CHAPTER 13. SIMULATIONS OF THE OXFORD WORLD MACROECONOMIC MODEL

1. Technical simulations

Below presenting simulations of monetary and real shocks, it is worth describing what we would expect to see, in general terms, in the different types of simulations.

The first distinction to draw is that between real and nominal variables. In general, in the long run only real shocks should affect real variables, like GDP and unemployment. Monetary shocks will change nominal variables, like the price level and nominal wages, but not the ratio of the two - real wages.

Two factors complicate the picture, however.

- First, monetary shocks do have real effects in the short to medium run because of the presence of nominal and real rigidities in wage and price setting. Moreover, the greater these rigidities, the longer it takes for the model to reach equilibrium following a shock, and 10 years, in many cases, does not constitute the long run.
- Second, endogenous monetary policy means that, while real variables may respond in similar ways across countries, nominal variables need not. Our interest rate reaction functions ensure that inflation is stabilised, but how long that takes to happen depends on the size of nominal rigidities and on the credibility of the monetary authorities, as summarised in the parameters of the reaction function. Consequently, long run impacts on the price level, nominal earnings, the exchange rate...etc can differ substantially across countries. In addition, the combination of nominal rigidities and a rule targeting inflation causes the model to be cyclical at business cycle frequencies, so that in many cases it will not have settled down even ten years after a shock. This is apparent in all the simulations below.

Tables 6-12 summarise the following simulations for the G3 and the UK

1. Fiscal shock - Government consumption raised by 1% of GDP
2. Investment up 1% of GDP ex ante
3. Monetary shock - Interest rates up 1% point

4. Monetary shock - ‘Equilibrium’ money supply raised 2%
5. Monetary shock - 5% exchange rate depreciation
6. World oil price + $10pb

Note that the simulations are run for all the countries and not only the one concerned. The shocks are applied from the first quarter of 2005 to the last quarter of 2009.

1.1. Fiscal shock - Government consumption raised by 1% of GDP (Table 6)

Table 6 shows the effects of a sustained rise in government expenditure on goods equivalent to 1% of GDP. The key points to note are:

- The rise in demand leads to a prolonged rise in output.
- However, with potential output unaffected directly by such a ‘demand’ shock, inflationary pressures quickly emerge. This in turn leads to higher interest rates, which squeeze private sector expenditure.
- In the long-run, output returns close to base levels - i.e. to potential output. Inflation also returns to base levels, but the price level and the nominal interest rates remain permanently higher, as does the real exchange rate - it is these responses which embody the ‘crowding’ out mechanism.
- The deterioration in competitiveness means that the current account position is permanently worse, as is the government deficit. And the government budget position continues to deteriorate throughout the period of the simulation as higher borrowing raises debt servicing costs.

It is worth highlighting that the long-run effect of such a demand shock on output is, if anything, likely to be negative in the Oxford Model because of its impact on business investment. Typically, investment rises in the short term, reflecting the accelerator effects of higher demand. In the long-run, however, the effect of higher real interest rates dominates so that investment falls below base levels. This in turn will lead over time to a lower capital stock and hence lower potential output.

Table 6: Fiscal Shock - Government Consumption Raised By 1% of GDP
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP					
	1	1.1	1.2	0.8	0.7
	3	0.4	1.7	0.5	0.3
	5	0.4	0.5	0.5	0.4
Consumer Prices	1	0.0	0.2	0.0	0.0
	3	1.2	1.6	0.7	0.8
	5	2.7	3.6	1.6	1.4
Average Earnings	1	0.6	0.2	0.2	0.7
	3	1.9	1.5	0.9	2.1
	5	3.0	3.1	1.6	2.6
Employment	1	0.5	0.3	0.2	0.1
	3	0.1	0.7	0.2	0.0
	5	0.2	0.5	0.2	0.0
Current account (% of GDP)	1	-0.4	-0.2	-0.3	-0.4
	3	-0.4	-0.4	-0.3	-0.4
	5	-0.6	-0.4	-0.3	-0.5
Short-term interest rates (% points)	1	0.6	0.5	0.6	0.7
	3	1.1	1.5	1.0	0.7
	5	0.7	1.8	1.1	0.7

1.2.Investment up 1% of GDP ex ante (Table 7)

This shock is in many ways analogous to the fiscal shock presented in Table 6. However, because the higher investment adds to the capital stock, and hence potential output, it leads to a sustained rise in output and a better inflation-output trade-off than higher government consumption.

Table 7: Investment Up 1% of GDP ex ante
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP	1	0.9	0.9	0.7	0.7
	3	0.9	1.1	0.7	0.6
	5	1.1	0.8	0.9	1.0
Consumer	1	0.1	0.2	0.0	0.0
Prices	3	0.9	0.9	0.6	0.8
	5	1.9	1.8	1.2	1.5
Average	1	0.5	0.1	0.3	0.7
Earnings	3	1.7	1.0	0.9	2.4
	5	2.7	1.8	1.6	3.0
Employment	1	0.4	0.3	0.2	0.1
	3	0.3	0.5	0.2	0.0
	5	0.4	0.5	0.2	0.0
Current	1	-0.3	-0.2	-0.3	-0.3
account	3	-0.3	-0.3	-0.3	-0.4
(% of GDP)	5	-0.4	-0.3	-0.3	-0.5
Short-term	1	0.4	0.3	0.5	0.6
interest rates	3	0.7	0.8	0.7	0.7
(% points)	5	0.2	0.9	0.6	0.5

1.3. Interest rates up 1% point (Table 8)

This simulation involves a sustained ex post rise in interest rates, with monetary policy assumed not to respond to the consequential changes in output and inflation. As noted earlier, such a policy would not be sustainable in the long run; we therefore present results only for two years.

This simulation implies that each 1% point rise in interest rates reduces GDP growth in the G3 by about ½% point in its first year, while inflation is reduced by ½% point after two years.

Table 8: Monetary Shock - Interest Rates Up 1% Point
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP	1	-0.5	-0.3	-0.5	-0.7
	2	-1.9	-0.9	-1.0	-2.1
Consumer Prices	1	-0.2	-0.0	0.0	-0.3
	2	-1.0	-0.2	-0.4	-1.2
Average Earnings	1	-0.2	0.0	0.1	-0.3
	2	-1.7	-0.2	-0.7	-2.6
Employment	1	-0.2	-0.1	-0.1	-0.1
	2	-0.8	-0.3	-0.3	-0.4
Current account (% of GDP)	1	0.0	0.0	0.0	0.2
	2	0.0	-0.1	0.0	0.6

1.4. Monetary shock - 'equilibrium' money supply raised 2% (Table 9)

As in simulation 1, this demand shock - albeit monetary rather fiscal - leads to a rise in GDP in the short term, which is crowded out in the longer term by a rise in the price level. Indeed, for such a shock to the level of the money supply, all nominal variables - prices, earnings etc - rise proportionately, while the exchange rate depreciates by the same extent. Hence, in the long run, real wages, profit margins, the real exchange rates etc are all unchanged. At the same time, inflation and nominal interest rates return to base levels, implying unchanged real interest rates.

The Model is therefore 'neutral' to monetary shocks in the long run (although adjustment is not complete within the five-year horizon shown here, and the Model exhibits damped cycles to its new equilibrium).

Table 9: 'Equilibrium' Money Stock + 2% *
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP	1	0.3	0.0	0.4	1.2
	3	1.0	0.0	0.6	-0.4
	5	-0.1	0.2	0.3	0.4
Consumer	1	0.1	0.0	0.1	0.4
Prices	3	1.2	0.1	0.9	1.8
	5	2.7	0.4	1.8	1.6
Average	1	0.1	0.0	0.1	0.8
Earnings	3	1.9	0.1	0.9	2.9
	5	2.8	0.3	1.6	1.5
Employment	1	0.1	0.0	0.1	0.2
	3	0.4	0.1	0.2	-0.1
	5	-0.1	0.1	0.1	0.0
Current account	1	0.0	0.0	-0.1	-0.3
(% of GDP)	3	0.0	-0.1	0.0	0.0
	5	0.1	-0.1	0.0	-0.2
Short-term	1	-0.5	-0.2	-1.1	-1.0
interest rates	3	0.0	-0.2	-0.5	0.3
(% points)	5	0.3	-0.2	-0.2	-0.2

* That is, the long run money supply (as given by the equation MON=GDP!-0.1 * RSH) is raised by 2%, with short-term interest rates changing to equate money supply and demand.

1.5. Monetary shock - 5% exchange rate depreciation (Table 10)

This shock is analogous to a shock to the level of the money supply. The improvement in competitiveness caused by the depreciation boosts net trade in the short term, and hence GDP rises above base although this positive effect may be mitigated by weaker real consumption caused by rising import prices. Both prices and earnings gradually rise - eventually by the full extent of the depreciation (although this adjustment tends to be slower for the G3 than for the more open smaller economies).

Table 10: Monetary Shock - 5% Exchange Rate Depreciation
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP	1	0.1	0.2	0.0	0.2
	3	-0.3	0.5	0.0	0.5
	5	0.5	-0.1	0.0	0.3
Consumer Prices	1	0.4	0.3	0.1	0.3
	3	1.4	1.4	0.6	1.1
	5	1.5	2.7	1.1	2.3
Average Earnings	1	0.1	0.0	0.1	0.3
	3	1.0	0.7	0.6	2.4
	5	1.8	1.7	1.0	3.7
Employment	1	0.0	0.1	0.0	0.0
	3	-0.2	0.2	0.1	0.1
	5	0.2	0.0	0.0	0.0
Current Account (% of GDP)	1	0.1	0.1	0.1	0.1
	3	0.4	0.4	0.3	0.7
	5	0.2	0.6	0.3	0.6
Short-term interest rates (% points)	1	0.2	0.1	0.3	0.3
	3	0.6	0.6	0.7	1.1
	5	0.4	1.0	0.5	1.0

1.6. World oil price plus $10pb (Table 11)

All of the simulations presented so far represent nominal shocks. A rise in the world oil price, in contrast, represents a 'real' shock. Higher energy costs lower the profitability of production and therefore reduce firms incentives to supply, cutting potential output. As a consequence, this shock leads to a sustained loss of GDP.

Table 11: World Oil Price + $10 pb
(% changes from base)

	Year	USA	Japan	Euro_12	UK
GDP	1	-0.2	-0.2	-0.2	-0.3
	3	-0.9	-1.1	-0.3	-0.3
	5	-0.4	-0.7	-0.1	-0.2
Consumer Prices	1	0.5	0.6	0.3	0.5
	3	1.0	0.7	0.6	0.2
	5	1.2	0.4	0.6	0.2
Average Earnings	1	0.1	0.0	0.0	0.0
	3	0.2	0.1	0.0	-0.7
	5	0.8	-0.2	0.0	0.0
Employment	1	-0.1	-0.1	-0.1	-0.1
	3	-0.5	-0.5	-0.1	0.0
	5	-0.2	-0.4	-0.1	0.0
Current account (% of GDP)	1	-0.3	-0.3	-0.3	0.2
	3	-0.3	-0.3	-0.3	0.2
	5	-0.4	-0.1	-0.2	0.1
Short-term interest rates (% points)	1	0.2	0.1	0.5	0.3
	3	0.2	-0.1	-0.1	-0.1
	5	0.1	-0.4	0.1	0.3

1.7. Conclusions

This overview has outlined the Oxford Model of the world economy and illustrated its key simulation properties. It has shown that, while the Model exhibits 'Keynesian' features in the short to medium term, its long-run properties are 'neoclassical' - i.e. attempts to raise growth and employment by boosting demand will ultimately lead to higher prices, with output in the long run determined by supply side factors - productivity and population growth.

2. Scenarios

The technical simulations of the first sections do not correspond to a realistic problem. The paper, which I quote in chapter 11 uses the model to analyze the Asian crisis of 1997. This is a more interesting but also a more difficult problem.

The country model includes an equation, which determines the exchange rate and another equation, which determines the interest rate. Both are endogenous variables. So, how can we simulate a devaluation that is an imposed change in the value of the exchange rate?

The paper (page 29 to 42) explains that this can be done in different ways, and each of them gives different results. This is followed by an analysis of the Asian crisis (pages 43 to 46).