Notes on the Classical Model: Expanded version

Introduction

The defining feature of the "classical" macro model is the assumption that the economy always operates at potential GDP or "full employment" (allowing, as usual, for a certain non-zero rate of measured unemployment—sometimes called the "natural rate"—when real GDP is at potential).

Experiments performed using the classical model should therefore be thought of in this way: What would happen in response to such-and-such a disturbance *if* the economy were to remain at potential GDP?

Another way of saying this is that the classical model *abstracts* from the "Keynesian" problem of insufficient Aggregate Demand and unemployment above the "natural rate."

The classical model falls into three "blocks." In what follows we'll walk through the three blocks, describe the interactions between these blocks, and finish with some reflections on the model as a whole.

1 Block 1: Labor market and production function

Independent factors in Block 1:

- The labor supply curve, N^s.
- The production function, which we may think of as the Cobb–Douglas form, $Y = AK^{\alpha}N^{1-\alpha}$.

"Need to know" features of the Cobb–Douglas production function:

- The marginal products of both labor and capital—that is, MPN = dY/DN and MPK = dY/dK are positive but declining ("diminishing returns").
- The function exhibits constant returns to scale: if we scale both N and K by a common factor λ then the output Y will change by that same factor.
- The "cross-partials,", dMPN/dK and dMPK/dN, are both positive. That is, an increase in K increases the marginal product of labor and an increase in N raises the marginal product of capital.

Variables determined in Block 1:

- Aggregate employment, N.
- The real wage, W/P.
- Real output, Y.

Factors capable of shifting the economy's *labor supply curve* include the size of the population; the demographic breakdown of the population (how many people of school age, of working age, and of retirement age?); people's preferences regarding the income derived from working versus leisure time; and relevant government policies, for example the official retirement age and the provision or not of subsidized or free child-care.

The factors capable of shifting the aggregate *production function* (drawn as output Y against labor input N) are just the size of the country's stock of capital, K, and Total Factor Productivity, A. The latter can be thought of as representing the state of technology and the degree of education/skill of the workforce.

The aggregate *labor demand curve*, N^d, while important to the analysis, is not an independent element. Assuming that firms operate in a competitive market and maximize profits, the labor demand curve is the same thing as the marginal product of labor curve, which is just the first derivative of the production function with respect to employment, dY/dN. The labor demand curve will therefore shift if and only if the production function shifts. More specifically, the labor demand curve will shift upward if anything increases the marginal product of labor at each N—that is, if A or K increase. And conversely for a decrease in A or K.

2 Block 2: Loanable funds and the rate of interest

Independent factors in Block 2:

- The net supply of loanable funds from households, S.
- The demand for loanable funds on the part of firms, I.
- The government's borrowing requirement, $G - T$.

Variables determined in Block 2:

- The volume of borrowing and lending.
- The rate of interest, r.
- The *composition* of Y by spending. (How much consumption, how much investment?).

Our picture of the loanable funds market is drawn with Loanable Funds (amount lent and borrowed per period) on the horizontal axis and the rate of interest on the vertical axis.

The *supply of loanable funds* is drawn as increasing with the rate of interest. Recall that drawing this supply curve with an upward slope depends on the assumption that the substitution effect of a higher interest rate outweighs the income effect. (Substitution effect: *save more* at higher r because saving is better rewarded. Income effect: with a higher interest rate you can meet a given savings target—such as the value of assets you want to have when you reach retirement age—while *saving less* each year, since your wealth cumulates faster.)

However, the amount people save will also depend on their income, so this curve is liable to shift if Y changes (something that can only originate in Block 1). An increase in Y will shift the curve to the right: with greater aggregate income households will tend to save more at any given interest rate (while probably also consuming more too.)

The *demand for loanable funds* on the part of firms slopes downward with respect to the rate of interest. If the interest rate is high that means that borrowing is costly and firms will wish to invest less (that is, to spend less in purchasing capital goods). If the interest rate is low borrowing is cheap and a greater number of the potential investment projects a firm has in mind will look worthwhile.

The main *shift factor* for the curve representing firms' demand for loanable funds is their *expectations* of the profit they can make via investment spending. Borrowing at interest rate r looks worthwhile only if the firm can make a rate of profit greater than r by utilizing the borrowed funds. Expectations are always somewhat uncertain. The curve will shift to the right if firms become more optimistic about future profits; it will shift left if they become more pessimistic, or just more uncertain.

The *total demand for loanable funds* includes both borrowing by firms and any borrowing that the government has to carry out to cover its spending in excess of tax revenue—that is, $G - T$. If the government's borrowing requirement increases this moves the total demand for funds to the right. The effect is then to raise the rate of interest, which in turn discourages investment spending by firms—an instance of "crowding out."

Note that the interest rate is assumed to move to whatever value is required to equate the quantity of loanable funds supplied with the quantity demanded. An excess of quantity demanded over quantity supplied will push r up, and an excess of quantity supplied over quantity demand will push r down.

Moreover, in the Classical system the rate of interest is taken to play a "shock absorbing" role. For example, what happens if firms' desire to borrow and invest falls? We might think this could lead to a recession, but in the Classical model it's not a problem: the interest rate will fall, and in response to that people will decide to save less and consume more. The reduction in investment spending will be offset by and increase in comsumer spending: no recession.

3 Block 3: Money and prices

Independent factors in Block 3:

- The supply (or stock) of money, M.
- The velocity of circulation of money, V.

Variables determined in Block 3:

- The overall price level, P.
- Implicitly: the nominal wage, W (with the help of Block 1).

In the classical system we start from the Equation of Exchange, $MV = PY$. Both sides of this equation represent the total flow of spending on the GDP over some period of time: on the left, the amount of money times the speed with which it circulates; on the right the quantity of output multiplied by its price. These must be equal if everything that is sold is paid for!

We can get something more out of the Equation of Exchange if we make the following classical assumptions:

- M is exogenous: the stock of money is set independently, perhaps by the nation's central bank (in the USA, the "Fed").
- V is "slow moving." It's pretty much constant in the short run, but subject to gradual change in the long run as "payments technology" advances (ATMs, debit cards, Apple Pay).
- Y is fully determined in Block 1: it's not going to change in response to changes in M, V or P.

It then makes sense to solve the Equation of Exchange for P, the price level, which has not been determined so far.

$$P = \frac{MV}{Y}$$

This gives a curve which slopes downward in the space of P (on the vertical axis) against Y (on the horizontal axis). This curve will be shifted by changes in M or V.

The equilibrium price level is found where a vertical line representing the Y value (determined in Block 1) intersects the curve $P = MV/Y$.

Note that Block 1 gives a determinate solution for the real wage W/P. But that only fixes the *ratio* of the nominal wage, W, to the price level, P. If Block 3 pins down P, then given the W/P in Block 1 it also enables us to solve for W. Example: suppose we know that $W/P = 10$ from Block 1. Then Block 3 tells us that $P = 2$. It follows that W must equal 20.

4 Relationships between the classical blocks

Having divided the classical macroeconomic model into three Blocks, it's important to understand how they relate to each other. This is actually fairly simple. For the most part, Block 1 is in the "driver's seat." That is, changes in Block 1 can influence what happens in Blocks 2 and 3, but not *vice versa*. In the short run this is all there is to it, but in the long run Block 2 can react back to influence Block 3.

Alright, so what do we mean by "short run" and "long run"? In this context:

- Long run: a period of time long enough that changes in the rate of investment spending, I, can have a significant effect on the economy's capital stock, K.
- Short run: any period less than the long run.

The point is that K—the total amount or value of machines, computers, factory buildings, offices, highways, airports, etc.—is much larger than the annual flow of investment spending. So even quite a large percentage change in I will not have a significant impact on K unless it is maintained for several years.

We know that changes in Block 2 can result in a higher or lower rate of investment spending; that such changes will eventually produce an appreciable change in K; and that a change in K will shift the production function in Block 1. But we label this a long-run effect for the reason just given. In the short run we treat K as given, which means that nothing that occurs in Blocks 2 or 3 can shift the solution for W/P, N and Y that we get from Block 1.

On the other hand, we've noted above that a change in Y originating in Block 1 can have effects in Blocks 2 and 3. Namely:

- If Y increases because of something that happens in Block 1, this will tend to shift the supply curve of loanable funds (Block 2) to the right.
- If Y increases because of something that happens in Block 1, we'll move along the $P = MV/Y$ curve in Block 3, to a lower price level. (Unless there's a simultaneous increase in M or V that shifts that curve to a higher level.)

Classical Dichotomy

A "dichotomy" is a sharp binary division. The Classical Dichotomy is a sharp division between the factors governing the values of "real" variables (employment, real wage, real output) and "nominal" ones (the price level, the nominal or dollar wage). The idea (which, as we'll see later, is not uncontroversial) is that changes in M, V or P can have no impact on the the real variables just mentioned (or only a temporary, fleeting effect).

In relation to our classical blocks, this means: *Nothing that happens in Block 3 can have any impact on Block 1.*

Long-run effects

Just to be more explicit about something said above: Any change in Block 2 which results in a change in the rate of investment spending will eventually—in the "long run"—react back on Block 1, since it will change the value of K. As we know, this will shift the production function in (N, Y) space and therefore also shift the marginal product of labor schedule and the aggregate labor demand curve.

This long-run effect is the only reaction back on Block 1 that is admitted by the classical system.

5 Concluding remarks on the Classical model

How far should we "trust" the Classical model—that is, believe its predictions? This is somewhat controversial, but the majority view among macroeconomists (with which I happen to agree) is, "It depends." You may ask, depends on what?

- Are we assuming that, given some disturbance or "shock," the initial state of the economy is "full employment" or potential GDP? Or might the initial state be a depressed economy with high unemployment?
- Is the disturbance "contractionary"—that is, something that tends to reduce the rate of spending, such as a lesser desire to invest on the part of firms or a greater desire to save (lesser desire to consume) on the part of households? Or is it "expansionary"—that is, something that tends to increase the rate of spending, such as greater optimism on the part of firms, or a shift towards more spending by consumers, or an increase in the supply of money, M, by the central bank?

Based on the answers to the above questions, the majority view would be:

- If we're starting from full employment and the disturbance is *expansionary*, the Classical model does a good job of describing the trade-offs we inevitably face. If there are *not* lots of workers looking for jobs, then (for example) we can produce more capital goods (investment spending) only if we shift resources out of producing consumer goods. More employment in government services means fewer workers in the private sector. And greater spending of dollars overall, if it happens, will just drive up prices.
- If we're starting from full employment and the disturbance is *contractionary*, the Classical model is much too optimistic in reckoning that a fall in one sort of spending will surely be offset by an increase in another sort, via the intermediation of the rate of interest. We most recently saw this in the Great Recession (2007–2009): a big drop in investment spending in the construction industry was *not in the least* offset by an increase in consumer spending.
- If we're starting from *less than full employment* (a possibility that's not really admitted by the Classical model) and the disturbance is *expansionary*, the extra spending may be more helpful than the Classical model admits. In this case there is not a strict trade-off between investment spending and consumer spending, or between government employment and private-sector employment. Even an increase in M might help to boost output and employment, not just prices. These are points to which we'll return in depth when we take a look at the Keynesian macroeconomic model.