B. Savings, Investment and Growth: New Approaches for Macroeconomic Modelling

B.1 Introduction

In macroeconomics, there are two contrasting views to the role of the savings rate. In a short-term Keynesian perspective, a rise in the savings rate s reduces the equilibrium income. However, the long run neoclassical growth model suggests that a rise in the savings rate raises equilibrium real income. Short term macroeconomic analysis is rarely linked to long term dynamics and this can be misleading for policymakers. Moreover, it leaves policymakers, who would like to know under which conditions a rise in the savings ratio shows up in a contractionary or an expansionary impact, confused. The following analysis – for a non-inflationary world - is straightforward and first recalls the simple long run neoclassical growth model (SOLOW, 1956) and the short run Keynesian macro model before we merge both approaches within a new medium-term model. We present the multipliers for monetary policy, fiscal policy and supply side policy (rise in the savings rate s). Section 2 presents the model and the final section gives some policy conclusions. Several conclusions reached are in marked contrast to the standard Keynesian model and also go beyond the monetarist debate.

Analytical Starting Points

There have been various attempts at describing macroeconomic modernization in the literature. Real business cycle economists have emphasized the role of productivity shocks in models where the central bank has almost no options to influence employment and output (PRESCOTT, 1986; PLOSSER, 1989). New classical theorists have put the focus on the relevance of intertemporal optimization and rational expectations (LUCAS, 1981; LJUNGQVIST/SARGENT, 2000). Modern Keynesian economists have focussed on the effects of monopolistic competition, markups and costly price adjustment (MANKIW/ROMER, 1991; ROMER, 1993). The new neoclassical synthesis combines elements from both the Keynesian perspective and the classical approaches into a single framework where GOODFRIEND (2004) and GOODFRIEND/KING (1997/2001) have been particularly active – along with others (e.g. CLARIDA/GALI/GERTLER, 1999; WOODFORD (2003).

Combining short term economic perspectives with long term economic analysis is done here on the basis of a modified consumption function based on a variant of the permanent income hypothesis: It is assumed that at the macroeconomic level consumers' spending is a function of current income (Y_t) and the steady state value (Y#) where weights a' for discounted Y# and (1 - a') for current income Y_t are used: $C_t = c(1 - a')Y_t + ca'Y\#/(1 + r)$. This consumption function may be interpreted as follows: one group of consumers is mainly influenced by current income, a second group mainly by long term expected steady state income; or each consumer considers both the current income and long term expected income.

Moreover, we consider a specific net investment function which implies – for a certain parameter set – that investment per capita demand is such that the capital accumulation dynamics are consistent with the capital-market driven capital supply accumulation implicit in the Solow growth model. Thus our medium term model is consistent with the transition dynamics of the capital stock. The investment function used states that net investment dK/dt is proportionate to the difference between the marginal product of capital Y_K - net of depreciation (depreciation rate δ) - and the real interest rate r; specifically we assume an adjustment parameter b'(K) where the adjustment speed is a positive function of the capital stock. The argument for the adjustment speed b to positively depend on K is that in a highly specialized interdependent economic system the adjustment speed for sectoral differentials in the net marginal product of capital and the real interest rate will be the higher the larger K is. A final goods producer relying on intermediate suppliers would want to avoid a diversion of suppliers from the profit maximization condition – ensuring efficient production. The more complex the supplier network is – in a larger economy (as proxied by K) - the supplier structure becomes more complex and hence the final goods producer faces high sunk costs (if suppliers are not efficient the economic viability of final goods producers is threatened). An alternative argument would be that with rising K the number of potential bidders willing to take over a company with unexploited opportunities for profits will increase – an increasing probability of takeovers will stimulate the management to rather quickly eliminate differences between the net marginal product of capital and the real interest rate. To put it differently: While from a microeconomic perspective each firm faces adjustment costs in investment projects we assume that each firm's adjustment speed is linked to the overall capital stock. The larger K, the smaller the optimum adjustment speed chosen by the individual firm.

The model to be presented combines a sticky price short-term analysis (output is determined by aggregate demand) with an implicit long run flexible price model (Solow growth model); the mixture of Keynesain elements and the Solow growth model is not a contradiction as we will not consider a model with deflation or inflation. The price level is given because the Keynesian perspective implies a constant price level due to underutilization of production capacities in the short run; at the same time the Solow model is consistent with a constant price level as long as we are not considering process innovations (WELFENS, 2006b).

One should not easily dismiss that an alternative modelling strategy based on explicit microeconomic foundation and intertemporal maximization analysis for consumers and investors could be a useful alternative to the approach suggested. However, as we rely on the well established permanent income hypothesis and simply combine standard Keynesian analysis and well established results from long run growth analysis we are not relying on opaque ingredients for the medium term model. Moreover, the consumption function presented could indeed be derived from a rather simple two period model (with period 2 representing the long run, period 1 the short run); intertemporal optimization would bring out the role of subjective time preference. The only shortcoming which might be serious is that we are not considering delayed price adjustment which one could combine with monopolistic competition in a model with n product varieties – but one may emphasize that the simple model presented here already is highly complex in the multiplier analysis. Finally, for policy makers it will be quite useful to have a model which includes both parameters from consumption and investment demand as well as relevant supply-side parameters so that a broad range of options can be carefully considered.

B.2 A Medium-term Keynes-Solow Model

For the case of a production function is $Y = K^{ß}L^{1 - ß}$, capital depreciation is δK (depreciation is proportionate to the capital stock K, $0 < ß < 1$), savings S = sY and gross investment I = S the standard neoclassical growth model (assuming that the population L is constant) shows that long steady state equilibrium capital intensity k# and output Y#, respectively, is given by the expression

$$k\# = [s/\delta]^{1/(1 - ß)} \quad (1a)$$

$$Y\# = L[s/\delta]^{ß/(1 - ß)} \quad (1b)$$

Here δ is the depreciation rate of capital, s is the savings rate.
Taking at first a look at the closed economy(with savings rate s, real interest rate r and output Y and government consumption G) one may at first state the IS curve for goods market equilibrium as Y = (1 - s)Y - br + G. Using the hybrid consumption function suggested (with $L[s/\delta]^{ß/(1 - ß)}$ representing the modified permanent income component) we get:

$$Y = (1 - s)\{(1 - \alpha')Y + [\alpha'/(1 + r)]\, L(s/\delta)^{ß/(1 - ß)} \} - br + G \quad (1c)$$

Taking into account the investment function suggested we are not using the investment demand in the form of b/r, rather – taking into account the production function, namely $Y_K = ßY/K$ - gross investment is given by δK + b[ßY/K - δ - r]K and thus the equilibrium condition for the goods market reads:

$$\begin{aligned} Y = {} & (1 - s)\{(1 - \alpha')Y + [\alpha'/(1 + r)]\, L(s/\delta)ß/(1 - ß)\} \\ & + b[ßY/K - \delta - r]K + \delta K + G \end{aligned} \quad (1d)$$

Note here that for comparing the hybrid model with the standard Keynesian setup one should set K = 1. What about the role of real government expenditure G? A rise of G will raise Y and hence consumption will increase – as in the standard case – but the effect on consumption and hence equilibrium medium term output is reduced through the factor (1 - α’). Moreover, the increase in Y implies an increase in the marginal product of capital (as long as K is constant) so that investment is raised. This is a quasi-accelerator effect, and the fiscal multiplier indeed is raised through the term bß. If one endogenizes r, one will have to take into account a crowding out-effect both through lower consumption – see the modified permant income component – and lower investment. Note also that a rise of the savings rate s has an ambiguous effect since a rise of s reduces consumption with respect to current income (fall of marginal consumption expenditures) but stimulates consumption through the positive permanent income effect. Depending on the various parameters government might indeed consider to raise s as a medium term supply-side policy alternative to standard Keynesian policy options. Already from the inspection of the simple goods market equilibrium condition we see that a richer set of parameters is now determining multipliers: besides the standard Keynesian parameters we have supply side parameter such as ß, b, δ and the weighting factor α' for modified permanent income. One should note the advantage of the above approach in the sense that it easily allows to consider various crucial aspects at the same time; e.g. in an extended version (with production function $Y = K^{ß}(AL)^{1-ß}$; A denoting the level of Harrod-neutral technology) one may consider the role of process innovations easily as a standard vintage approach (STOLERU, 1978; p. 405) implies not only that A is rising at a certain rate but the depreciation rate δ, too. The multipliers for a setup with contant level of technology will be studied in more detail subsequently.

As the steady state value Y# is obtained from the differential equation for the change in the capital intensity k := K/L, namely

$$dk/dt = s(Y/L) - \delta k = sk^{ß} - \delta k \tag{1e}$$

long run output Y# is obtained by taking $t \to \infty$ or by setting dk/dt = 0. Rational forward-looking individuals with infinite time horizons would thus expect Y to converge towards Y# in the long run. The simple neoclassical growth model has the well-known implication that the higher the savings rate, the higher equilibrium output. Hence in a long run perspective, a rise in the savings rate will lead to higher equilibrium output.

B.2.1 Capital Accumulation Dynamics and Profit Maximization

It is unclear how the neoclassical SOLOW growth model can be reconciled with profit maximization which suggests that dk/dt should depend on the difference between the net marginal product of capital Y_K - δ and the exogenous real interest rate r (note that we are considering an economy without inflation here). We briefly suggest a way to resolve the problem. One may interprete equation (1c) as the change in the supply of new capital per capita; this typically is represented by the supply of savings in capital markets. The change in the demand for new capital per capita can be written – as proposed here – as:

$$dk^D/dt = b(Y_K - \delta - r)k \tag{1''a}$$

The equation - with b representing a positive parameter - says that net investment per capita is proportionate to

- the difference between the net marginal product of capital and the real interest rate

- the capital intensity k

Note that dk^D/dt will finally fall as the net marginal product of capital Y_K - δ is approaching the exogenous real interest rate; however, this effect is mitigated by the rise of k over time until finally Y_K - δ = r so that net investment demand per capita becomes zero.
The adjustment parameter b is exogenous at first glance. However, if the investment goods market is to be in equilibrium all the time, that is dk/dt = dk^D/dt, we must have b[r + δ] = δ and s = bß. This follows from rewriting equation (1"a) as

$$dk^D/dt = b(ßk^{ß-1} - r - δ)k = bßk^{ß} - [br + bδ]k. \qquad (1''b)$$

Clearly the path for k^D# will coincide with the k# in equation (1') only if

$$bß = s; \qquad (1''d)$$

and

$$b[r + δ] = δ \qquad (1''e)$$

These two equations imply [s/ß] [r + δ] = δ and therefore:

$$r = δ[(ß/s) - 1] \qquad (1''f)$$

By implication the real interest rate is positive only if ß > s. If (1"f) is fulfilled the supply of net investment per capita and the demand for net investment per capita coincide at any point of time. Note that the condition for the case of the golden rule (condition which maximizes per capita consumption) is fulfilled if δ = r and in the long run r = Y_K if ß/s = 2, that is s = ß/2. As ß is put for OECD countries typically at around 0.33 the optimal savings rate – maximizing long run per capita consumption – thus would be 16.5%. Note that for the case of a real money demand function m = hY - h'r (m is real money balances M/P where M and P stand for the nominal money stock and the price level, respectively; r is the real interest rate relevant in the present set-up with zero inflation) the implication is that the central bank must set long run [M/P] per capita such that we have

$$[m/L]\# = hk\#^{ß} - h'k\#^{ß-1} \text{ since } r = ßY/K = ßk^{ß-1}.$$

The general solution to (1"b) is – with e' denoting the Euler number - given by the solution of the Bernoullian differential (see Appendix G.4) equation $dk^D/dt = bßk^{ß} - b[r + δ]k$; the solution for this is

$$k^D(t) = \{C_0 e'^{-(1-ß)b(r+δ)t} + ß/[r + δ]\}^{1/(1-ß)} \qquad (1''g)$$

where C_0 is determined by initial conditions. The adjustment speed is the higher the higher b as well as the real interest rate and the lower ß. The adjustment speed for $k^D(t)$ is identical with that for k(t) if (1 - ß)δ = (1 - ß)b(r + δ) which requires (r + δ) = δ/b and this condition indeed is equal to equation (1"e). If adjustment speeds on the supply side and the demand side in the capital market are not coinciding we could have a picture as shown in the subsequent graph where during an initial time period the supply of net investment per capita is higher than the demand for investment per capita such that we will have unemployment while in a second period (after point F) we will have inflation as demand exceeds supply; in principle one also could have a first period of inflation followed by a second transition period of unemployment.

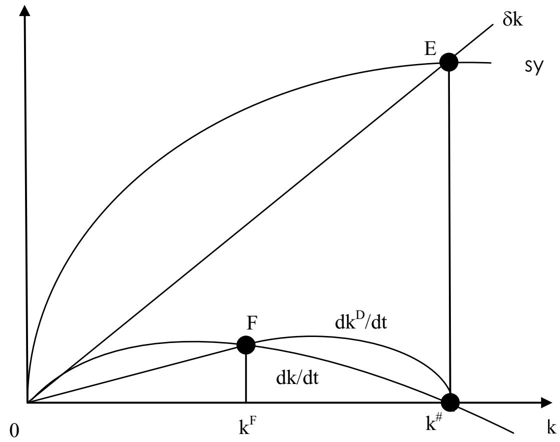

Fig. 24. Transitory Equilibrium (point F) and Steady-state Equilibrium ("time" 0F = unemployment, "time" FE' = inflation)

We thus may argue that the SOLOW growth model could indeed be consistent with profit maximization. Subsequently we will use the net investment function suggested in (1"a) in a medium term KEYNES-SOLOW model; the above specification is the only formulation which is consistent with the long run steady state value of the SOLOW model.

B.2.2 Chosing a Consistent Investment Function and a New Consumption Function

An investment function – for net investment – consistent with (1"a) thus is $I' = b(Y_K - r - \delta)K$ which will be used subsequently as the function describing investment demand. Whenever net investment is given by this equation we know that investment demand dynamics are potentially consistent with the SOLOW growth model. A possible modification of the case of unemployment (with the unemployment rate $u > 0$) or inflation ($\pi > 0$) could be formulated as $I' = b(Y_K - r - \delta)Ke'^{-\sigma' u - \sigma'' \pi}$ where e' denotes the Euler number and σ' is a the semi-elasticity (in absolute terms) of net investment with respect to the unemployment rate (σ" is the semi elasticity with respect to the inflation rate). Subsequently we will use the net investment function $I' = b(Y_K - \delta - r)K$.

Next we turn to a standard Keynesian model of a closed economy which implies that output is determined by aggregate demand consisting of consumption C, gross investment I and real government expenditures G. We denote reinvestment as I^R, net investment as $I'(r, Y_K, K)$, and we also consider a standard consumption function $C = cY^d$ (Y^d is aggregate demand). Hence output Y is given by

$$Y = cY^d + I^R + I'(r, Y_K, K) + G \tag{2}$$

It is assumed that net investment $I' = b(Y_K - \delta - r)K$ so that total investment $I := I^R + b(Y_K - \delta - r)K$ which implies for the goods market equilibrium

$$Y = cY^d + I^R + b(Y_K - \delta - r)K + G \tag{3}$$

The capacity effect of investment is neglected in the standard Keynesian setup and thus the marginal product of capital is constant in the short run. Output Y is driven by aggregate demand and thus is given – with $s := 1 - c$ and $I^R = \delta K$ - by the equation

$$Y^d = Y = [\delta K - by + G + b(Y_K - \delta - r)K]/s \tag{4}$$

$$dY/ds = -[\delta K - by + G + b(Y_K - \delta - r)K]/s^2 < 0 \tag{5}$$

The conclusion is that the savings rate negatively affects the short term equilibrium real income: A rise in the savings rate ($s' > s$) implies that at any real income the desired savings $S = s'Y$ is higher than before; however, the condition $I = S$ then implies a fall of equilibrium Y. This is in some contrast to the statement that savings from an individual perspective is useful and desirable as it is the basis for the accumulation of wealth. Note that the negative multiplier in (5) strongly differs – according to (1b) - from the neoclassical long run multiplier which is given by $dY\#/ds = ß/(1 - ß)L[1/\delta]^{ß/(1 - ß)}[s]^{-1/(1 - ß)} > 0$.

A straightforward hypothesis which combines the short run and the long run is to assume that output in the medium term is determined by weighted impacts from the demand side and the supply side (here the supply side is set equal to Y#):

$$Y = [1 - a'(t)]Y^d + a'(t)Y\# \tag{6}$$

The closer the economy is to full capacity utilization the higher a' is. In a situation of extreme capacity underutilization such as the Great Depression 1930-34 – with US output showing a cumulative fall of 27% (Germany 16%, France 11%) – a' is close to zero so that aggregate demand indeed determines output.

The idea of taking into account both impacts from the demand side and the supply side will be considered subsequently in a formal model whose approach is slightly different than the above equation, but the spirit is the same. Indeed, one may consider a medium term model which means taking into account that a rise in K will reduce the marginal product of capital (in contrast to the standard Keynesian analysis) and where we use the following modified consumption function, which is a simplified version of the permanent income hypothesis: The consumption function chosen emphasizes that consumption C is influenced not only by the present income but also by the long run expected income (here Y#); with a consumption function

$$C = ca''Y + ca'[1/(1 + r)]Y\# \tag{7}$$

we get the following equilibrium condition for the goods market in the medium term Keynes-Solow model:

$$Y = c\{a''Y + a'[1/(1 + r)]L[s/\delta]^{ß/(1-ß)}\} + \delta K + b(ßY/K - \delta - r)K + G; \quad \text{with } a'' := (1 - a') \tag{6'}$$

The consumption function suggested (for simplicity with a' independent of time) here states that C = cY + ca'[Y# - Y], and hence consumption will be higher than implied by the standard consumption function C = cY whenever there is a positive expected difference between long run output Y# and present output Y. Approaching the steady state, we indeed will see that consumption C is converging towards $C_t = cY_t$. Expected future income – read steady state income Y# – is discounted by 1/(1 + r); as an alternative, one might want to multiply it by a different discount factor which would also reflect the subjective probability that the economy will converge towards the hypothetical Y#. A more complex approach could take into account both demand and supply-side dynamics over many periods, but the approach presented here catches the basic idea of taking into account both present and future income.

In the above equation we have taken into account that the marginal product is equal to ßY/K. Assuming r to be exogenous we have medium term equilibrium output – based on our medium term approach – given by:

$$Y = \{ca'[1/(1 + r)]L[s/\delta]^{ß/(1-ß)} + \delta K(1 - b) - brK + G\}/[s + ca' - bß] \tag{6''}$$

Note that the above equation determines Y through medium term aggregate demand where consumers are forward looking economic agents.

B.2.3 Multiplier Analysis

We now can take a look at the simple multiplier for the goods market (and later we turn to the broader picture with goods market, money market and the foreign exchange market). From (6") we get – while assuming that s + ca' > bß:

$$dY/dG = 1/[s + ca' - bß] > 0 \tag{7'}$$

In the medium term model fiscal policy is (ignoring at first the impact of ca') more effective than in the short run standard model since a rise of G raises output which translates not only into higher consumption but also into higher net investment since a rise of Y also implies a rise of the average product of capital. If by coincidence equation (1''d) is fulfilled so that bß = s the multiplier would be 1/(ca'); note that an economy which is close to the steady state value of output $Y^{\#}$ may be expected to have a' close to unity so that the fiscal multiplier is relatively small. If s + ca' approaches bß the multiplier will approach infinity. Whether such a case is of any practical relevance is an empirical question; note that one can dismiss the idea to artificially reduce the capital stock as a means to eliminate an excess supply in the capital market – followed by an expansionary fiscal policy whose multiplier thus is raised as the condition s = bß is fulfilled: An artificial reduction of the capital stock would, of course, reduce expected long run income.

Moreover, one should emphasize that approaching $Y^{\#}$ the equilibrium condition for the goods market will become $Y = cY^{\#} + \delta K^{\#} + G$ so that with Y approaching $Y^{\#}$ government consumption G is endogeneous. By implication it is clear that a fiscal multiplier – and therefore fiscal policy - makes no sense if the economy is close to $Y^{\#}$ (the long run case). The following multiplier analysis thus is confined to a medium term policy perspective.

The medium term fiscal multiplier from (7') could be smaller or larger than the traditional short-run fiscal multiplier 1/s. If the transitory consumption demand effect as captured by ca' exceeds bß, we will have a smaller fiscal multiplier than the short-run Keynesian model suggests. The higher ß and b are, the higher is the fiscal multiplier. Thus fiscal policy becomes more effective if there is a change in technology which leads to a rise of ß and if the responsiveness of investors with respect to differences between the net marginal product of capital and the real interest rate has increased. The reason is straightforward since for a given interest rate a rise of G which translates into a rise of Y will have the higher an impact of the marginal (and average) product of capital and net investment the larger ß and b, respectively. The increasing role of information and communication technology (ICT) might have raised ß since increasing output is facilitated – at least in those sectors where supply is based on software and digital inputs. From this perspective ICT might have raised the effectiveness of fiscal policy. However, to the extent that expansion of ICT has translated into a rise of a' there is an offsetting effect, and only empirical analysis can tell whether the fiscal multiplier has increased or fallen in the digital economy.

In a period in which there is a high gap between present and long term income, a'' will be relatively high so that the fiscal multiplier is relatively low. From this perspective, emphasis on expansionary fiscal policy in a deep recession – such as the case during the Great Depression – is indeed useful, namely to the extent that deep recession is translated by economic actors as falling weight of future long run income. With massive underutilization of capacity, one could also argue that b – the reaction parameter in the net investment function – will be close to zero which also reinforces the statement that expansionary fiscal policy in a deep recession should be quite useful to raise real income. The fiscal multiplier effect should also be high if the time horizon of people is shortening, as is typically the case in periods of high business uncertainty or in war periods. If the output elasticity of capital is increased (ß goes up) – e.g., in the context of the unfolding of the New Economy –, the fiscal multiplier is reduced. It is also reduced if investors' responsiveness to a difference between the marginal product of capital and the real interest rate increases (e.g., the parameter b could be raised through reduced information costs about such differences). Again consider the impact of the new economy and information and communication technology which has raised market transparency with respect to investment opportunities in non-ICT fields while the ICT field itself – given its enormous technological dynamics – is rather opaque for outside investors.

As regards the multiplier for L it is obvious that a higher L raises the long run expected equilibrium real income – hence permanent income is raised - and therefore the multiplier is positive provided that s > ca' + bß. In an economy with a relatively small capital stock or with a very small responsiveness (sufficiently small b) of net investment with respect to the marginal product of capital, we have a positive multiplier.

$$dY/dL = \{ca'[1/(1 + r)][s/\delta]^{ß/(1 - ß)}\}/[s + ca' - bß] > 0 \quad (9)$$

$$\begin{aligned} dY/ds = \{&-(1 + a')\{ca'[1/(1 + r)]L[s/\delta]^{ß/(1 - ß)} + (\delta - br)K + G\} \\ &+ [(s + ca' - bß)ca'[1/(1 + r)]L[ß/(1 - ß)]s^{ß(1 - ß)}]/\delta^{ß/(1 - ß)}\} \\ &/ (s + ca' - bß)^2 \end{aligned} \quad (10)$$

A sufficient condition for dY/ds to be positive is given by: $s + ca' > bß$, $\beta > s$ and $ca'[1/(1 + r)]L[s/\delta]^{ß/(1 - ß)} + G < (br - \delta)K$ where there has to be $br > \delta$. These conditions – suggesting under the assumption that $br > \delta$ - that a rise of the savings rate raises output if the savings rate is and the impact (a') of the long run real income on consumption are relatively high - point to interesting empirical issues. Thus a society with a large positive gap between Y# and Y (and hence a high parameter a') is likely to benefit from government measures which stimulate the savings rate: medium term income will rise. To the extent than one interpretes ß as a distribution parameter one may conclude that in a country with a critically high ß – as might be observed in developing countries or in some transition economies – a rise of the savings rate might reduce medium term equilibrium output.

The real interest rate can, of course, be endogenized (assuming a zero inflation rate) by taking into account the money market equilibrium condition:

$$M/P = hY - h'r \quad (11)$$

$$r = [hY - M/P]/h' \quad (12)$$

If we endogenize the interest rate we get from inserting (12) into (6')

$$\begin{aligned} Y = c\{&a''Y + a'[1/(1 + [hY - M/P]/h')]L[s/\delta]^{ß/(1 - ß)}\} + \delta K \\ &+ b(ßY/K - [hY - M/P]/h')K] + G \end{aligned} \quad (13)$$

Using Cramer's rule we can calculate the multipliers for monetary and fiscal policy from differentiating (6') and (11) and the respective equation written in matrix notation:

$$\begin{pmatrix} h & -h' \\ (s + ca' - b\beta) & bK - \dfrac{ca'L}{(1+r)^2}\left(\dfrac{s}{\delta}\right)^{\beta(1-\beta)} \end{pmatrix} \begin{pmatrix} dY \\ dr \end{pmatrix} = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & \left(\dfrac{dY}{ds}\right)' \end{pmatrix} \begin{pmatrix} dG \\ d(M/P) \\ ds \end{pmatrix}$$

Where $\left(\frac{dY}{ds}\right)'$ denotes $(s + ca' - b\beta)\frac{dY}{ds}$ with the $\frac{dY}{ds}$ from equation (10)

And therefore

$$\left(\frac{dY}{ds}\right)' = \left\{-\left\{ca'\left[1/(1+r)\right]L[s/\delta]ß/(1-ß) + (\delta - br)K + G\right\}\right.$$

$$\left. + [(s + ca' - bß)ca'[1/(1+r)]L[ß/(1-ß)]s^{(2ß-1)/(1-ß)}]/\delta^{ß/(1-ß)}\right\}/(s + ca' - bß)$$

$$\det(A) = \det\begin{pmatrix} h & -h' \\ (s + ca' - b\beta) & bK - \dfrac{ca'L}{(1+r)^2}\left(\dfrac{s}{\delta}\right)^{\beta(1-\beta)} \end{pmatrix}$$

$$= \{([s + ca' - bß]h' + hbK)[1 + r]^2\delta^{ß/(1-ß)} - ca'Lhs^{ß/(1-ß)}\}/[1 + r]^2\delta^{ß/(1-ß)}$$

which implies:

$$\frac{1}{\det(A)} = \frac{(1+r)^2\,\delta^{\beta/(1-\beta)}}{\left((s + ca' - b\beta)h' + hbK\right)(1+r)^2\,\delta^{\beta/(1-\beta)} - ca'Lhs^{\beta/(1-\beta)}}$$

And therefore the Multipliers are:

$$\frac{dY}{dG} = \frac{h'(1+r)^2\,\delta^{\beta/(1-\beta)}}{\left((s + ca' - b\beta)h' + hbK\right)(1+r)^2\,\delta^{\beta/(1-\beta)} - ca'Lhs^{\beta/(1-\beta)}}$$

$$(s + ca' - b\beta)h' + hbK < 0 \;\Rightarrow\; \frac{dY}{dG} < 0$$

In a poor country – with very low s and low K – the condition for dY/dG is likely to be met so that fiscal policy is ineffective with respect to output. The condition stated implies that for dY/dG < 0; (s + ca' - bß) needs to be negative, but this is not sufficient as in equation (7). As well (s + ca' - bß) > 0 does not imply dY/dG > 0 but still is a necessary condition. Empirically, it will be interesting to study whether bß exceeds s + ca'. The multiplier dY/dG shows an ambiguous impact of the size of the country considered since a rise of L reduces any positive multiplier result; the same holds for K as long as s + ca' - bß is positive. The more strongly investors react to any difference between the net marginal product and r (parameter b) the lower is the fiscal multiplier.

The medium term fiscal multiplier is the larger (assuming that it is positive) the larger the interest elasticity of money and h', respectively, is. Comparing the above fiscal multiplier to the familiar short run Keynesian multiplier

$$dY/dG = 1/(s + hb/h')$$

– suggesting that the higher h' the larger the multiplier – we have a similar result. However, here we also see the impact of the effect of changes in aggregate demand on the average product of capital and investment, respectively; and we see the impact of reinvestment and of the technology parameter ß. The lower the depreciation rate the lower is the fiscal multiplier.

Compared to our simple fiscal multiplier we can see – as an impact from the money market –that a rise of a', namely the weight consumers attach to long run income has an ambiguous impact on the multiplier; the impact of ca' is positive if $h(1 + r)^2\delta^{\beta/(1-\beta)}$ falls short of $Lhs^{\beta/(1-\beta)}$; a low real interest rate and a low income elasticity of the demand for money as well as a low capital depreciation rate make it more likely that the impact of ca' is positive. The impact of the savings rate is not as strong as the simple multiplier for the goods market suggests: the money demand effect is reducing the denominator. The higher the level of the real interest rate the smaller is the fiscal multiplier (assuming dY/dG > 0) which points to a strategic advantage of countries with low real interest rates – this could e.g. reflect credibility of monetary policy or of fiscal policy. The US which is known to have the lower real interest rates among OECD countries – except for the special case of Switzerland – thus should have an advantage while the Euro zone has a disadvantage once that the conflicts about the non-fulfillment of the Stability and Growth Pact contribute to higher real interest rates. This points to an interesting paradox, namely that ministers of finance eager to loosen the stability pact in order to get a larger room for manoeuvre in fiscal policy matters ultimately will reduce the effectiveness of fiscal policy. The higher the depreciation rate the smaller is the fiscal multiplier provided that it is positive. This is an important message for developing countries eager to catch up with advanced industrialized countries: (i) in such countries repair management in firms often is relatively poor which implies a relatively high depreciation rate; (ii) choice of technology often is biased by government in favour of importing advanced capital equipment from OECD countries which, however, is not only likely to be inconsistent with international relative factor price differentials but also could force the country to pursue a modernization policy which tries to be in line with that in advanced countries; there is pressure to always introduce latest foreign technologies fast so that the effective depreciation rate could be high.

$$\frac{dY}{dM/P} = \frac{bK(1+r)^2\,\delta^{\beta/(1-\beta)} - ca'Lhs^{\beta/(1-\beta)}}{\left((s + ca' - b\beta)h' + hbK\right)(1+r)^2\,\delta^{\beta/(1-\beta)} - ca'Lhs^{\beta/(1-\beta)}}$$

$$\frac{dY}{ds} = \frac{bK(1+r)^2\,\delta^{\beta/(1-\beta)}}{\left((s + ca' - b\beta)h' + hbK\right)(1+r)^2\,\delta^{\beta/(1-\beta)} - ca'Lhs^{\beta/(1-\beta)}}\left(\frac{dY}{ds}\right)'$$

Obviously the multiplier for monetary policy is zero if $bK(1 + r)^2\delta^{\beta/(1-\beta)}$ is equal to $ca'Lhs^{\beta/(1-\beta)}$. The multiplier for monetary policy will be infinte in absolute terms if $((s + ca' - b\beta)h' + hbK)(1 + r)^2\delta^{\beta/(1-\beta)}$ is approaching $ca'Lhs^{\beta/(1-\beta)}$. Note that for the special case that the depreciation rate is zero the multiplier is unity. Dividing the numerator and the denominator by $bK(1 + r)^2\delta^{\beta/(1-\beta)}$ we can see that the multiplier is greater unity – provided that it is positive – if the condition holds that $\{[s + ca' - b\beta)h']/bK + h\}$ is smaller than unity.

Comparing the above monetary policy multiplier to the familiar Keynesian short-run multiplier – $dY/d(M/P) = 1/([sh'/b] + h)$– we can see that there is no liquidity trap if $s + ca'$ is equal to $b\beta$.

Monetary policy is the more effective, the higher b – assuming that the multiplier is positive. A supply-side policy, defined as a rise of s, can hav a positive or a negative impact where the sign for the multiplier dY/ds depends on a complex set of parameter conditions. The multiplier is zero if the interest elasticity of the demand for money is zero. The multiplier is the higher the higher the depreciation rate is and the higher the size of the capital stock is the lower the multiplier (assuming (dY/ds)' to be positive).

As regards the impact of real money balances one might want to consider a refined model in which real output is affected by real money balances so that $Y = (M/P)^{ß'}K^{ß}L^{1 - ß - ß'}$; in addition one might want to modify the savings function by assuming S = sY[Y/(M/P + K)] so that savings per capita fall – assuming a given per capita income – as the ratio income to wealth increases.

Finally, one should note that from (6”) we get the slope of the medium term goods market equilibrium schedule ISM as

$$dr/dY = [s + (ca' - bß)]/[-ca'L(s/\delta)^{ß/(1 - ß)} – b]$$

which can be larger or smaller than the short-run schedule of the familiar IS curve with slope dr/dY = -s/b. If we assume that (i) ca' = bß or (ii) ca' < bß while the numerator remains positive the slope of the ISM curve is definitively smaller in absolute terms than the standard IS curve. To put it different: An expansionary monetary policy will raise output in the medium term more strongly than in the short run (see appendix). However, we have a certain paradox of monetary policy since in the long run monetary policy is endogenous as we have emphasized. Any medium term monetary policy which reduces in a non-inflationary world the interest rate temporarily below the steady state equilibrium interest rate – the natural interest rate to use WICKSELL's term – must adopt in the long run a contractionary monetary policy which brings up the interest rate to the natural level. We thus may conclude that expansionary monetary policy will have an effect on medium term output only if individuals discount future monetary policy strongly, or if the initial interest rate was above the natural rate.

Open Economy: Mundell Fleming Solow Model

For the case of an open economy we have to distinguish the case of fixed exchange rates versus the case of flexible exchange rates. The subsequent model is a hybrid Mundell-Fleming-Solow model (MFS) where – denoting real net capital imports as Q and q=eP*/P (e is the nominal exchange rate, P the price level, * denotes foreign variables) - we have added the following balance of payments equilibrium condition to equations (6') and (12):

$$Q (r, r^*, q^*) = q^*J(q^*, Y, Y\#) - X(Y^*, Y^*\#, q^*) \quad (14)$$

In the context of an open economy we also have to modify the investment function I, which now includes – following the model of FROOT/STEIN (1991) who emphasize the role of imperfect capital markets – the real exchange rate variable, since a real depreciation of the currency of country I (home country) will stimulate the inflow of foreign direct investments: I = δK + b(ßY/K - δ - r) + Hq*, where the parameter H is positive. Therefore net capital imports depend not only on the ratio of the domestic real interest rate r to the foreign interest rate variable, but also on the real exchange rate eP*/P. As consumption depends on both Y and Y# it is natural to state the hypothesis that imports also depend on both Y and Y#; and that real exports positively depend on both Y* and Y*#. Compared to traditional modelling, the impacts of q* and of Y# and Y*# are new in our statement of the balance of payments equilibrium condition; one may note that in principle one additionally might want to consider the impact of q*#/q* on capital inflows as well as trade, but for the sake of simplicity we will ignore this here. In a small open economy we can thus state the following equation system with e, Y and r as endogenous variables (case of flexible exchange rates). We can calculate the multipliers for three exogenous variables, namely for expansionary monetary policy (dM) or fiscal policy (dG) or a change of current foreign output (Y*) or a change of long run foreign output (dY*#) or a change of long run domestic output (dL) as well as the impact of a rise in the savings ratio (ds). In reality, a rise in the savings ratio could be linked to special incentives of government aimed at raising the savings rate and the investment ratio so that ds>0 can be interpreted as supply side policy. The medium term goods market equilibrium condition in an open economy with foreign direct investment reads:

$$Y = c\{a''Y + a'[1/(1+r)]L[s/\delta]^{\beta/(1-\beta)}\} + \delta K + b(\beta Y - eK) \tag{15}$$
$$+ Hq^* + G + X(Y^*, Y^{*\#}, q^*) - q^*J(q^*, Y, Y\#)$$

Differentiating (15), (12) and (14) gives the following system of equations in matrix notation :

$$\begin{pmatrix} s + ca' - b\beta + q^*J_Y & k_2 & -H + J + q^*J_{q^*} - X_{q^*} \\ h & -h' & 0 \\ q^*J_Y + Q_{[M/P]/Y}\dfrac{[M/P]}{Y^2} & -Q_r & -Q_{q^*} + J + q^*J_{q^*} - X_{q^*} \end{pmatrix}\begin{pmatrix} dY \\ dr \\ dq^* \end{pmatrix} =$$

$$= \begin{pmatrix} 1 & 0 & k_1 & X_{Y^*} & X_{Y^{*\#}} & \dfrac{a'}{1+r}\left(\dfrac{s}{\delta}\right)^{\beta/(1-\beta)} \\ 0 & \dfrac{1}{P} & 0 & 0 & 0 & 0 \\ 0 & -\dfrac{Q[M/P]/Y}{PY} & 0 & X_{Y^*} & X_{Y^{*\#}} & 0 \end{pmatrix}\begin{pmatrix} dG \\ dM \\ ds \\ dY^* \\ dY^{*\#} \\ dL \end{pmatrix}$$

$$k_1 = -Ya'' - \frac{a'L(s-\beta)}{(1+r)(1-\beta)\delta^{\beta/(1-\beta)}}s^{\frac{2\beta-1}{1-\beta}}$$

$$k_2 = bK - \frac{ca'L}{(1+r)^2}\left(\frac{s}{\delta}\right)^{\beta/(1-\beta)}$$

This implies:

$$B = \det\begin{pmatrix} s + ca' - b\beta + q^*J_Y & k_2 & -H + J + q^*J_{q^*} - X_{q^*} \\ h & -h' & 0 \\ q^*J_Y + Q_{[M/P]/Y}\dfrac{[M/P]}{Y^2} & -Q_r & -Q_{q^*} + J + q^*J_{q^*} - X_{q^*} \end{pmatrix}$$

$$= (-H - X_{q^*} + J + q^*J_{q^*})(-Q_{q^*}h + h'(q^*J_Y + Q_{[M/P]/Y}\ [M/P]/Y^2)) + (-Q_{q^*} - X_{q^*} + J + q^*J_{q^*})[-h'(s + ca' - b\beta + q^*J_Y) - h(bK - ca'L[s/\delta]^{\beta/1-\beta}/(1 + r)^2)]$$

Furthermore we will define:

$U = 1/B$

The multipliers for a change in G, M, s and other variables are as follows:

$dY/dG = -Uh'(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*})$

$$dY/dM = -\frac{U}{P}k_2\left(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*}\right) + Q_r\left(-H + J + q^*J_{q^*} - X_{q^*}\right)$$
$$- Uh'Q_{[M/P]/Y}[1/P]/Y(-H - Xq^* + J + q^*J_{q^*})$$

$dY/ds = -Uk_1h'\left(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*}\right)$

$dr/dG = -Uh(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*})$

$$dr/dM = U/P\left\{\left(s + ca' - b\beta + q^*JY - XY\right)\left(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*}\right) - \left(q^*J_Y + Q_{[M/P]/Y}\left[M/P\right]/Y^2\right)\left(-H + J + q^*J_{q^*} - X_{q^*}\right)\right\}$$
$$- UhQ_{[M/P]/Y}[1/P]/Y\left(-H - X_{q^*} + J + q^*J_{q^*}\right)$$

$dr/ds = -Uk_1h(-Q_{q^*} + J + q^*J_{q^*} - X_{q^*})$

$dY/dY^* = -Uh'X_{Y^*}(H - Q_{q^*})$

$dY/dY^*\# = -Uh'X_{Y^*}\#(H - Q_{q^*})$

$$dY/dL = -U\frac{a'}{1 + r}\left(\frac{s}{\delta}\right)^{\beta/(1-\beta)} h'\left(-Q_{q^*} - X_{q^*} + J + q^*J_{q^*}\right)$$

$dr/dY^* = -Uh\ X_{Y^*}(H - Q_{q^*})$

$dr/dY^*\# = -UhX_{Y^*\#}(H - Q_{q^*})$

$$dr/dL = -U\frac{a'}{1 + r}\left(\frac{s}{\delta}\right)^{\beta/(1-\beta)} h\left(-Q_{q^*} - X_{q^*} + J + q^*J_{q^*}\right)$$

$$dq^*/dY^* = U\,X_{Y^*}(-hQ_r + h'(q^*J_Y + Q_{[M/P]/Y}[M/P]/Y^2)) + [-h'(s + ca' - b\text{ß} + q^*J_Y) - h(bK - ca'L[s/\delta]^{\text{ß}/(1-\text{ß})}/(1+r)^2)])$$

$$dq^*/dY^*\# = U\,X_{Y^*\#}(-hQ_r + h'(q^*J_Y + Q_{[M/P]/Y}[M/P]/Y^2) + [-h'(s + ca' - b\text{ß} + q^*J_Y) - h(bK - ca'L[s/\delta]^{\text{ß}/(1-\text{ß})}/(1+r)^2))$$

$$dq^*/dL = U\frac{a'}{1+r}\left(\frac{s}{\delta}\right)^{\text{ß}/(1-\text{ß})}\left[-hQ_r + h'\left(q^*J_Y + Q_{[M/P]/Y}[M/P]/Y^2\right)\right]$$

One can see that U is negative if the following conditions are met:

$$s + ca' > b\text{ß} \qquad \text{(I)}$$

$$q^*J_Y > X_Y \qquad \text{(II)}$$

$$(1 + r)^2 bK > ca'L(s/\delta)^{\text{ß}/(1-\text{ß})} \qquad \text{(III)}$$

$$J > Q_{q^*} + X_{q^*} - q^*J_{q^*} \qquad \text{(IV)}$$

As well as:

$$J > H + X_{q^*} - q^*J_{q^*} \qquad \text{(V)}$$

$$Q_{q^*}h > h'q^*J_Y \qquad \text{(VI)}$$

Or alternatively

$$J < H + X_{q^*} - q^*J_{q^*} \text{ which is equivalent to } H > Q_{q^*} \qquad \text{(V')}$$

$$Q_{q^*}h < h'q^*J_Y \qquad \text{(VI')}$$

Depending on which set of conditions is met, we can draw the following conclusions about the multipliers:

$dY/ds > 0$ if $s < \text{ß}$

$dY/dG > 0$

$dY/dM > 0$ if V and VI are met

dY/dY^* depends on the sign of X_{Y^*} and if V and VI or V' and VI' are met

$dY/dY^*\#$ depends on the sign of $X_{Y^*\#}$ and if V and VI or V' and VI' are met

$dY/dL < 0$

Note that if s = ß/2 – which implies fulfilment of the golden rule – the multiplier for dY/ds indeed is positive. The medium term model suggests that fiscal policy can be effective. Monetary policy – under certain conditions – also is effective; namely if imports are relatively high in comparison to the impact of the real exchange rate on foreign direct investment inflows and the net exports of goods and services, respectively. An important aspect concerns supply-side policy: If the savings rate is smaller than ß a rise of s will raise medium term output. The impact of a rise of Y* and Y*#, respectively, can differ in the respective sign which suggest that international policy coordination is more complex than the standard macro model suggests. Governments with emphasis on long run output – hence governments with a more long run time horizon – thus could favour different policy options than short-run oriented political actors. The assignment debate thus is affected. An explicit two country model could offer more refined results. The multipliers for the exchange rate also are interesting:

dr/dG > 0

dr/dM < 0 if V'. is met

dr/ds < 0

dr/dY* depends on the sign of X_{Y*} and if V. or V'. is met

dr/dY*# depends on the sign of $X_{Y*\#}$ and if V. or V'. is met

dr/dL < 0

A rise of government consumption raises the interest rate which is in line with the standard model. Expansionary monetary policy will reduce the interest rate under certain conditions while a rise of the savings rate will reduce the interest rate. The impact of Y* and Y*# on the interest rate might differ in sign. A rise of long run employment will reduce the medium term interest rate.

B.3 Conclusions and Possible Extensions

The results show a more differentiated picture than the familiar debate on Keynesianism versus monetarism. The analysis suggested here is a useful medium term analysis bridging in a consistent way short run standard macroeconomic analysis and long term growth analysis. Many refinements and modifications are possible, and there is a broad set of empirical issues which emerges in the model suggested. The relative size of s, ß, δ and b are of particular importance. Changes of the technological regime – such as the switch to the New Digital Economy – could alter ß, δ and b.

The model presented suggests that policymakers should not only consider monetary and fiscal policy but also policies stimulating the savings ratio (and the investment ratio) as well. The more consumption is influenced by long run expected steady state income, the more attractive supply-side policies are. Countries with a stable political system should be able to exploit the impact of policy measures designed to raise long run output. However, in countries with political instability or with politicians without much reputation government will naturally have a bias in the field of supply-side policy; instead of raising the savings rate, government will be inclined to follow the logic of the short-run Keynesian model and try to raise short run output by reducing the savings ratio. With only temporary increases in output and a growing stock of public debt, there is a considerable risk that the debt-GDP ratio will increase and hence the anticipated future tax rate τ'. Indeed in a two-period approach, it must hold that real government consumption as well as real interest rate payment on the stock of public debt (B) and discounted future government expenditures $G^{\#}$ be equal to current tax revenue and discounted future tax revenue:

$$G + rB + G\#/(1 + r) = \tau Y + \tau' Y\#/(1 + r). \tag{16}$$

In a more elaborate MFS model, taking into account that the current tax rate and the future tax rate will negatively affect present consumption and investment, one could endogenize τ' while assuming, for example, that G = G#. Risk-averse taxpayers will calculate τ' not simply from (16), rather with G = G# they will calculate it as:

$$\tau' = (1 + r)\{G + rB + G\#/(1 + r) - \tau Y]\}Y\# + \Omega^T \tag{17}$$

The variable Ω^T indicates the credibility of government tax policies, or alternatively, its history in political cheating. If past governments have always kept their promises in the field of taxation and borrowing, Ω^T is zero. The more often taxes or deficit-GDP ratios were raised in violation of election promises (or international treaties such as the Stability and Growth Pact in the Euro zone) the higher Ω^T will be. Thus, Ω^T can be considered within a broader approach an endogenous variable which could be explained in the framework of a New Political Economy approach. At the bottom line, a loss in government reputation will therefore reduce present consumption and investment. Moreover, it might reduce net foreign direct investment inflows and hence net capital inflows.

The new approach presented can be extended in various ways (WELFENS, 2005) and allows to combine short run macroeconomic analysis with many of the standard results of modern growth theory – as e.g. summarized in JONES (1998). The model presented also raises many new issues for the debate about the efficiency of fiscal policy and monetary policy.

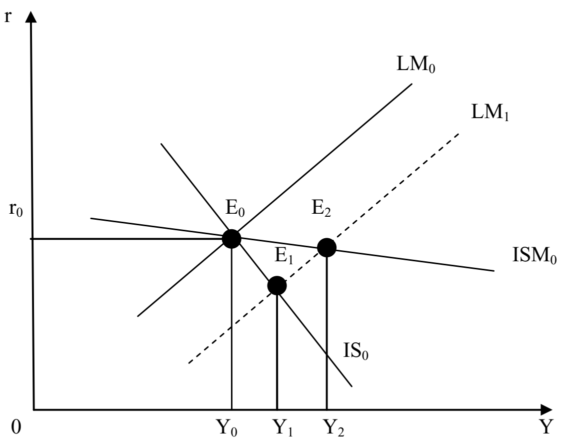

Fig. 25. Standard IS-LM Model versus Keynes-Solow Model

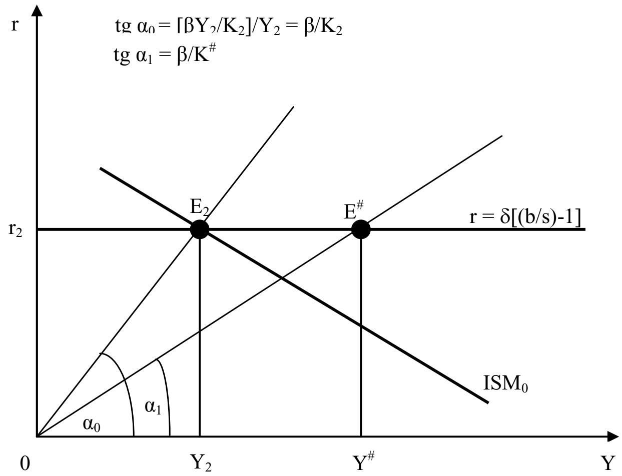

Fig. 26. Medium Term and Long Run Equilibrium

As regards the money market: note that – with m := M/P – in the long run the condition must hold: $(m/L)^{\#} = hk^{\#ß} - h'ßk^{\#ß-1}$

http://www.springer.com/978-3-540-79411-0

Innovations in Macroeconomics
Welfens, P.J.J.
2008, XVI, 455 p. 106 illus., Hardcover
ISBN: 978-3-540-79411-0