Rettevejledning til

Eksamen på Økonomistudiet, Vinter 2011/2012

Makro A og Macro A, 2. årsprøve

Efterårssemestret 2011

(Tre-timers prøve uden hjælpemidler)

Målbeskrivelse:

Faget videreudvikler langsigtsdelen af Økonomiske Principper 2, Makro.

I Makro A opstilles og analyseres alternative formelle modeller til forståelse af de langsigtede, trendmæssige tendenser i de vigtigste makroøkonomiske variable, såsom aggregeret indkomst og forbrug (per capita), indkomstfordeling, realløn og realrente, nettofordringsposition overfor udlandet, teknologisk niveau og produktivitet samt ledighed. I sammenhæng hermed præsenteres empirisk materiale under anvendelse af simple statistiske metoder.

Faget bygger op til Makro B ved at beskrive det forankringspunkt, økonomiens fluktuationer foregår omkring. Det bygger også op til Makro C ved at omfatte de mest fundamentale versioner af de langsigtsmodeller, som også indgår i Makro C.

De studerende skal lære de vigtigste såkaldte stiliserede empiriske fakta om økonomisk vækst og strukturel ledighed at kende, og de skal kende til og forstå den række af økonomisk teoretiske modeller, som i kurset inddrages til forklaring af disse fakta og til forståelse af økonomiens trendmæssige udvikling i det hele taget.

En vigtig kundskab, der begyndende skal erhverves i dette kursus, er selvstændig opstilling og analyse af formelle, makroøkonomiske modeller, som af type er som kendt fra faget, men som kan være variationer heraf. Der vil typisk være tale om modeller, som er formulerede som, eller er tæt på at være formulerede som, egentlige generelle ligevægtsmodeller. En del af denne kundskab består i en verbal formidling af en forståelse af modellernes egenskaber.

En anden vigtig kundskab er at kunne koble teori og empiri, så empirisk materiale kan tilvejebringes og analyseres på en måde, der er afklarende i forhold til teorien. Igen er verbal formidling af de konklusioner, der kan drages ud af samspillet mellem teori og empiri, en vigtig del af den beskrevne færdighed.

De typer af modeller, der skal kunne analyseres, omfatter modeller for lukkede såvel som for åbne økonomier, statiske såvel som dynamiske modeller, dynamiske modeller med såvel diskret tid som kontinuert tid. Modellerne skal både kunne analyseres generelt og ved numerisk simulation (sidstnævnte dog kun af ikke-stokastiske dynamiske modeller i diskret tid).

De studerende skal opnå færdigheder i at foretage økonomiske analyser i de typer af modeller, faget beskæftiger sig med, herunder analyser af strukturelle, økonomisk politiske indgreb og formidle analysens indsigter.

Topkarakteren 12 opnås, når de beskrevne færdigheder mestres til en sådan fuldkommenhed, at den studerende er blevet i stand til selvstændigt at analysere nye (fx økonomisk politiske) problemstillinger ved egen opstilling og analyse af varianter af de fra kurset kendte modeller under inddragelse og analyse af relevant empiri og afgive absolut fyldestgørende verbal forklaring af de opnåede analyseresultater.

Problem 1.

This problem asks the students to reproduce elements of explanations stated on very specific pages of the text book.

1.1. Chapter 9, Section 9.2, pages 244-246 (in the first edition of the book pages 277-280).

The concepts of non-rivalry and non-excludability should not be confused here (or in 1.2). This question is concerned with the non-rivalry and the explanation here is *not* that ideas can be copied by others. The explanation is rather the implication the non-rival character of ideas has for the cost functions of private firms engaging in production of ideas and/or idea based products. It is reasonable to assume constant returns to the rival inputs (the replication argument) implying constant marginal (and average variable) cost arising from the rival inputs. Because one and the same idea can be used in production of all units the development cost is to be considered a fixed cost. The total average cost curve therefore lies above the flat marginal cost curve. Under perfect competition the price will equal marginal cost and the fixed cost will not be covered implying negative profits. The forms will see this and therefore not engage in production of ideas under perfect competition. Under imperfect competition, on the other hand, the price can be above marginal cost and therefore the fixed cost can potentially be covered.

1.2 Chapter 9, Section 9.2, pages 247-248 (in the first edition of the book pages 281-282).

Here the focus is on non-excludability and the starting point is the obvious fact that if a idea can be freely used by others than the inventor (without costs at all), there is no commercial perspective in developing ideas. There should, however, be a discussion of the *degree* of excludability of ideas (as asked for), this ranging from absolute non-excludability to imperfect excludability. Furthermore, when it comes to the implications of a patent system, its double function of ensuring some monopoly power (tending to overcome the problem addressed in 1.1) and ensuring some excludability (tending to overcome the problem addressed in 1.2) should be mentioned.

1.3 In the R&D based model of economic growth (Chapter 9 of the text book), the technological variable A_t in period t represents and should be interpreted as (the productive effect of) the stock of all ideas developed up to and including period t. Furthermore, the model - both in its semi-endogenous and in its endogenous growth version - has the property that the rate of growth of income per worker in the long run becomes equal to the rate of growth of technology, that is, the growth rate of A_t. If we can associate the stock of productive ideas with the number of all patents granted, then according to the model, the growth rate of the stock of patents should come close to the growth rate of GDP per worker in the long run. Figure 1 shows that over the 50 years from 1950 to 2000, GDP per worker in the US seems to grow at a relatively constant rate (except for business cycles) of approximately 1.9 % per year. Figure 2 shows that the stock of patents granted in the US also grows at a remarkably constant rate, e.g., with no indication of a decreasing trend in the growth rate, and the growth rate is very close to that of GDP per worker. This fits remarkably well with the model.

Problem 2.

2.1 The first order conditions arise from setting the first derivatives of profit, , $zR\left(a\left(w_i\right)L_i\right)-w_iL_i$, with respect to w_i and L_i, respectively, equal to zero. This gives:

$$zR'\left(a(w_i)L_i\right)a'\left(w_i\right)L_i=L_i, \tag{1}$$

$$zR'\left(a(w_i)L_i\right)a\left(w_i\right)=w_i. \tag{2}$$

From (2), $zR'\left(a(w_i)L_i\right)=w_i/a\left(w_i\right)$. Inserting into (1) gives the "Solow condition":

$$\frac{a'(w_i)w_i}{a(w_i)}=1. \tag{3}$$

Both (1) and (2) have a 'marginal revenue (MR) equal to marginal cost (MC)' interpretation. In (1) the MR (left hand side) and MC (right hand side) are associated with a (small) change in w_i. In (2) they are associated with a change in L_i.

The intuition for (3) is that maximizing profits,

$$zR\left(a\left(w_i\right)L_i\right)-\frac{w_i}{a(w_i)}\cdot a(w_i)L_i,$$

requires that effective labour input, $a\left(w_i\right)L_i$, is bought as cheaply as possible per unit, that is, $w_i/a(w_i)$ should be minimized. This requires (as long as the optimum is given by the first order conditions) that a one percent increase in w_i gives a one percent increase in $a(w_i)$, or:

$$\frac{da(w_i)}{a(w_i)}/\frac{dw_i}{w_i}=1\Leftrightarrow\frac{\frac{da(w_i)}{dw_i}w_i}{a(w_i)}=\frac{a'(w_i)w_i}{a(w_i)}=1.$$

2.2 Given the specific form:

$$a(w_i)=(\frac{w_i-v}{v})^{\eta}, \tag{4}$$

one finds by differentiation:

$$\frac{a'(w_i)w_i}{a(w_i)}=\frac{\eta(\frac{w_i-v}{v})^{\eta-1}\frac{1}{\nu}w_i}{(\frac{w_i-v}{v})^{\eta}}=\frac{\eta\frac{1}{\nu}w_i}{\frac{w_i-v}{v}}=\eta\frac{w_i}{w_i-v}.$$

The Solow condition (3) then reads:

$$\eta\frac{w_i}{w_i-v}=1,$$

and solving for w_i gives:

$$w_i=\frac{v}{1-\eta}. \tag{5}$$

This is the w_i that follows from the first order conditions for profit maximization. To show that this is actually the optimal wage rate, or a global minimum for $w_i/a(w_i)$, requires more. Figure 1 below reveals that with the given form of the efficiency function $a(w_i)$, the point indicated, where the slope of the tangent, $a'(w_i)$, equals the slope of the ray, $a(w_i)/w_i$, is the point on the efficiency function with the largest value of $a(w_i)/w_i$ and thereby the smallest value of $w_i/a(w_i)$. This point is exactly given by $a'(w_i)=a(w_i)/w_i$, or $a'(w_i)w_i/a(w_i)=1$.

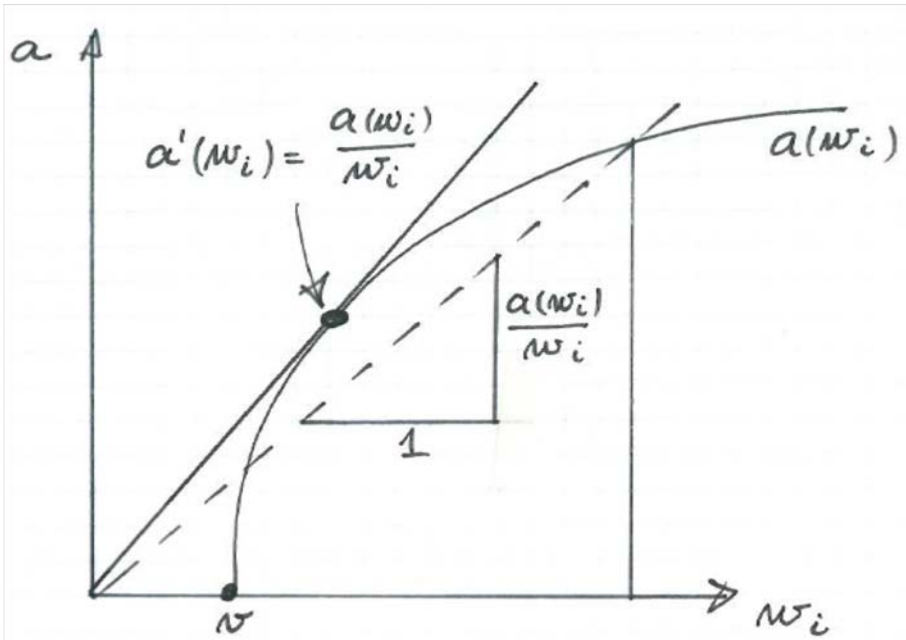

Figure 1

Inserting the expression for w_i of (5) into (4) gives:

$$a_i = (\frac{\frac{v}{1-\eta} - v}{v})^\eta = (\frac{\eta}{1-\eta})^\eta \equiv a^*. \tag{6}$$

Equation (5) says that the firm's optimal wage rate is given by a mark-up factor, $1/(1-\eta)$, times the outside option, v: The higher v is, the higher a wage rate w_i must the firm pay to obtain a given level of productivity, and the higher η is, the more effective are wage increases in providing more productivity.

2.3 Inserting the optimal value for w_i into the second of the first order conditions, (2), gives:

$$zR'(a^* L_i)\, a^* = w_i, \tag{7}$$

where, of course, the w_i appearing is given by (5) and a^* is given by (6). Again, to show that (7) actually gives the optimal employment requires more. First, given our assumptions on the revenue function R, equation (7) has a unique solution in L_i since the left hand side decreases from infinity to zero as L_i increases from zero to infinity. Second, this solution is the optimal employment level since everywhere to the left of it MR is larger than MC, so L_i should be increased, and vice versa to the right.

Inspection of (5) and (7) shows that in the *partial* equilibrium (where v is exogenous) z affects L_i, but not w_i. This fits well with the empirical (stylized) facts of business cycles, one of which is that over the business cycle employment is more volatile than and much closer correlated with output than real wages are. It does not fit well with the empirical (stylized) facts of growth, since one of these is that in the long run real wages increase with and are proportional to labour productivity (since a possible interpretation of z is that it contains productivity shocks).

From the problem set the following equations are restated:

$$v = (1 - u)\, w + ub, \tag{8}$$

$$w_i = w, \tag{9}$$

$$L_i = L = (1 - u)\, N, \tag{10}$$

$$b = c\bar{w}, \tag{11}$$

2.4 Inserting (11) into (8) gives $v = (1 - u)\, w + uc\bar{w}$, and then inserting this expression for v into (5) gives:

$$w_i = \frac{(1 - u)\, w + uc\bar{w}}{1 - \eta} \Leftrightarrow (1 - \eta)\, w_i = (1 - u)\, w + uc\bar{w}.$$

Using the equilibrium condition (9), that is, $w_i = w$, then gives

$$w = \frac{u}{u - \eta} c\bar{w}. \tag{*}$$

This is only meaningful if $u > \eta$. (It is shown below that there is an equilibrium where this is fulfilled). In that case $w > c\bar{w} = b$.

Equation (*) is independent of the values of the shocks. Now, given that $z^t = 1$, the w on the left hand side of (*) is (by definition) the same as the $\bar{w}$ on the right hand side. These cancel and one can easily solve for u, finding:

$$\bar{u} = \frac{\eta}{1 - c}. \tag{12}$$

2.5 Return to (7). From the equilibrium condition (9), the w_i on the right hand side can be set equal to the general real wage level w, and from (10) the L_i on the left hand side can be set equal to L and therefore to $(1 - u)\, N$. Hence:

$$w = zR'\left(a^* (1 - u)\, N\right) a^*. \tag{**}$$

Again, this is independent of the values of the shocks. Now, for $z^t = 1$, and hence $z = z^p$, the equilibrium general wage level w equals $\bar{w}$, and (as above) the equilibrium unemployment rate u is $\bar{u}$. It then follows from (**) that $\bar{w} = z^p R'\left(a^* (1 - \bar{u})\, N\right) a^*$, which can be written as:

$$\bar{w} = Kz^p, \text{ where } K \equiv R'\left(a^* (1 - \bar{u})\, N\right) a^*. \tag{13}$$

From (12) and (13) one can see directly that in the *general* equilibrium with $z^t = 1$, the permanent shock z^p does not affect the rate of unemployment and therefore not the employment level, $L = (1 - \bar{u})N$, but it gives proportional changes in the real wage rate $\bar{w}$. This fits with the empirical facts of growth, but contradicts those of the business cycle.

2.6 Equation (*) holds independently of the shocks. Inserting (13), $\bar{w} = Kz^p$, into (*), gives (14) below. Likewise (**) holds independently of the shocks. Inserting $z = z^t z^p$ gives (15). Hence, an equilibrium rate of unemployment and wage rate, u^* and w^*, respectively, at given shocks z^t and z^p must be solutions in u and w to:

$$w = \frac{u}{u - \eta} cKz^p, \tag{14}$$

$$w = z^t z^p R'\left(a^*\left(1-u\right)N\right)a^*. \tag{15}$$

The intuition behind the negative relationship between u and w of the "wage curve", (14), is: Other things being equal, an increase in u implies a lower value of the outside option v (using here that $w > b$), implying that the representative firm can obtain a given productivity level by a lower wage rate w_i. The increasing relationship of (15): At a higher wage rate w and thereby a higher MC, the employment level that equates MR and MC is smaller because the revenue function exhibits diminishing returns to L_i ($R' > 0$ and $R'' < 0$). In equilibrium a smaller employment level in each firm requires a higher rate of unemployment.

2.7 The figure should be as Figure 2 below (ignoring first the dashed curves).

Since the strictly decreasing curve (14) has a vertical asymptote for $u = \eta$, and falls down to $\frac{1}{1-\eta}cKz^p$ as u goes to one, and the strictly increasing curve (15) has a vertical asymptote at $u = 1$ (because $R'(x) \to \infty$ as $x \to 0$), there must be a unique intersection (u^*, w^*), where $\eta < u^* < 1$, and $w^* > \frac{1}{1-\eta}cKz^p > 0$. It can be seen directly from (14) and (15), that 1) both of the curves shift in the vertical direction proportionally to the permanent shock z^p, and 2) the curve (14) is unaffected by the temporary shock z^t, while the curve (15) shifts vertically in proportion to the temporary shock z^t.

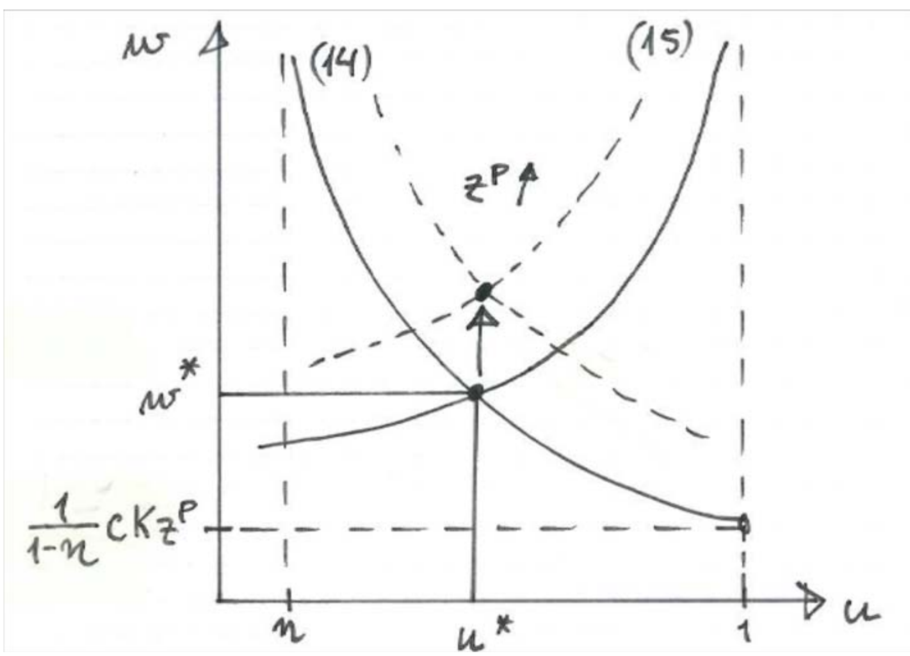

Figure 2

2.8 Permanent shocks: Since both of the curves for (14) and (15), respectively, shift vertically in proportion to z^p, the point of intersection will occur for the same u^* as before the shock and at a proportionally changed w^*. This is illustrated in Figure 2 above by the dashed curves. So, the permanent shock only builds itself into the real wage rate and not into the rate of unemployment or the employment level. This is in good accordance with the empirical facts of growth.

Temporary shocks: Since z^t shifts the curve for (15), but does not shift the curve for (14), shifts in z^t will imply that the equilibrium point (u^*, w^*) moves along the wage curve (14).This is illustrated in Figure 3 below.

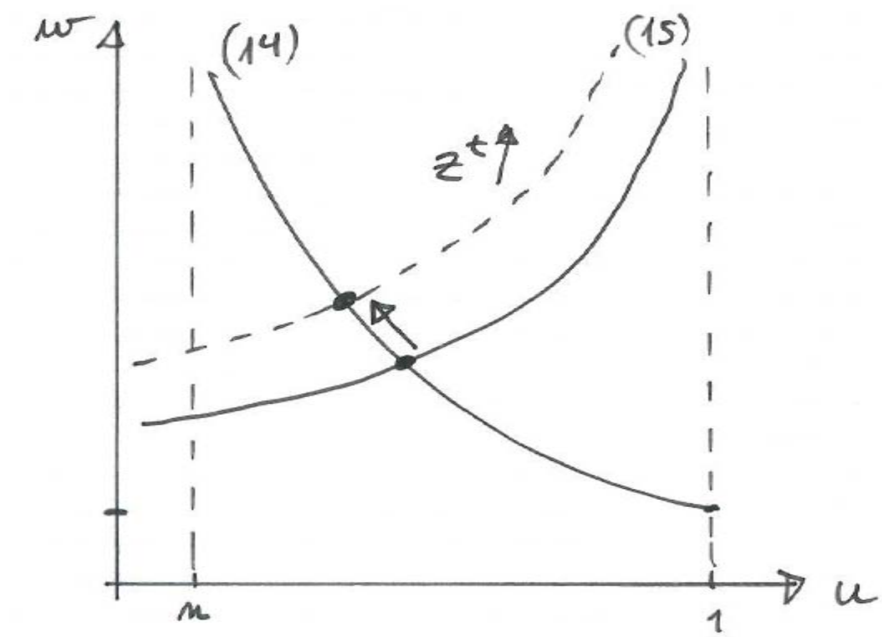

Figure 3

Both u^* and w^* shift and they go in opposite directions, so employment and real wages move in the same direction. It depends on the slope of the wage curve at the "old" equilibrium to what extent shifts in z^t build themselves into the real wage and employment, respectively. It is a possibility that the temporary shock will to a relatively large extent create fluctuations in employment. In case, this will be in good accordance with the empirical facts of business cycles.

The model can thus potentially be compatible with both the empirical facts of growth and those of the business cycle.