts actually cause real GDP to increase or decrease?

Rachel: We don't see the technology level. Dozens of items affect the technology level, and we can't easily measure the cumulative effects.

Illustration: The expanding use of the internet, cellular phones, genetically modified crops raise the technology level; wars, natural catastrophes (hurricanes, monsoons), droughts, epidemics lower the technology level; political changes, legal changes, international trade may raise or lower the technology level. We rarely know if the technology level is above or below its trend line.

Jacob: Wars, natural catastrophes, politics, and legal changes are not technology; why are they in *A*?

Rachel: *Technology level* is catch-all phrase, meaning everything besides labor and capital. Opening the country to international trade raises the technology level, since people learn how other nations produce goods.

Jacob: If technology level includes so much, isn't the macroeconomic model useless? It says that everything and anything might cause recessions and booms.

Rachel: On the contrary: the model says that only items affecting the ability to produce real goods affect recessions and booms. In contrast, some other models say that growth of the money supply or government fiscal policy (like the stimulus package of 2009) affects the real economy. Business people tend to believe Barro's model, that only real items affect real GDP. The other models, although dominant in past decades, do not accord well with empirical data. The 2009-2010 world economy, in which stimulus packages, fiscal spending, and money growth seem to worsen long-term economic performance, supports Barro's view. (Of course, macroeconomists who support other models believe that the 2009-2010 economy supports their view.)

Jacob: How do we test if the model is correct?

Rachel: We assume shifts in the technology level are the primary causes of recessions and prosperity in the short run; the supply of capital and (to a lesser extent) the supply of labor are fixed. (In the long run, the growth rate of the capital stock is the primary cause of higher real GDP. The first four chapters of the textbook cover the long-run, which affects a country's development.) We examine whether each item, such as consumption, investment, real interest rate, inflation rate, price level, unemployment rate, real wage rate, and money supply should be positively or negatively correlated with real GDP according to the model. We then compare the theoretical predictions with empirical data.

Jacob: Do we quantify the correlation that each item should have with the real economy?

Rachel: Economic research papers quantify these items. The textbook for this course focuses on the type of cyclicity. Barro mentions some relations from empirical data, but the final exam does not test these figures. Know relations of five types: strongly pro-cyclical, weakly pro-cyclical, acyclical, weakly counter-cyclical, and strongly counter-cyclical. Different macroeconomic models give different predictions. Barro does not always distinguish strongly vs weakly pro-cyclical or counter-cyclical. Know the instances where he does emphasize the relative strength, such as consumption vs investment or temporary vs permanent changes in government spending or temporary vs permanent changes in the real wage rate.

Jacob: Can we show that one model is better or worse than another from the cyclical effects?

Rachel: The relations are not always clear, and it is especially difficult to show causality. For example, Barro's model assumes money is neutral, so a change in the money supply does not affect real GDP. Some other economists assume that an increase in the money stock increases real GDP. Empirically, money is positively correlated with real GDP. Barro assumes the correlation is endogenous: that is, the monetary authorities expect higher real GDP, so they raise the money supply. We are not criticizing Barro here; his arguments are sound, and money probably is neutral.

**** Exercise 10.2: Short term vs long-term**

- A. How does Barro distinguish short term vs long-term relations?
- B. Is the Solow growth model a short term or long-term model?
- C. Is the equilibrium business cycle model a short term or long-term model?

Part A: Short term means the capital stock K is fixed; long term means the capital stock K varies.

Jacob: Doesn't Barro also assume that the labor supply is fixed in the short term?

Rachel: In his first discussion of labor, Barro assumes the labor supply is fixed to simplify the model. In later chapters, Barro assumes the labor supply is upward sloping if the substitution effect dominates the income effect and downward sloping if the income effect dominates the substitution effect.

Jacob: Doesn't Barro also assume the supply curve of capital services is upward sloping?

Rachel: The capital stock K is fixed in the short run; the capital utilization rate κ varies in the short run. The supply of capital services is κK .

Part B: The Solow growth model deals with changes in the capital stock K or capital per worker k ; it is long-term model.

Part C: The equilibrium business cycle model says "economic fluctuations are short-term responses to shocks to the technology level A ." It is a short term model. The textbook explains: "The main feature that makes the analysis short term is that we assume, as an approximation, that we can hold fixed the stock of capital, K . That is, in thinking about the relatively brief duration of a recession or boom, we do not allow enough time to elapse for the changes in machines and buildings – the goods included in K – to be significant."

See Barro, Macroeconomics, Chapter 8, page 134.