Danmarks Statistik
MODELGRUPPEN

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ADAM multipliers - july 2013

Resumé:

A series of multiplier analyses that illustrate the properties of ADAM are presented below. The calculations are made with the model version july 2013 using the baseline lang13.

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Nøgleord: Multiplikatorer Jul13

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Introduction

A series of multiplier analyses that illustrate the properties of ADAM are presented below. The calculations are made with the model version july 2013 using the baseline lang13.

The model version july 2013 replaces the previous model version from October 2012. The main changes in the july 2013 model version are mainly due to the implementation of revised working hours in the National Accounts. The current model version is described in tmk230114 and other papers that can be found on ADAM's homepage.[1)] ADAM's homepage documents the current version of the model. The homepage also presents a series of papers that describe changes in the model and other analysis.

All the multiplier analyses are based on a baseline. A baseline represents a solution with respect to the endogenous variables given a stylized projection of the exogenous variables. The present baseline, lang13, is based on the historical data bank from july 2013 that contains annual historical data up to and including 2012. The baseline is based on a scenario with steady-state growth driven by domestic growth in productivity.

The growth rates chosen reflect historical growth rates in the Danish economy. Demography and labor supply are assumed to be unchanged. So that the number and structure of the population is projected to be unchanged. Productivity growth in the Danish economy is assumed to be 1.5 percent per annum. The growth in the market for Danish exports is likewise assumed to be 1.5 percent. Import prices and competitive prices in the export market are assumed to grow by 2 percent annually. In steady-state the domestic prices and costs will grow by 2 percent like foreign prices, and the Danish GDP will grow by 1.5 percent reflecting the annual productivity growth.

This development in output is achieved by assigning the growth in productivity to labor and this is reflected by a corresponding increase in real wages of 1.5 percent. The real interest rate is constant and fixed at 1.5 percent, like the growth rate of labor productivity. Thus, the Danish economy can grow in steady state with unchanged demand structure, unchanged composition of output and income, unchanged economic policy, unchanged tax and public expense burden, and unchanged sectoral composition etc. The replacement rate of unemployment insurance is also unchanged and the equilibrium level of unemployment is approximately 100.000 (4 percent).

Overall, it is a baseline of the Danish economy repeating itself in to the future roughly as we know it today with a real growth of 1.5 percent and an inflation rate of 2 percent. In the short term, it is necessary to allow for deviations while variables are adjusting to steady state but the equilibrium scenario is achieved within a short time frame. For a discussion of the structure and construction of the baseline bank see chapter 10 in the ADAM book, also available for download at ADAM's homepage.

The multipliers are calculated relative to this baseline. In the following sections, the experiments are carried out by changing one or a few of the exogenous variables. Then the model is simulated to calculate the effect on the endogenous variables. The purpose is to illustrate the properties of ADAM. There is no provision for possible ties between the exogenous variables. This means that one has to be careful in the interpretation of the experiments as real world economic events are rarely confined to changes in one exogenous variable. For example, in the interest rate experiment in section 15 below, considerations such as the effect of interest rate changes on foreign demand are not taken into account, see grh12912 for more.

It is worth noting the premise that before we shock ADAM, the economy is following a baseline, which ends up in steady-state equilibrium. Economic policy-induced shocks to ADAM maybe directed against short-run deviations from the steady state, i.e. stimulating the economy if the present unemployment is above its long-run equilibrium; or the shocks may try to change the steady state, i.e. increasing the labor supply in order to expand the scope for private and public consumption or increasing energy taxes to reduce the input of energy in output and consumption.

It should also be noted that the standard version of ADAM has no fiscal reaction function which would automatically secure the sustainability of public finances. Without a reaction function the government budget balance can become permanently negative or positive depending on the experiment. This is not sustainable and it may be appropriate to accompany shocks to the model by say a tax change to balance the public budget, see section 18 and 19.

The discussion on each of the experiments is presented briefly, a detailed discussion of the key mechanisms in ADAM can be found in chapter 11 in the ADAM book.

The experiments concern the following exogenous variables or groups of variables:

1. General government purchase of goods
2. General government employment
3. General government investment in buildings
4. General government investment in machinery
5. Foreign demand
6. Income tax rates
7. Indirect tax rates
8. Foreign prices
9. Oil prices
10. Labor supply - number of workers
11. Labor supply - working hours
12. Productivity - labor efficiency
13. Productivity - machinery efficiency
14. Productivity – efficiency of all factors
15. Interest rates
16. Private consumption
17. Hourly wages
18. General government purchase of goods, balanced by taxes
19. Labor supply - early retirement scheme, balanced by taxes

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All experiments are chosen to be expansionary in order to facilitate comparison. In some of the experiments, the positive effect on activity is temporary and in others the effect is permanent. In general, a demand shock in ADAM e.g. an additional public purchase of goods affects production and employment in the short run. However, in the long run a pure demand shock has no effect on employment. In contrast, a supply shock such as an increase in the labor force has a permanent effect on employment and output, and an increase in efficiency has a permanent effect on output. This is in line with most models of a small open economy with a fixed exchange rate and a Phillips curve.

In the first half of the experiments, the shock expands aggregate demand. In most cases policy instruments are used to stimulate domestic demand, and in other cases foreign demand for domestic goods and services changes. Experiment 1-5 affect the volume of aggregate demand directly and the short-term impact on GDP is significant. In experiment 6, demand increases indirectly due to the increase in disposable income and the short-term impact on GDP is smaller than the previous cases. In experiment 7-9 aggregate demand also expands indirectly through the effect on prices and real income, ditto the effect on output is smaller. Experiment 1-4 and 6-7 present a shock to fiscal policy instrument variables. In all cases the shock is calibrated to have a direct impact of 1000 million kroner on public budget in the first year, equal to 133 million Euro, which is approximately equal to 0.06 percent of GDP in 2005. Experiment 5 and 8-9 shock foreign demand and prices.

Experiment 10-15 present supply shocks. Experiments 10-12 are different but comparable shocks to the labor supply, cf. rbj14512. Experiment 12 concerns labor productivity and can also be compared with experiment 13-14 that shock the efficiency of other production factors.

Experiment 15 describes a shock to interest rates. Experiment 16 and 17 show the effect of a temporary shock to two of the model's central relations, namely private consumption relation and wage relation.

In experiment 18 and 19 a budget restriction is introduced. Experiment 18 repeats the public purchase of goods and services experiment (section 1), while experiment 19 is a shock to labor supply similar to 10. Thus, the effect from a fiscal budget restriction is shown both for a demand shock and a supply shock.

Finally we should note that comparison with models from other countries may be difficult, for example due to different budget restrictions. Special Danish conditions (e.g. regulatory mechanisms in taxes and transfers etc) incorporated in ADAM produces distinct multipliers and make comparison with other countries difficult. As mentioned the interest and exchange rates are exogenous in ADAM because the Danish economy is modeled as a credible shadow member of the euro zone. Note also that expectations in ADAM are adaptive or constant, i.e. constant inflationary expectations reflecting the constant exchange rate.

A similar document for the previous model, October 2012, can be found here.

1. General government purchase of goods

More government purchase increases the demand for private output. Consequently, private employment rises in the short run. In the long run, there is no effect on private employment. The table below presents the effect of a permanent increase in general government purchase of goods and services. The public expenditure is increased permanently by 0.1 percent relative to the baseline. The increase corresponds to 1000 million kroner in the first year of the experiment in 2005 prices.

Table 1. The effect of a permanent increase in general government spending

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	42	283	373	367	352	488	721	879	950	978
Pub. consumption	*fCo*	1034	1042	1058	1074	1091	1176	1270	1371	1480	1597
Investment	*fI*	316	641	460	300	224	131	174	193	186	174
Export	*fE*	-56	-115	-185	-262	-347	-824	-1255	-1579	-1790	-1916
Import	*fM*	527	773	691	589	535	464	462	445	422	421
GDP	*fY*	844	1109	1053	933	833	573	523	505	497	511
						1000 Persons					
Employment	*Q*	0.76	1.26	1.40	1.36	1.24	0.56	0.19	-0.01	-0.13	-0.15
Unemployment	*Ul*	-0.41	-0.64	-0.70	-0.67	-0.61	-0.27	-0.09	0.00	0.06	0.08
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.03	-0.03	-0.04	-0.07	-0.08	-0.10	-0.11	-0.12
Priv. saving surplus	*Tfn_hc/Y*	0.01	-0.03	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
Balance of payments	*Enl/Y*	-0.04	-0.05	-0.05	-0.05	-0.05	-0.06	-0.08	-0.10	-0.11	-0.12
Foreign receivables	*Wnnb_e/Y*	-0.07	-0.14	-0.20	-0.25	-0.29	-0.53	-0.81	-1.13	-1.45	-1.78
Bond debt	*Wbd_os_z/Y*	0.02	0.03	0.06	0.08	0.11	0.33	0.60	0.89	1.19	1.49
						Percent					
Capital intensity	*fKn/fX*	-0.08	-0.08	-0.07	-0.06	-0.05	-0.02	0.00	0.01	0.01	0.02
Labour intensity	*hq/fX*	-0.06	-0.05	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
User cost	*uim*	0.00	0.01	0.02	0.03	0.04	0.07	0.08	0.08	0.08	0.08
Wage	*lna*	0.01	0.03	0.06	0.08	0.10	0.18	0.21	0.22	0.21	0.20
Consumption price	*pcp*	0.00	0.01	0.02	0.03	0.04	0.08	0.10	0.11	0.11	0.11
Terms of trade	*bpe*	0.00	0.01	0.02	0.02	0.03	0.05	0.06	0.06	0.06	0.06
						Percentage-point					
Consumption ratio	*bcp*	-0.03	-0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Wage share	*byw*	-0.01	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.02	0.02

The immediate effect of an increase in government purchase of goods and services is that total demand rises. The increased demand is met partly through domestic production and partly through imports. The expansion in domestic economic activity raises private sector employment and lowers unemployment. The lower unemployment rate pushes prices and wages upward and reduces competitiveness. The lower competitiveness makes the market share of exports fall and the market share of imports rise, which reduces the positive effect on domestic production. Eventually, the effect on employment disappears and employment returns to its baseline. The long run effect on unemployment is also zero reflecting that the permanent increase in wages and prices deteriorates competitiveness and crowds out any impact on employment.

The short run effect is closely related with the Keynesian income multiplier. The ***income multiplier*** refers to the final change in income arising from an initial change in spending. In this case the initial change concerns government spending. The final change in income is larger than the initial change in income. This is because the immediate increase in income creates additional private demand and leads to more income, which in turn creates more spending and more demand, and so on. In this case, the income multiplier can be seen as the ratio between the effect on GDP and the change in government purchase of goods and services. In a closed economy, the multiplier for domestic demand is larger than one because the exogenous increase in government purchase of goods and services creates additional domestic demand in the form of more private investment and larger private consumption. However, the ADAM multiplier for GDP remains less than one because higher demand triggers not only GDP but also imports, see ADAM book for further discussion.

Wages and domestic prices increase in the medium and long run. But not equally. Prices adjust gradually to total production costs, which includes more than wages. Imported goods and

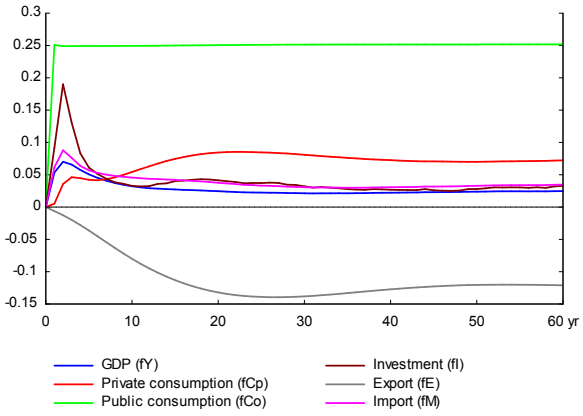
services are for instance part of production cost. As the prices of imported goods are unchanged, prices increase less than wages. This results in a permanent positive effect on real wages, real income and private consumption. The long-term macro-consumption function in ADAM relates consumption to income and wealth and ensures that private consumption, real income and real wealth attain the same growth rate in the long run. Whenever real wages and real disposable income change permanently, private consumption changes. Increased public spending creates a permanent positive *real wage effect*. Thus the composition of GDP changes permanently towards higher public and private consumption and lower net exports relative to the baseline.

The real wage effect also translates into a long-run effect on ***terms of trade***. The positive change in the real wage increases domestic demand and reduces foreign demand. In the new equilibrium employment returns to its baseline while wages and prices increase permanently, which results in a permanent change in the long-run terms of trade.

The consumption equation stabilizes the saving surplus of the private sector in the long run. Thus the private sector saving surplus returns to the baseline. In contrast, the government budget balance and the balance of payments become negative in the long run. This reflects the absence of an automatic fiscal reaction, for a balanced budget experiment see section 18.

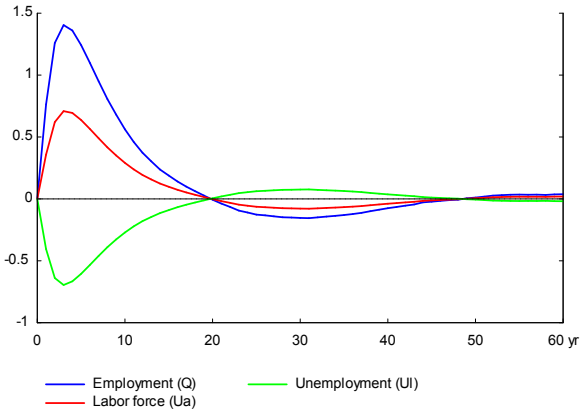
Figure 1. The effect of a permanent increase in general government spending

Supply-Use balance: Multiplier in pct.



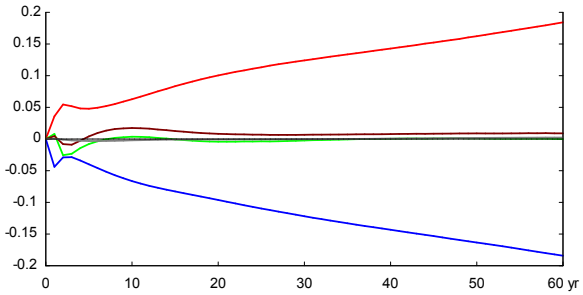
GDP (fY)
Private consumption (fCp)
Public consumption (fCo)
Investment (fI)
Export (fE)
Import (fM)

Labor market: Multiplier in 1000 people.



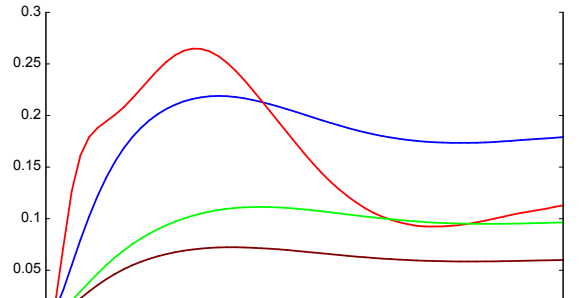
Employment (Q)
Labor force (Ua)
Unemployment (Ul)

Saving balance: Percentage share of GDP



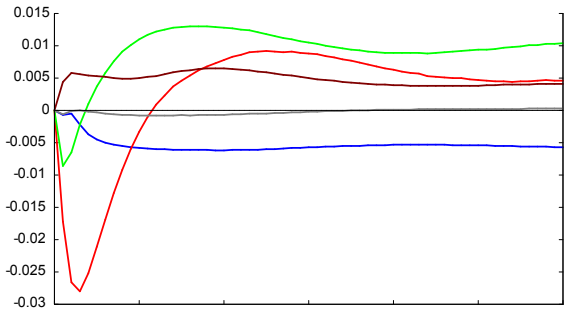
Government sector (Tfn_o/y)
Foreign sector (Tfn_e/y)
Private sector (Tfn_hc/y)
Households (Tfn_h/y)
Interest income, private sector (Tin_hc/y)

Wage and prices: Multiplier in pct.



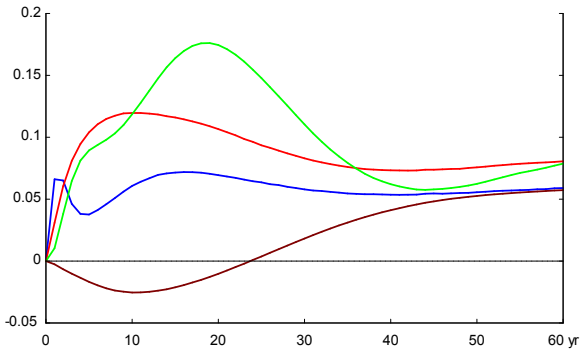
Hourly wage (lna)
House price (phk)
Consumption deflator (pcp)
Production price (pxn)

Taxes and income transfers: Percentage share of GDP



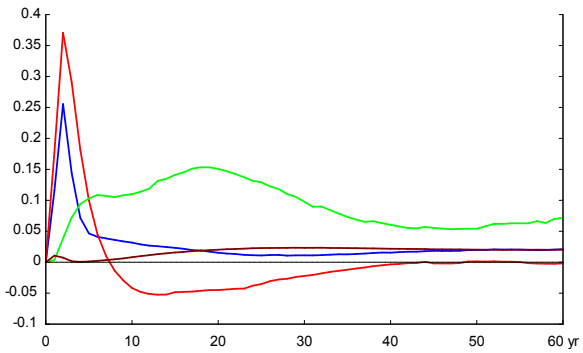
Corporation tax (Syc)
Transfer (Ty_o)
Personal tax (Syk+Sya)
Indirect tax (Spt)
Pension tax (Sywp)

Real income and wealth: Multiplier in pct.



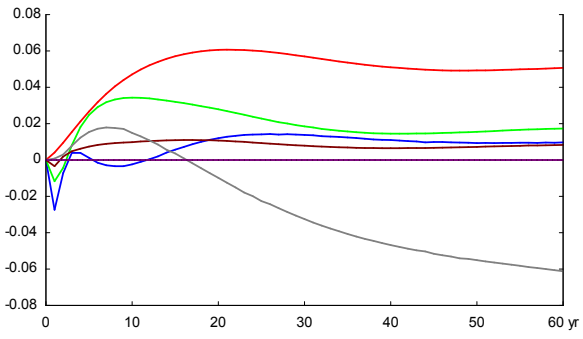
Income (Ydl_hc/pcp)
Wage bill (Yw/pcp)
Wealth (Wcp/pcp)
Pension wealth (Wp/pcp)

Private investment: Multiplier in pct.



Machinery (flmp)
Building (flbp)
Housing (flbh)
Labor productivity (kqyfn)

Different ratios and asset prices: Multiplier in pct.point



Consumption ratio (bcp)
Terms of trade (bpe)
Wage share (byw)
Tax burden (bsyp)
Share price (pws_kax)
Bond price (pwbs)

2. General government employment

Salaries are a major part of general government expenditures. In this experiment, general government employment is raised permanently. The payroll in the public sector is increased by 1000 million kroner in 2005 prices, which provides an additional permanent employment in the public sector of 2370 persons, approximately equal to 0.1 percent of the total employment.

Table 2. The effect of an increase in general government employment

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	128	299	394	466	547	1097	1615	1952	2107	2156
Pub. consumption	*fCo*	1233	1249	1269	1289	1309	1415	1530	1653	1784	1924
Investment	*fI*	139	272	186	111	82	107	173	158	96	26
Export	*fE*	-102	-226	-371	-532	-708	-1698	-2644	-3385	-3871	-4143
Import	*fM*	271	384	345	299	277	232	149	11	-131	-229
GDP	*fY*	1164	1250	1184	1095	1020	779	635	494	388	344
						1000 Persons					
Employment	*Q*	2.63	2.73	2.65	2.48	2.28	1.29	0.54	0.02	-0.30	-0.39
Unemployment	*Ul*	-1.40	-1.35	-1.30	-1.21	-1.11	-0.63	-0.26	-0.01	0.15	0.19
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.03	-0.03	-0.03	-0.04	-0.04	-0.08	-0.10	-0.13	-0.15	-0.17
Priv. saving surplus	*Tfn_hc/Y*	0.01	-0.01	0.00	0.00	0.01	0.01	-0.01	-0.01	-0.01	0.00
Balance of payments	*Enl/Y*	-0.02	-0.03	-0.03	-0.03	-0.04	-0.07	-0.11	-0.14	-0.16	-0.17
Foreign receivables	*Wnnb_e/Y*	-0.08	-0.13	-0.18	-0.23	-0.27	-0.56	-0.94	-1.38	-1.85	-2.32
Bond debt	*Wbd_os_z/Y*	-0.01	0.01	0.02	0.05	0.08	0.32	0.66	1.04	1.47	1.92
						Percent					
Capital intensity	*fKn/fX*	-0.06	-0.05	-0.04	-0.03	-0.02	0.02	0.05	0.08	0.10	0.11
Labour intensity	*hq/fX*	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.04	0.04
User cost	*uim*	0.02	0.03	0.05	0.06	0.08	0.13	0.17	0.18	0.18	0.17
Wage	*lna*	0.03	0.08	0.13	0.18	0.22	0.38	0.46	0.48	0.47	0.44
Consumption price	*pcp*	0.02	0.03	0.05	0.07	0.08	0.16	0.21	0.24	0.25	0.24
Terms of trade	*bpe*	0.01	0.02	0.03	0.04	0.06	0.10	0.12	0.13	0.13	0.12
						Percentage-point					
Consumption ratio	*bcp*	-0.02	-0.01	0.00	0.00	0.00	0.01	0.03	0.04	0.04	0.04
Wage share	*byw*	0.02	0.04	0.05	0.06	0.07	0.09	0.09	0.08	0.07	0.06

An increase in public sector employment lifts total employment and the overall wage bill. More income creates higher demand. Higher demand expands domestic production and employment further. The income multiplier reinforces itself to create higher demand and higher employment in the way that is described in section 1.

Compared to the public purchase of goods and services experiment, the effect on employment and income is stronger and faster in the present experiment. An increase in public purchases increases imports, and hence part of the public expenditure goes directly into foreign production and foreign employment. In the present shock all initial expenditures go directly into domestic employment. In the short term, the employment effect is approximately twice as large compared to the first experiment. Other short term effects - like the effect on GDP- are also larger in the present experiment.

A rapid increase in employment produces a sharp fall in unemployment, which necessitates a strong increase in wages leading to a significant deterioration of competitiveness. As a result, the fall in exports is more pronounced. Thus, the expansionary effect of the shock is stronger in the short run, but the subsequent fall in net-exports is deeper. The fall in exports reduces domestic production over time and the effect on employment is also reduced at a similar rate. Gradually, employment returns to its baseline, as the permanent increase in employment in the public sector is offset by a permanent fall in employment in the private sector. The displacement of private employment by public employment is the original definition of ***crowding out***, and in terms of employment, there is full crowding out in ADAM.

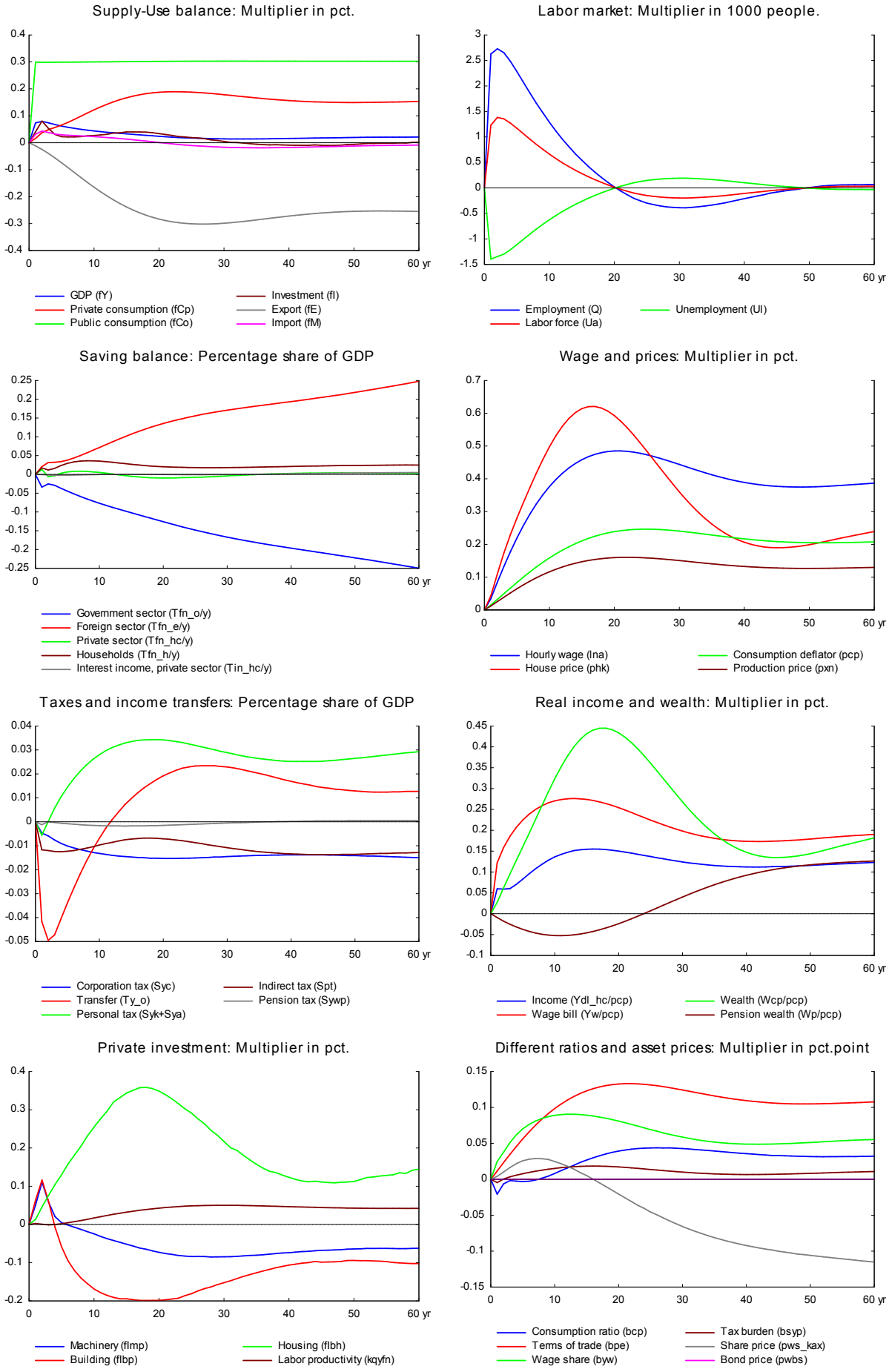
But the crowding out effect also applies to production and demand. The fall in net exports reduces private production, and the fall roughly corresponds to the increase in government production. The higher government consumption is offset by a reduction in net exports so the increase in total demand is much smaller than the increase in public consumption. Government production

displaces private production and government consumption displace other demand. In ADAM there is also crowding out in terms of production and demand. But crowding out of production and demand is partial because the higher real wage increases productivity.

There is a positive effect on real wages, real disposable income and private consumption in the long run. This is because imports are part of production inputs. Since import prices are unchanged, output prices increase less than wage increases, this creates a real wage effect.

The public finances deteriorate permanently in the long run. If the government chooses to raise taxes in the long run, the higher real wage will not translate to a higher disposable income. The tax increase would reduce the income effect and there would be no permanent positive effect on private consumption and overall domestic production in the long run.

Figure 2. The effect of an increase in general government employment



3. General government investment in buildings

Government investments in buildings and capital in general are often used to boost demand in a weak economy due to its high labor content. Government investments in buildings are increased permanently by 5 percent of the baseline corresponding to 1000 million kroner in 2005 prices in the first year . Section 4 holds a similar scenario of more government investments in machinery.

Table 3. The effect of a permanent increase in public investment in buildings

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	36	200	262	268	276	474	705	843	879	857
Pub. consumption	*fCo*	-7	52	111	168	222	458	646	798	920	1017
Investment	*fI*	1281	1435	1337	1246	1202	1168	1214	1217	1194	1165
Export	*fE*	-54	-112	-184	-260	-344	-801	-1209	-1503	-1664	-1713
Import	*fM*	404	528	480	419	385	348	334	289	233	197
GDP	*fY*	812	1007	1014	978	952	950	1034	1089	1124	1162
						1000 Persons					
Employment	*Q*	0.83	1.14	1.22	1.17	1.07	0.52	0.17	-0.05	-0.21	-0.25
Unemployment	*Ul*	-0.44	-0.58	-0.60	-0.57	-0.52	-0.25	-0.08	0.03	0.10	0.12
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.03	-0.03	-0.04	-0.06	-0.07	-0.08	-0.09	-0.10
Priv. saving surplus	*Tfn_hc/Y*	0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balance of payments	*Enl/Y*	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.07	-0.09	-0.10	-0.10
Foreign receivables	*Wnnb_e/Y*	-0.06	-0.13	-0.18	-0.22	-0.26	-0.47	-0.72	-0.99	-1.26	-1.53
Bond debt	*Wbd_os_z/Y*	0.01	0.03	0.05	0.08	0.11	0.31	0.54	0.78	1.04	1.28
						Percent					
Capital intensity	*fKn/fX*	-0.03	-0.01	0.01	0.03	0.05	0.13	0.18	0.21	0.23	0.23
Labour intensity	*hq/fX*	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
User cost	*uim*	0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.08	0.08	0.07
Wage	*lna*	0.01	0.03	0.05	0.07	0.09	0.16	0.19	0.20	0.19	0.16
Consumption price	*pcp*	0.00	0.01	0.02	0.03	0.04	0.07	0.09	0.10	0.10	0.10
Terms of trade	*bpe*	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.05	0.05
						Percentage-point					
Consumption ratio	*bcp*	-0.02	-0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.02
Wage share	*byw*	-0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	-0.01	-0.01

The higher public investment raises private sector production and employment in the short run. Compared to the government purchase of goods and services experiment, the effect on the domestic economy is larger because the import content of building investments is low. The income multiplier increases the initial effect proportionally.

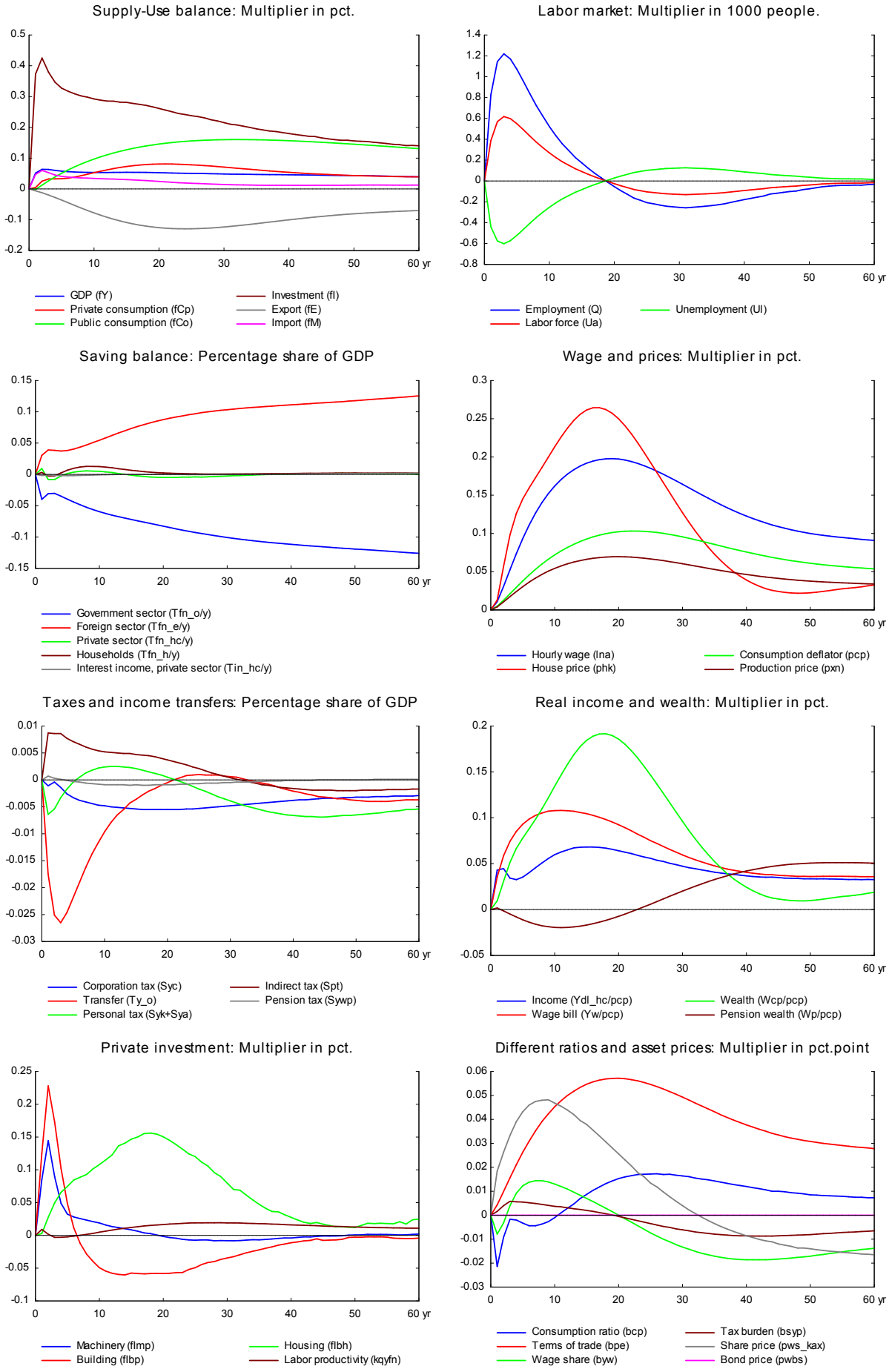
In the medium term, the expansion of the domestic economy entails a higher wage and price level and a fall in competitiveness. A lower competitiveness reduces exports and raises imports. Consequently, domestic production and employment fall. Over time the effect on unemployment disappears.

The expansionary nature of public investment raises production in the short run. The higher production requires an equivalent increase in capital. And a given change in capital requires a more than proportional change in investment. This is because capital stock is far larger than annual investment. As a result, the impact on investment peaks strongly in the short run. This reflects the *accelerator mechanism*. The accelerator impact on building investments is larger than the impact on machinery. This is because buildings are used for longer periods and the ratio between capital stock and investment is higher.

As in the previous two experiments, real wages increase permanently leading to a permanent positive effect on private consumption. There is also a small positive effect on production in the long run. This is because the relative price of capital falls due to the import content in investment. This induces an increase in the capital intensity of the production and hence an increase in labor productivity. Consequently, the same workforce can produce a higher output. In general, there are some long run effects on production due to factor substitution in most of the demand shocks, usually the substitution effects are smaller. For more about substitution and relative factor prices see the experiments on supply side shocks from section 12 onwards.

A permanent increase in public investments can deteriorate the government budget permanently, which may require other fiscal measures, e.g. a tax increase on higher public investment in recession may be financed by lower public investments during economic booms.

Figure 3. The effect of a permanent increase in public investment in buildings



4. General government investment in machinery

Instead of investment in buildings, public investments in machinery can be increased to boost economic activity. The short-term expansionary effect is smaller due to the higher import content of machinery. Government investment in machinery is increased permanently by 5 percent of the baseline, which corresponds to 1000 million kroner in 2005 prices in the first year.

Table 4. The effect of a permanent increase in public investment in machinery

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	10	74	98	101	106	215	349	436	458	443
Pub. consumption	*fCo*	-10	151	286	400	495	784	904	956	978	987
Investment	*fI*	865	944	890	842	816	779	802	802	791	776
Export	*fE*	-36	-68	-107	-149	-196	-461	-710	-895	-996	-1025
Import	*fM*	465	530	512	488	476	463	453	421	380	354
GDP	*fY*	347	556	649	706	751	876	923	914	890	870
						1000 Persons					
Employment	*Q*	0.33	0.54	0.61	0.62	0.59	0.34	0.13	-0.02	-0.13	-0.16
Unemployment	*UI*	-0.17	-0.27	-0.30	-0.30	-0.29	-0.17	-0.06	0.01	0.06	0.08
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.03	-0.04	-0.04	-0.05	-0.06	-0.07	-0.08	-0.08
Priv. saving surplus	*Tfn_hc/Y*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Balance of payments	*Enl/Y*	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.06	-0.07	-0.08	-0.08
Foreign receivables	*Wnnb_e/Y*	-0.05	-0.10	-0.14	-0.19	-0.23	-0.43	-0.64	-0.87	-1.08	-1.29
Bond debt	*Wbd_os_z/Y*	0.02	0.04	0.07	0.10	0.13	0.31	0.51	0.71	0.92	1.11
						Percent					
Capital intensity	*fKn/fX*	0.00	0.00	0.01	0.02	0.02	0.04	0.05	0.06	0.06	0.06
Labour intensity	*hq/fX*	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02
User cost	*uim*	0.16	0.24	0.31	0.36	0.41	0.52	0.54	0.53	0.50	0.47
Wage	*lna*	0.00	0.01	0.02	0.04	0.05	0.09	0.11	0.11	0.11	0.09
Consumption price	*pcp*	0.00	0.01	0.01	0.02	0.02	0.04	0.05	0.06	0.06	0.06
Terms of trade	*bpe*	0.00	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03
						Percentage-point					
Consumption ratio	*bcp*	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Wage share	*byw*	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02

Like building investments, machinery investments have expansionary effects on the economy in the short run. Investment in machinery increases demand in the short run, which translates into higher production and employment. The lower unemployment will increase wage growth and reduce competitiveness. As competitiveness falls, exports fall and imports rise. Over time, the loss of competitiveness implies that unemployment returns to equilibrium. The employment effect of machinery investments is smaller because the import content of machinery investments is higher than that of building investments. The smaller effect on domestic activity effect implies that the pressure on wages and prices is smaller. And the resulting real wage effect on consumption is also lower.

It is also worth noting that the impact on total investment is smaller when investing in machines than when investing in buildings. This is because the accelerator impact is smaller. Machines are used for a shorter time period and the ratio between the stock of machinery and investment is smaller.

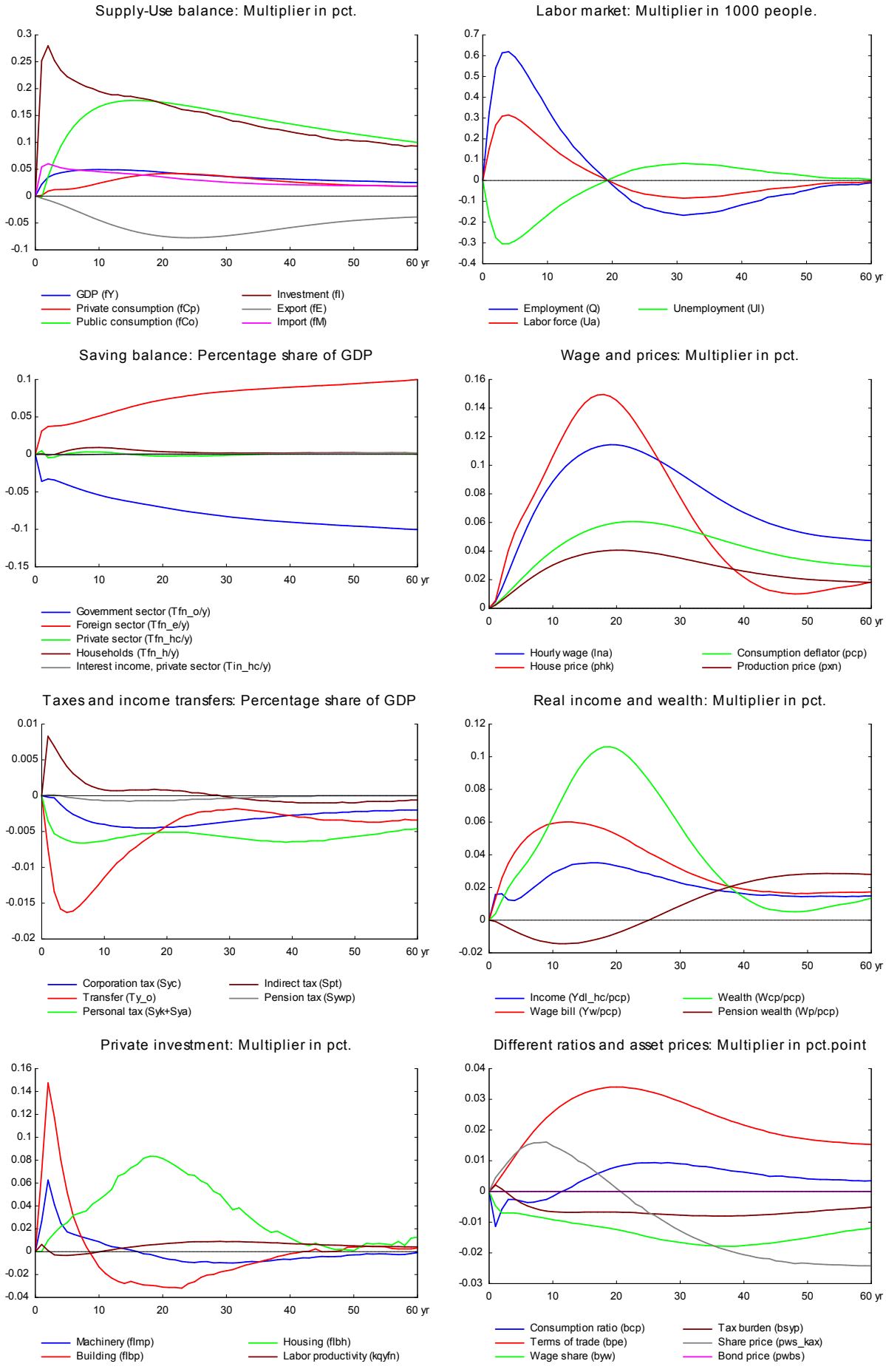
Note that the smaller impact on domestic production and income implies a stronger deterioration of public budget in the short run than when public building investments or the public purchase of goods and services increase. This is, however, not evident from the tables above because the public demand shocks are made comparable in fixed prices, i.e. all shocks are calibrated to have an impact of 1000 million kroner in 2005 prices on the public budget in the first year. This implies that the immediate public budget impacts differ in current prices, and the immediate budget impact of machinery investment is smallest because the price deflator of machinery is the smallest. One factor behind the small machinery deflator is the falling computer prices. The short-run deterioration of the public budget is larger in the present experiment than in building investment experiment, due to the smaller economic activity effect in the present experiment measured per krone expenditure. It should also be noted that the modest accompanying increase in government consumption reflects that the higher government stock of capital triggers an

increase in depreciation, which is part of government consumption.

The four demand experiments discussed so far have similar effects on the domestic economy but differ in terms of the magnitude of the impact on economic activity. An increase in government employment has the largest immediate impact on the domestic economy as it has no direct link to imports. An increase in government investment in machinery has the smallest impact on the domestic economy as the import content is high. Similarly, the long-term impact on government budget is the highest in the former and the smallest in the latter.

All the experiments are considered without funding and the public budget balance deteriorates permanently. The public expenditure can be financed by reducing other public expenditures or by increasing revenues. Section 18 below demonstrates financing the public purchase of goods and services by raising income taxes. If income taxes are raised to finance public expenditures the positive effect on private consumption will turn negative as real disposable income permanently falls, consequently competitiveness will not necessarily deteriorate.

Figure 4. The effect of a permanent increase in public investment in machinery



5. Foreign demand

The focus now shifts from the public sector to the foreign sector. Foreign trade is an essential part of the Danish economy. Exports are a key demand component and constitute about 50 percent of GDP. An increase in foreign demand for Danish products makes Danish firms expand production, and employment increases in the short run. Table 5 presents the effects of a permanent 0.115 percent increase in foreign demand without accompanying effects on foreign prices and foreign interest rates. The shock amounts to a 1000 million kroner increase in exports in 2005 prices in the first year.

Table 5. The effects of a permanent increase in foreign demand

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	39	200	257	255	244	317	464	569	612	626
Pub. consumption	*fCo*	-8	-10	-9	-8	-7	-4	-2	-1	-1	0
Investment	*fI*	302	527	381	287	226	131	152	167	169	167
Export	*fE*	868	821	826	787	759	527	320	191	148	169
Import	*fM*	678	840	791	735	705	674	699	719	736	771
GDP	*fY*	512	685	654	581	514	304	246	222	209	208
						1000 Persons					
Employment	*Q*	0.52	0.88	0.99	0.97	0.90	0.41	0.13	-0.01	-0.09	-0.11
Unemployment	*Ul*	-0.27	-0.45	-0.49	-0.47	-0.44	-0.20	-0.06	0.01	0.04	0.05
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.01	0.02	0.03	0.02	0.02	0.01	0.01	0.00	0.00	0.00
Priv. saving surplus	*Tfn_hc/Y*	0.00	-0.02	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
Balance of payments	*Enl/Y*	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
Foreign receivables	*Wnnb_e/Y*	-0.01	-0.02	-0.02	-0.01	0.00	0.04	0.06	0.06	0.05	0.04
Bond debt	*Wbd_os_z/Y*	-0.02	-0.05	-0.08	-0.10	-0.12	-0.17	-0.17	-0.16	-0.14	-0.12
						Percent					
Capital intensity	*fKn/fX*	-0.04	-0.04	-0.03	-0.03	-0.02	0.00	0.02	0.02	0.03	0.03
Labour intensity	*hq/fX*	-0.03	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
User cost	*uim*	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.04	0.04
Wage	*lna*	0.01	0.02	0.04	0.06	0.07	0.13	0.15	0.16	0.15	0.14
Consumption price	*pcp*	0.00	0.01	0.01	0.02	0.03	0.05	0.07	0.08	0.08	0.08
Terms of trade	*bpe*	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.04	0.04
						Percentage-point					
Consumption ratio	*bcp*	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Wage share	*byw*	-0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01

Exports increase immediately reflecting the increase in foreign demand. However, the initial increase in exports is less than 1000 million as the average short run export demand elasticity is less than one. The higher exports makes domestic production and employment expand, see more on the income multiplier process in section 1. As production increases the demand for capital and other factors of production increases, and hence investment increases. This is reflected on the higher accelerator impact on investment. Investments increase also due to the substitution effect.

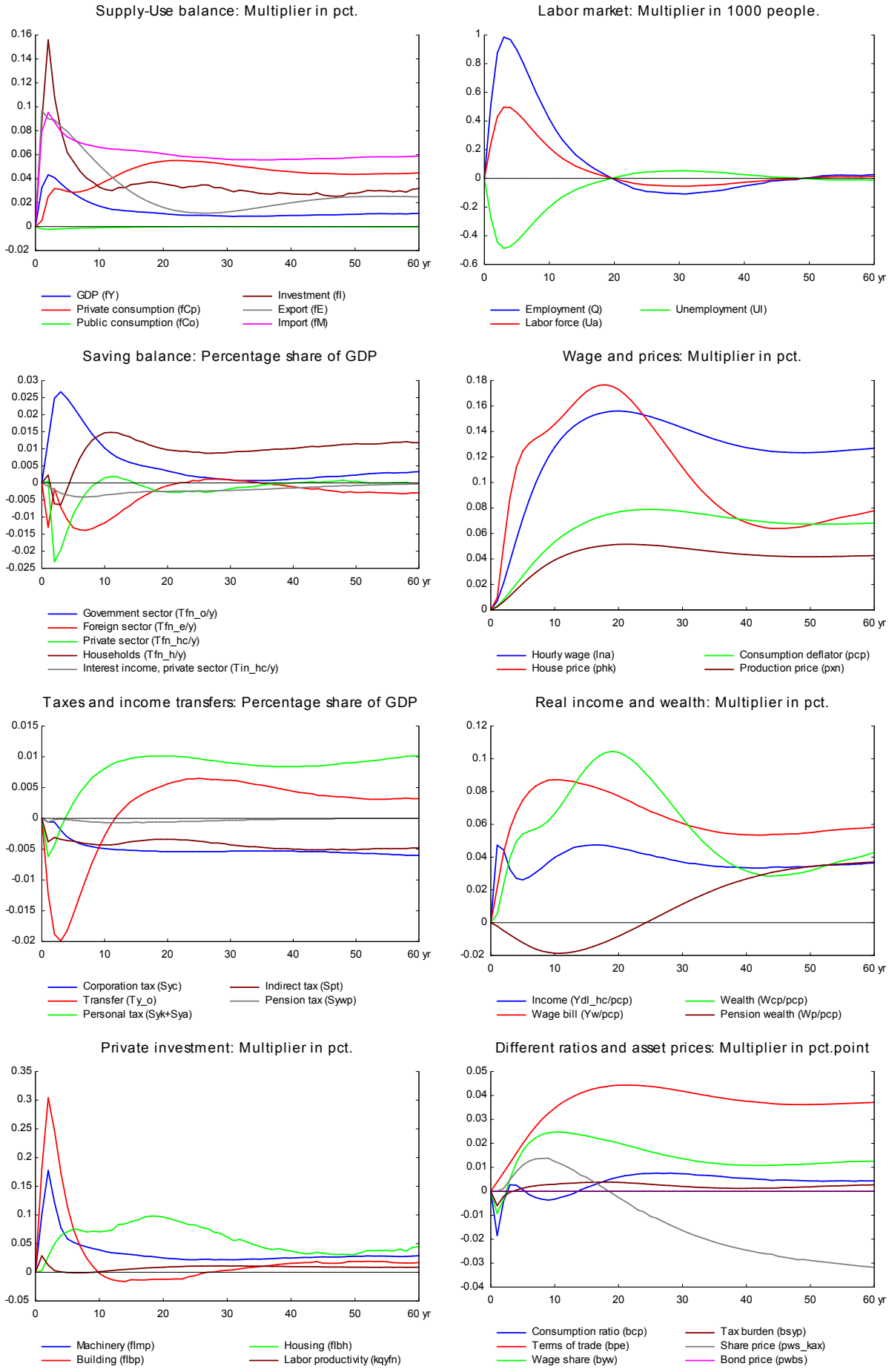
The expansion of the domestic economy increases the export prices. This is because export prices reflect production cost and the higher employment puts upward pressure on wages and hence on the cost of production. As prices grow relative to the baseline, competitiveness worsens, which dampens exports and stimulates imports. Because of this the long term effect on export volumes is smaller than the initial export demand shock, see more about the crowding out process in section 2. Wages increase more than the general price levels due to the deadweight from the non-responding exogenous import prices. This creates a real wage effect and real disposable income and private consumption increase permanently.

Imports also increase due to an increase in domestic economic activity in the short run. The higher export prices increase earnings from exports, but higher imports have a negative effect on the trade balance. The net result is a small improvement in the trade balance.

The long-term positive effect on the balance of payments is also a result of higher interest income from abroad. In contrast to the previous public demand shocks, it is now the budget balance of the foreign sector that deteriorates permanently while the public budget balance improves in the long term. It is not necessary to consider a tax increase in order to keep public debt unchanged. On the

contrary, it is possible to loosen the fiscal policy slightly. In general, higher foreign demand is a demand shock similar to higher government purchases, but the shocks differ considerably concerning their long-term effects on public budget sustainability and on the balance of payments.

Figure 5. The effects of a permanent increase in foreign demand



6. Income tax rates

Income tax rates can be reduced to stimulate economic activity. The expansionary effects arise through the effect on disposable income. Income tax rates for all income categories are permanently reduced by 0.82 percent. The shock corresponds to an immediate loss in tax revenue of 1000 million kroner in 2005 prices, corresponding to 0.064 percent of disposable income in the private sector.

Table 6. The effect of a permanent fall in income tax rates

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	352	705	941	1094	1194	1461	1678	1844	1935	2000
Pub. consumption	*fCo*	-3	-6	-8	-8	-8	-4	0	2	3	3
Investment	*fI*	136	375	523	574	589	489	383	326	301	293
Export	*fE*	-17	-50	-98	-155	-221	-655	-1077	-1349	-1460	-1471
Import	*fM*	196	420	542	581	584	469	356	285	247	249
GDP	*fY*	272	597	806	914	959	821	637	553	549	592
						1000 Persons					
Employment	*Q*	0.22	0.56	0.84	1.03	1.12	0.74	0.15	-0.16	-0.26	-0.22
Unemployment	*Ul*	-0.11	-0.29	-0.43	-0.51	-0.55	-0.36	-0.07	0.08	0.13	0.11
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.05	-0.03	-0.02	-0.02	-0.02	-0.03	-0.05	-0.07	-0.08	-0.09
Priv. saving surplus	*Tfn_hc/Y*	0.03	0.01	-0.01	-0.02	-0.03	-0.02	-0.02	-0.01	-0.01	-0.01
Balance of payments	*Enl/Y*	-0.01	-0.03	-0.04	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.10
Foreign receivables	*Wnnb_e/Y*	-0.02	-0.07	-0.12	-0.17	-0.22	-0.46	-0.69	-0.94	-1.18	-1.42
Bond debt	*Wbd_os_z/Y*	0.03	0.05	0.07	0.08	0.08	0.16	0.32	0.54	0.78	1.02
						Percent					
Capital intensity	*fKn/fX*	-0.01	-0.02	-0.03	-0.02	-0.01	0.04	0.07	0.09	0.09	0.09
Labour intensity	*hq/fX*	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.01	-0.01
User cost	*uim*	0.00	0.01	0.01	0.02	0.03	0.06	0.07	0.07	0.07	0.06
Wage	*lna*	0.00	0.01	0.03	0.04	0.06	0.15	0.19	0.19	0.17	0.14
Consumption price	*pcp*	0.00	0.00	0.01	0.02	0.02	0.07	0.09	0.10	0.09	0.09
Terms of trade	*bpe*	0.00	0.00	0.01	0.01	0.02	0.04	0.05	0.05	0.05	0.04
						Percentage-point					
Consumption ratio	*bcp*	-0.03	-0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Wage share	*byw*	0.00	-0.01	0.00	0.00	0.01	0.03	0.02	0.02	0.01	0.00

The immediate effect of a fall in income taxes is a fall in public revenues and (real) disposable income increases consequently, which raises private consumption. Domestic demand booms and production and employment increase. The employment effect in the first few years is slower than in the previous experiments. This is because the short-run income elasticity of consumption is lower than 1, so the change in income taxes does not affect demand as directly as a change in government purchases. The effect after a few years is more comparable to the public purchase experiment. In the medium run, the lower unemployment raises wage growth and hence prices. Consequently, competitiveness worsens, the market share of exports fall, and the market share of imports rise.

Compared to the previous demand shocks, the effect on private consumption is larger when income taxes are reduced. Because the shock directly affects disposable income and hence private consumption. The higher private consumption raises investment in housing and house prices and the impact on housing is high as the initial impact on consumption is high. This in turn raises housing wealth, which stimulates private consumption for a longer period. The demand for dwelling increases as the income effect increases. But it takes time to expand the stock of housing. Consequently, the house price of existing houses will remain high for a longer period.

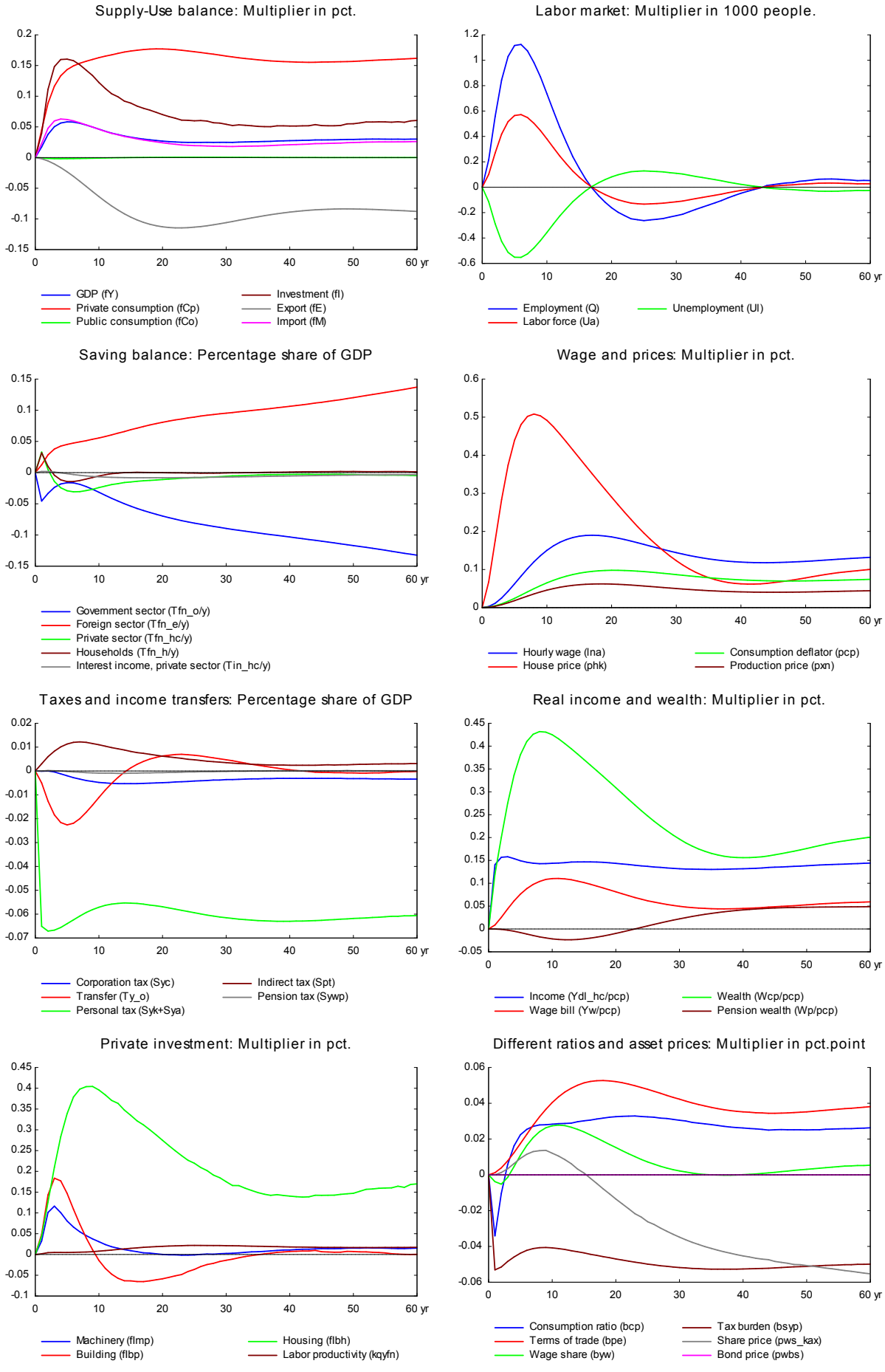
As in the other fiscal experiments, the short-run effect on the public budget is moderated by the short-run reaction in the economy, i.e. the short-run fall in unemployment and unemployment benefits. In the long run, the lower tax income results in a permanent deterioration of the public budget and the balance of payments.

It may be noted that there is a positive composition effect on GDP. This effect is caused by the increase in private consumption as higher private consumption increases the content of indirect taxes in GDP. The composition effect accounts for about 40 percent of the long-term effect on

GDP reported in the table. However, the effect does not add to the real size of the economy. Total production and total employment are not changed in the long run.

Note also that the positive effect on labor supply of a tax reduction is not considered in the present experiment. There is no link between labor supply and income taxes in ADAM. But one can choose to raise labor supply when reducing income tax rates. An accompanying increase in labor supply would have a positive effect on production and government finances, see the supply side shocks below.

Figure 6. The effect of a permanent fall in income tax rates



7. Indirect taxes

Instead of direct taxes, governments can reduce indirect taxes to create expansionary effects in the economy. The effect on the economy goes through a reduction in final prices. Table 7 presents the effect of a permanent reduction in indirect taxes. The VAT rate is reduced by approximately 0.2 percentage points, which corresponds to an immediate loss in revenue of 1000 million kroner in 2005 prices. (See experiment)

Table 7. The effect of a permanent reduction in indirect taxes

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	312	639	862	1008	1104	1378	1626	1831	1959	2050
Pub. consumption	*fCo*	-3	-7	-9	-10	-10	-7	-3	0	1	1
Investment	*fI*	174	435	558	598	612	519	427	383	367	363
Export	*fE*	37	26	0	-40	-92	-494	-932	-1245	-1404	-1455
Import	*fM*	200	431	541	576	582	483	383	316	275	270
GDP	*fY*	316	646	843	949	998	884	714	637	631	671
						1000 Persons					
Employment	*Q*	0.25	0.61	0.91	1.10	1.19	0.85	0.26	-0.08	-0.21	-0.20
Unemployment	*Ul*	-0.13	-0.32	-0.46	-0.55	-0.59	-0.41	-0.12	0.04	0.10	0.10
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.02	-0.02	-0.02	-0.03	-0.05	-0.07	-0.08	-0.09
Priv. saving surplus	*Tfn_hc/Y*	0.03	0.01	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01	0.00	0.00
Balance of payments	*Enl/Y*	-0.01	-0.03	-0.03	-0.04	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
Foreign receivables	*Wnnb_e/Y*	0.01	-0.02	-0.07	-0.12	-0.16	-0.38	-0.59	-0.82	-1.06	-1.30
Bond debt	*Wbd_os_z/Y*	0.06	0.08	0.09	0.09	0.10	0.17	0.32	0.54	0.77	1.01
						Percent					
Capital intensity	*fKn/fX*	-0.01	-0.03	-0.03	-0.02	-0.02	0.03	0.07	0.08	0.09	0.09
Labour intensity	*hq/fX*	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	-0.01	-0.01	-0.01	-0.01
User cost	*uim*	-0.04	-0.03	-0.03	-0.02	-0.01	0.02	0.04	0.04	0.04	0.03
Wage	*lna*	0.00	0.01	0.02	0.04	0.06	0.16	0.21	0.21	0.20	0.18
Consumption price	*pcp*	-0.08	-0.08	-0.07	-0.07	-0.06	-0.03	0.00	0.01	0.01	0.01
Terms of trade	*bpe*	-0.01	0.00	0.00	0.00	0.01	0.03	0.05	0.05	0.05	0.04
						Percentage-point					
Consumption ratio	*bcp*	-0.04	-0.02	-0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.02
Wage share	*byw*	0.00	0.00	0.00	0.01	0.01	0.04	0.04	0.03	0.02	0.02

The cut in VAT immediately reduces prices for final goods and services. This in turn raises real disposable income and thereby private consumption. In the previous income tax experiment, the expansion comes from a direct increase in disposable income. In the present experiment, the expansionary effect arises as the fall in prices increase real income. The short-term effect on private consumption is smaller than the effect in the previous income tax experiment. Fall in income tax directly affects consumption through nominal disposable income, whereas VAT goes through prices and concerns a broader group of goods than just private consumption. The rise in private consumption expands production and employment. It also increases the demand for housing, and house prices and housing investment increase. The fall in unemployment increases wage growth, which in turn raises production costs and producer prices. As a result competitiveness worsens, exports fall and imports rise in the long run. Thus, the positive effect on private consumption and housing investment is counterbalanced by a permanent negative effect on net exports.

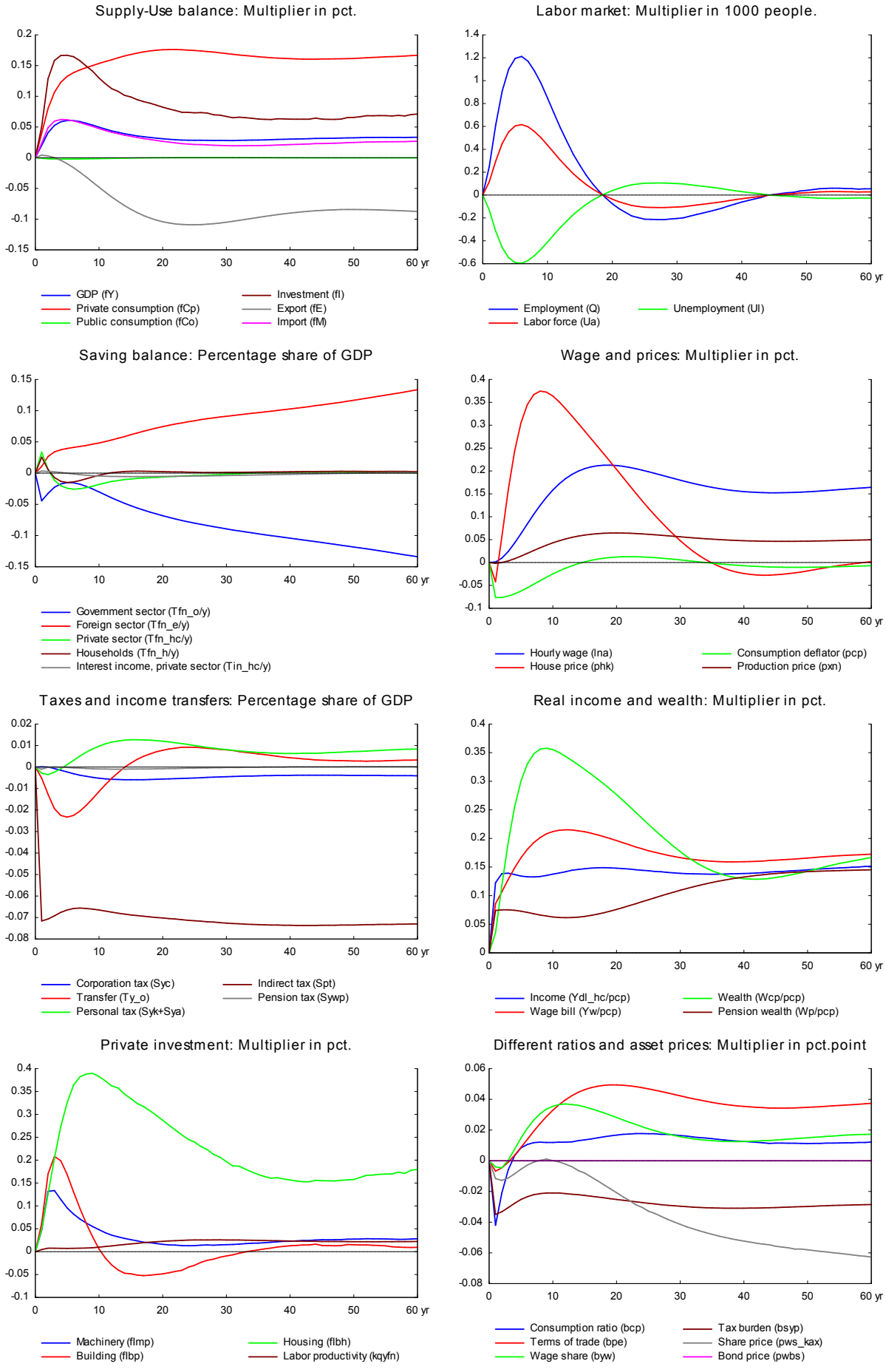
The VAT reduction affects the relationship between production costs and final market prices. Despite the rise in wages and output prices, consumption prices fall when VAT rates are reduced. Like a lower income tax, the lower VAT has a positive long-term effect on real income, which gives rise to a change in the composition of demand.

A fall in indirect taxes has also a positive effect on production. The rise in wages makes capital relatively cheaper and the capital intensity of production increases and makes labor more productive, as a result production increases.

Note that there is no VAT on house price. But, there is a negative first year effect on house price. This is because the house price equation determines the real house price – nominal house price divided by consumption price – and the latter falls as VAT rates fall. In the following years the

increased demand stimulates house price but in the long run the house price effect is slightly negative reflecting that the supply price, the housing investment deflator, does include VAT. In general, the VAT experiment resembles the direct tax experiment, but there are some differences, for example, there is an immediate positive impact on service exports as the lower consumer price stimulates the fixed-price purchases of foreign tourists. Just like the fall in direct taxes, the reduction in VAT deteriorates the public balance permanently.

Figure 7. The effect of a permanent reduction in indirect taxes



8. Foreign prices

The previous sections have focused on various forms of demand shocks, where public expenditures/revenues are changed by a 1000 million kroner. Here the focus shifts to foreign prices. The stimulus effect comes from the foreign sector like in the case of a foreign demand shock. A rise in foreign prices improves Danish competitiveness and expands exports in the first period, thus it has the characteristics of a demand shock, and in the long run the employment effect is crowded out. The table below presents the effect of a permanent 1 percent increase in foreign prices measured in Danish krone.

Table 8. The effect of a permanent increase in foreign prices in Danish krone

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	-882	-923	-1280	-1679	-1922	-1611	-680	65	495	640
Pub. consumption	*fCo*	-30	-34	-29	-23	-20	-14	-10	-3	5	11
Investment	*fI*	810	1337	537	5	-296	-441	-23	224	251	166
Export	*fE*	2265	2772	3144	3319	3431	3056	2046	929	22	-509
Import	*fM*	102	555	221	-34	-122	166	436	416	221	-4
GDP	*fY*	1968	2381	1878	1374	1029	534	595	488	233	-19
						1000 Persons					
Employment	*Q*	2.75	4.23	4.42	4.15	3.78	2.46	1.83	1.10	0.30	-0.26
Unemployment	*Ul*	-1.46	-2.14	-2.18	-2.03	-1.84	-1.20	-0.89	-0.53	-0.14	0.13
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.07	0.14	0.12	0.10	0.08	0.04	0.05	0.05	0.04	0.03
Priv. saving surplus	*Tfn_hc/Y*	-0.11	-0.15	-0.09	-0.03	0.01	0.06	0.02	-0.01	-0.02	-0.02
Balance of payments	*Enl/Y*	-0.04	-0.02	0.03	0.07	0.09	0.10	0.07	0.04	0.02	0.01
Foreign receivables	*Wnnb_e/Y*	-0.20	-0.33	-0.33	-0.29	-0.22	0.19	0.46	0.57	0.56	0.51
Bond debt	*Wbd_os_z/Y*	-0.17	-0.33	-0.44	-0.53	-0.59	-0.75	-0.85	-0.92	-0.94	-0.90
						Percent					
Capital intensity	*fKn/fX*	-0.18	-0.18	-0.14	-0.12	-0.10	-0.10	-0.09	-0.05	-0.01	0.03
Labour intensity	*hq/fX*	-0.09	-0.05	-0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.00
User cost	*uim*	0.57	0.62	0.66	0.69	0.72	0.83	0.92	0.98	1.01	1.01
Wage	*lna*	0.10	0.18	0.26	0.34	0.42	0.70	0.90	1.03	1.10	1.10
Consumption price	*pcp*	0.37	0.44	0.48	0.53	0.57	0.73	0.85	0.95	1.01	1.03
Terms of trade	*bpe*	-0.33	-0.28	-0.25	-0.23	-0.20	-0.11	-0.05	-0.01	0.01	0.01
						Percentage-point					
Consumption ratio	*bcp*	0.03	0.04	0.01	-0.03	-0.06	-0.09	-0.05	-0.01	0.01	0.02
Wage share	*byw*	-0.07	-0.05	-0.02	0.00	0.01	0.03	0.04	0.05	0.04	0.03

The rise in import and competitive prices improves competitiveness so export and home market shares increase immediately. More exports lead to an expansion of the economy in the same way as described in the first four sections and especially in section 5 on export market expansion. The higher import prices also increase the Danish consumption prices, and this lowers real income and consumption. However, the first-year fall in private consumption does not offset the gain in market share for Danish production. As a result, unemployment begins to fall already in the first year and the lower level of unemployment raises wages relative to the baseline. Eventually, the competitive advantage will be lost and unemployment will return to the baseline. In the long term, Danish wages and prices will increase by approximately 1 percent.

There is an immediate positive impact on imports despite the increase in import prices. The higher import prices reduce imports, but the higher production requires more inputs, which are partly imported. The short-term demand elasticities are relatively high in the import equations. Thus, the positive demand effect dominates and we get a net increase in imports. The higher production also increases investment in machinery and business buildings in the short run. The immediate effect on housing investment is negative, due to the fall in real income and housing demand. After the initial fall, house price and housing investment start a positive adjustment process as private consumption starts moving back to its baseline.

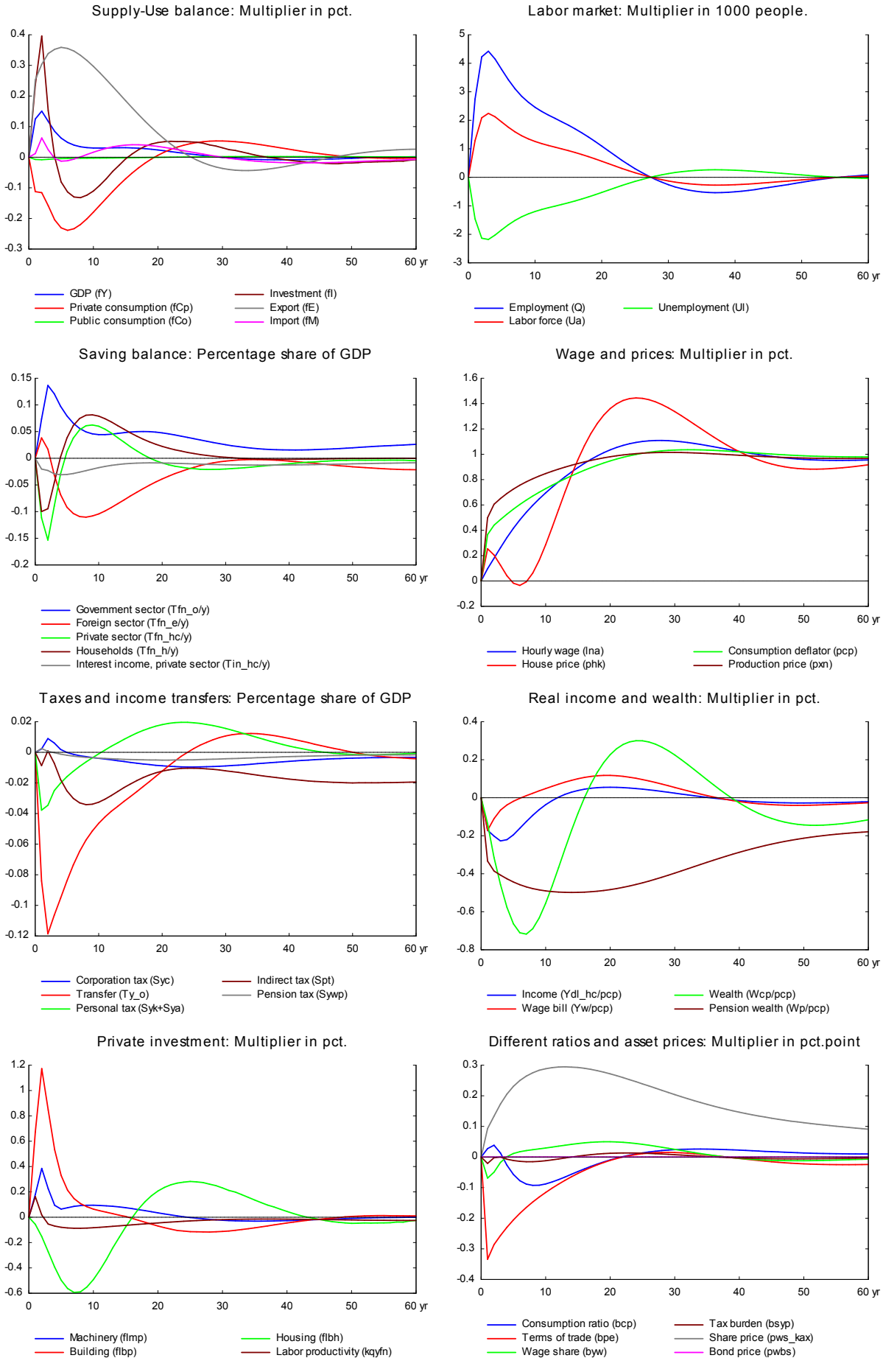
In the long run, the foreign price increase works like a monetary shock and affects only domestic price levels. Thus, both the foreign and domestic prices increase by 1 percent in relation to the baseline implying that relative prices and hence quantity variables are unaffected in the long run. This property is inherent in the construction of demand equations in ADAM and in the general indexation, which makes public revenues and expenditures react proportionally to nominal

changes.

Note that the long-term effect of a permanent change in foreign prices and the long-term effect of a temporary shock to the wage relation, cf. section 17, are similar with respect to the absence of long-run effects on real variables. They are also similar with respect to the long-term effect on public and foreign debt. In both cases there is a long-run effect reflecting the accumulated budget effects in the transition period before equilibrium is reached. They are also quite similar concerning the adjustment process but note that the transitions differ with respect to sign. A temporary positive wage shock triggers a period with unemployment above baseline, while a permanent foreign price increase triggers a period with unemployment below baseline.

The response of exports to the competitive gain peaks gradually, due to among others capacity constraints and lack of inventory. This is captured by an error correction mechanism, and is one of the key features of ADAM. The effect on exports peaks after a few years. This reflects that the short-term price elasticity is lower than the long term price elasticity in the export equations, so that the error correction process makes the initial response in exports less than the response in the following years. After reaching its peak, exports declines as competitiveness deteriorates.

Figure 8. The effect of a permanent increase in foreign prices in Danish krone



9. Oil prices

The experiment presents the effect of a permanent 10 percent increase in world market oil prices.The experiment has a lot of similarity with the previous experiment. A change in world oil prices affects also other countries and hence foreign markets and foreign prices will be affected. However, the oil experiment does not take the international spillover into account.

Table 9. The effect of a permanent 10 percent increase in world market oil prices

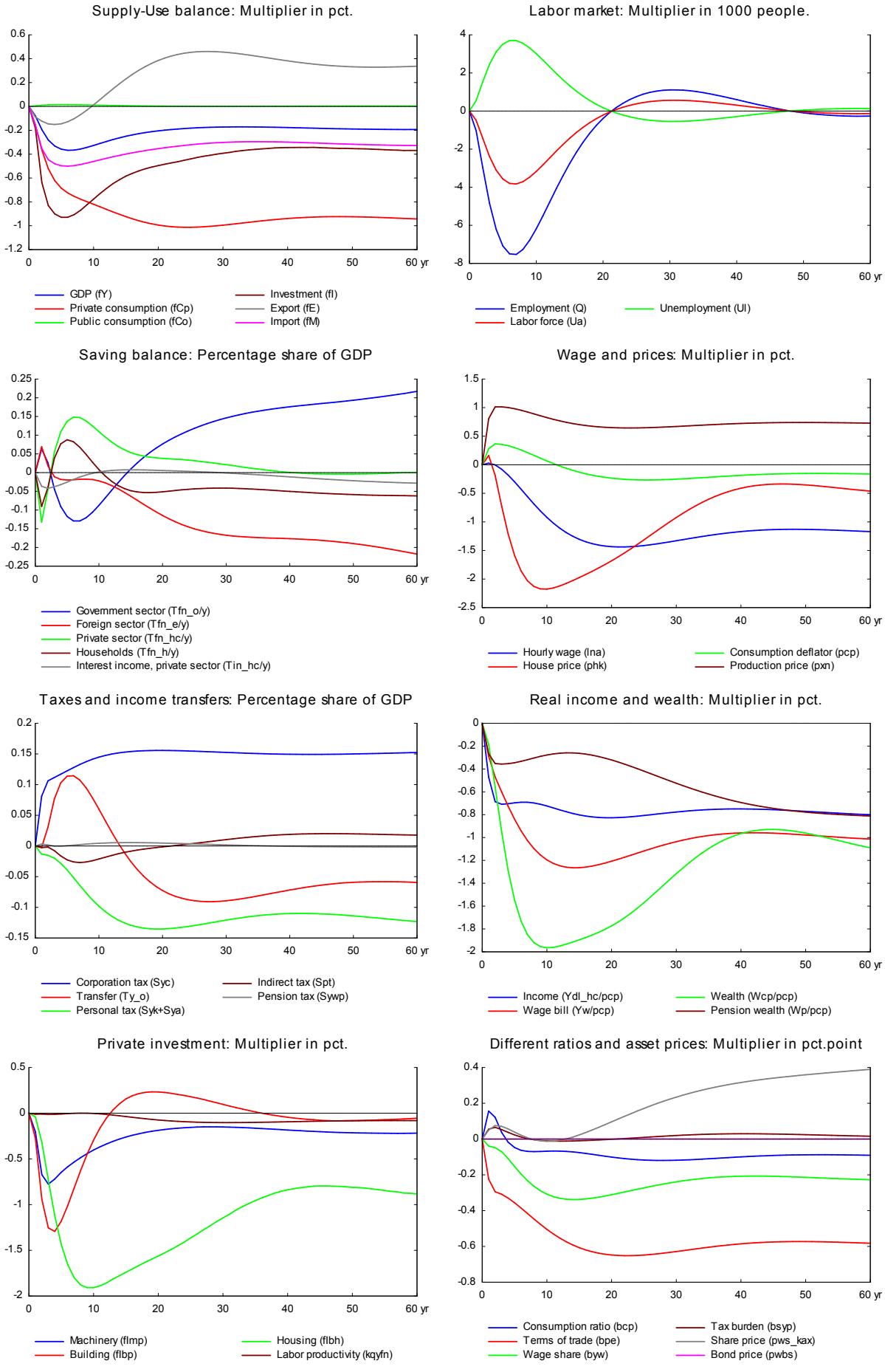
		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	-1219	-2912	-4223	-5108	-5704	-7362	-8935	-10359	-11370	-12034
Pub. consumption	*fCo*	18	41	55	61	64	52	30	15	6	4
Investment	*fI*	-625	-2154	-2931	-3240	-3410	-3103	-2522	-2309	-2209	-2123
Export	*fE*	-796	-1129	-1361	-1423	-1392	135	2562	4605	5836	6315
Import	*fM*	-1364	-3118	-4056	-4450	-4685	-4694	-4379	-4182	-4093	-4139
GDP	*fY*	-1251	-3073	-4516	-5392	-5905	-5805	-4784	-4223	-4044	-4133
						1000 Persons					
Employment	*Q*	-1.03	-2.99	-4.84	-6.21	-7.08	-6.18	-2.75	-0.39	0.76	1.11
Unemployment	*Ul*	0.55	1.55	2.45	3.11	3.51	3.01	1.33	0.18	-0.38	-0.55
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.06	0.03	-0.04	-0.09	-0.12	-0.09	0.01	0.08	0.12	0.15
Priv. saving surplus	*Tfn_hc/Y*	-0.13	-0.04	0.06	0.11	0.14	0.11	0.05	0.04	0.03	0.02
Balance of payments	*Enl/Y*	-0.07	-0.02	0.01	0.02	0.02	0.02	0.06	0.11	0.15	0.17
Foreign receivables	*Wnnb_e/Y*	-0.09	-0.07	0.01	0.10	0.18	0.47	0.71	1.08	1.55	2.03
Bond debt	*Wbd_os_z/Y*	-0.07	-0.06	0.02	0.13	0.26	0.78	0.79	0.44	-0.09	-0.67
						Percent					
Capital intensity	*fKn/fX*	0.11	0.20	0.23	0.23	0.21	-0.05	-0.26	-0.37	-0.42	-0.43
Labour intensity	*hq/fX*	0.08	0.13	0.14	0.14	0.13	0.10	0.11	0.12	0.13	0.14
User cost	*uim*	0.22	0.27	0.24	0.21	0.17	-0.03	-0.17	-0.23	-0.23	-0.20
Wage	*lna*	0.03	0.00	-0.08	-0.18	-0.30	-0.92	-1.30	-1.43	-1.41	-1.33
Consumption price	*pcp*	0.28	0.37	0.36	0.33	0.30	0.07	-0.13	-0.23	-0.27	-0.25
Terms of trade	*bpe*	-0.22	-0.29	-0.30	-0.32	-0.35	-0.50	-0.60	-0.64	-0.64	-0.62
						Percentage-point					
Consumption ratio	*bcp*	0.16	0.12	0.04	-0.02	-0.05	-0.07	-0.08	-0.10	-0.12	-0.12
Wage share	*byw*	-0.04	-0.05	-0.07	-0.11	-0.15	-0.31	-0.34	-0.31	-0.27	-0.24

The increase in oil prices raises expenditure on energy imports, and the balance of payments deteriorates immediately. Nevertheless, energy exports also increase and offset most of the negative effect on the balance of payments. The public budget improves in the short run because higher oil prices mean higher taxable profits in the hydrocarbon-extracting industry.

The increase in energy price affects the general price level, and the accompanying fall in real income reduces consumption and economic activity. In the medium run, the higher unemployment moderates wages and increases competitiveness, so the period of contraction is followed by a period of expansion in employment and production.

The long-term effect on employment is zero like in the previous demand shock experiments. Thus, the increase in oil prices also represents a shock to the supply side of the international economy but it does not constitute a permanent supply shock to the employment. The long-term effect on GDP is negative partly due to the substitution effect of the permanent fall in the relative price of labor, and partly due to the permanent fall in private consumption, which triggers a fall in the content of indirect taxes in GDP. In general, the higher oil price works as a negative demand shock in the short run, and in the long run it works as a supply shock as relative factor prices change in the long run. The higher public revenues can be used to increase e.g. private consumption. Higher consumption would reduce the negative impact on wages and the positive impact on exports.

Figure 9. The effect of a permanent 10 percent increase in world market price of oil



10. Labor supply - number of workers

Now, the focus shifts to supply side shocks and a positive shock to labor supply is the first of the supply shocks presented in sections 10 - 14. Labor input in ADAM's production function is defined in terms of efficiency corrected labor hours, i.e. as a product of three elements: labor productivity, working hours per year per employed and employment. A change in any of these three components changes the labor input, and the three experiments of sections 10 - 12 present a shock to each of the three elements. In all cases production increases in the medium and long run. In the following, we consider the effect of a permanent increase in the number of people in the work force caused by a reduction of 27000 in the number of people outside the labor force not receiving transfers. The work force increases approximately by 1 percent of the total employment.

Table 10. The effect of a permanent increase in labor supply

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	773	1839	2487	2564	2242	-1293	-4379	-6115	-6720	-6565
Pub. consumption	*fCo*	-17	-41	-61	-75	-84	-117	-151	-191	-225	-249
Investment	*fI*	604	1807	2770	3214	3312	2244	1233	1200	1734	2392
Export	*fE*	748	1641	2631	3706	4859	10975	16796	21627	25063	27124
Import	*fM*	574	1573	2310	2617	2678	2395	2787	3870	5110	6165
GDP	*fY*	1497	3550	5297	6513	7328	9003	10253	12131	14153	15895
						1000 Persons					
Employment	*Q*	1.63	4.42	7.39	10.03	12.20	18.14	21.40	24.43	26.62	27.56
Unemployment	*Ul*	13.65	11.15	9.65	8.38	7.33	4.47	2.87	1.39	0.32	-0.13
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.15	-0.12	-0.03	0.06	0.13	0.28	0.35	0.45	0.56	0.65
Priv. saving surplus	*Tfn_hc/Y*	0.12	0.03	-0.08	-0.17	-0.21	-0.13	0.01	0.06	0.06	0.04
Balance of payments	*Enl/Y*	-0.03	-0.08	-0.11	-0.11	-0.08	0.15	0.36	0.51	0.62	0.69
Foreign receivables	*Wnnb_e/Y*	0.06	0.05	0.01	-0.03	-0.03	0.57	2.02	3.93	6.01	8.08
Bond debt	*Wbd_os_z/Y*	0.20	0.34	0.39	0.35	0.25	-0.65	-1.85	-3.29	-4.97	-6.79
						Percent					
Capital intensity	*fKn/fX*	-0.09	-0.20	-0.28	-0.33	-0.35	-0.38	-0.49	-0.65	-0.75	-0.78
Labour intensity	*hq/fX*	-0.04	-0.08	-0.09	-0.08	-0.07	-0.02	-0.01	0.00	0.02	0.03
User cost	*uim*	-0.14	-0.26	-0.36	-0.44	-0.52	-0.83	-1.04	-1.14	-1.15	-1.10
Wage	*lna*	-0.31	-0.71	-1.03	-1.31	-1.55	-2.37	-2.86	-3.08	-3.06	-2.91
Consumption price	*pcp*	-0.14	-0.27	-0.39	-0.49	-0.59	-1.00	-1.30	-1.49	-1.56	-1.54
Terms of trade	*bpe*	-0.10	-0.18	-0.26	-0.32	-0.38	-0.61	-0.75	-0.82	-0.83	-0.79
						Percentage-point					
Consumption ratio	*bcp*	-0.14	-0.08	0.00	0.07	0.10	0.00	-0.15	-0.23	-0.27	-0.26
Wage share	*byw*	-0.10	-0.22	-0.29	-0.33	-0.36	-0.42	-0.45	-0.42	-0.36	-0.30

The increased labor supply is not automatically soaked up in the economy at once as there is no demand side response, so unemployment increases. The higher unemployment reduces the growth of wages and prices. The decline in prices relative to the baseline improves competitiveness, as a result production and exports increase and gradually pull the extra labor force into employment. Employment increases until the additional labor force is employed and the rate of unemployment is back at its structural level.

The positive effect on employment, the negative effect on wages and the positive effect on exports is permanent. Private consumption rises in the short run as the unemployed people receive unemployment benefits and other social benefits. The long term impact on private consumption is negative. This is because the lower wages reduce real wage and real disposable income permanently as import prices are unchanged.

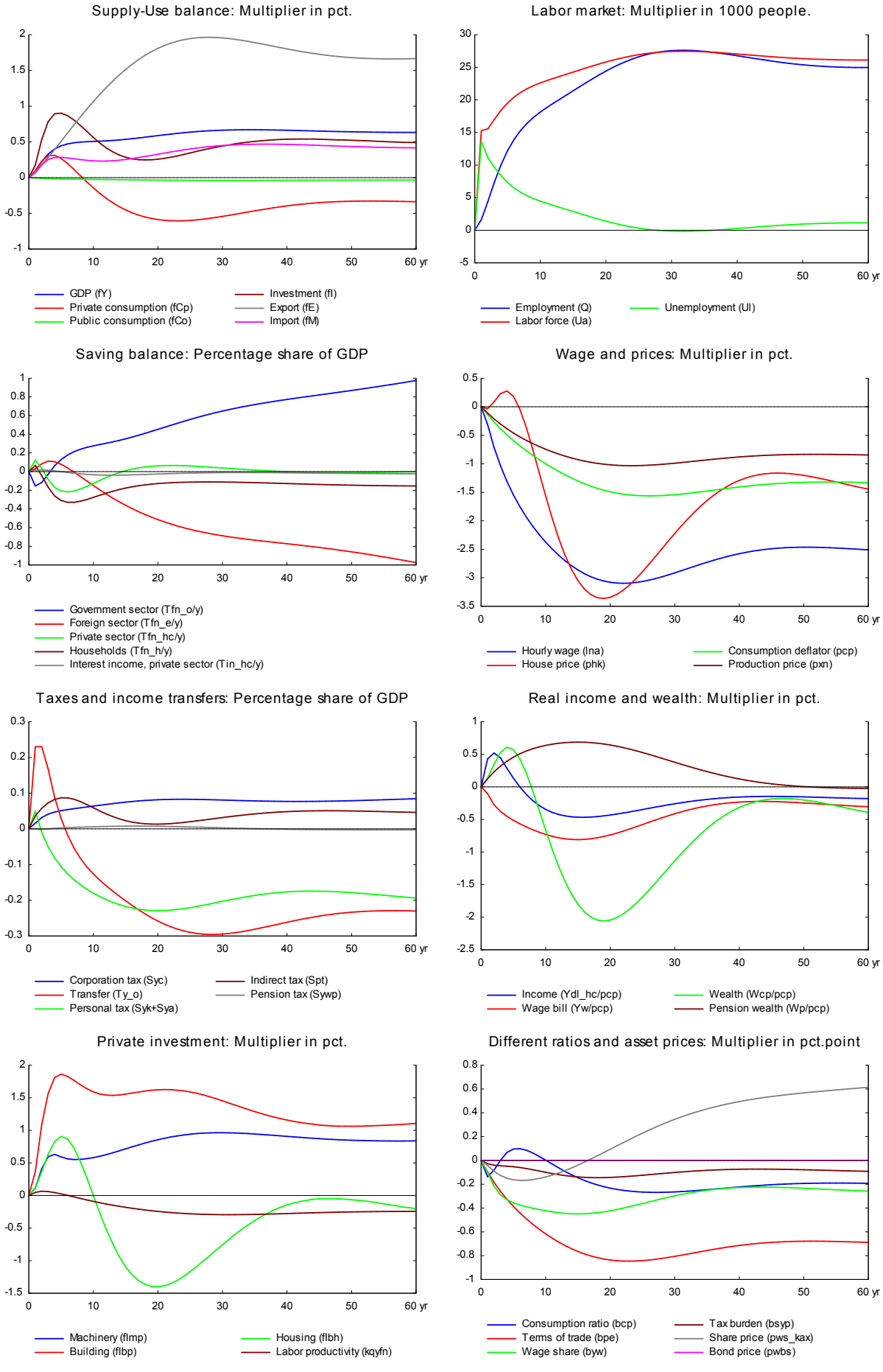
Overall, there is a positive effect on production in the long run because of the permanent increase in employment. At the same time, there is also a change in relative price of production factors, and labor has become relatively cheaper. Substitution of labor for capital makes production more labor intensive and aggregate productivity falls. This offsets part of the increase in production.

There is a significant positive effect on public budget in the long term. The fall in public expenses exceeds the fall in revenues. Transfer payments and public wage-expenses decline as hourly wages fall. Other public expenditures also fall as prices fall. On the revenue side taxes on

personal income fall when hourly wages fall. But the number of tax payers increases and this offsets some of the fall in tax revenue.

The negative long-term impact on consumption should be seen in relation to two things: the absence of a fiscal reaction function and the size of the foreign trade elasticities. The increase in the labor force expands the tax base and improves public finances permanently. If the improvement were returned as tax reductions, consumption would increase. If the foreign trade elasticities were higher, the necessary fall in terms of trade and real wages would be smaller and consumption would respond less negatively. In general, a permanent increase in the labor force has a permanent positive effect on employment and output. This provides higher tax revenue for the government and a potential for higher public spending or lower taxes, which in turn could boost domestic demand and moderate the need for higher exports.

Figure 10. The effect of a permanent increase in labor supply with 27000 people



11. Labor supply - working hours

The supply of labor input will also increase if working hours increase. An increase in working hours raises employment in terms of hours and in the short run it reduces the number of workers employed. Table 11 presents the effect of a permanent 1 percent increase in working hours.

Table 11. The effect of a permanent increase in working hours

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	587	1487	3207	4245	4489	1706	-1085	-2491	-2853	-2517
Pub. consumption	*fCo*	-73	-98	-129	-154	-170	-206	-236	-275	-314	-346
Investment	*fI*	551	1698	3132	4339	4841	3757	2314	2074	2553	3210
Export	*fE*	819	1858	3001	4117	5284	11071	16209	20517	23745	25844
Import	*fM*	475	1402	2809	3816	4203	3871	3955	4880	6073	7162
GDP	*fY*	1372	3415	6157	8400	9852	11977	12738	14383	16431	18344
						1000 Persons					
Employment	*Q*	-25.47	-22.66	-18.84	-15.06	-11.94	-5.03	-3.11	-1.03	0.83	1.79
Unemployment	*Ul*	13.53	11.03	9.08	7.24	5.73	2.45	1.51	0.49	-0.42	-0.88
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.13	-0.10	-0.15	-0.01	0.09	0.26	0.28	0.35	0.43	0.51
Priv. saving surplus	*Tfn_hc/Y*	0.10	0.03	0.02	-0.16	-0.26	-0.20	-0.03	0.04	0.04	0.03
Balance of payments	*Enl/Y*	-0.02	-0.07	-0.14	-0.17	-0.17	0.05	0.25	0.39	0.48	0.54
Foreign receivables	*Wnnb_e/Y*	0.08	0.11	0.03	-0.11	-0.23	-0.12	0.94	2.47	4.17	5.87
Bond debt	*Wbd_os_z/Y*	0.19	0.32	0.47	0.48	0.41	-0.50	-1.53	-2.64	-3.93	-5.36
						Percent					
Capital intensity	*fKn/fX*	-0.09	-0.21	-0.33	-0.42	-0.45	-0.39	-0.40	-0.51	-0.60	-0.64
Labour intensity	*hq/fX*	-0.04	-0.08	-0.12	-0.12	-0.11	-0.03	-0.02	-0.01	0.00	0.01
User cost	*uim*	-0.15	-0.29	-0.41	-0.49	-0.57	-0.82	-0.98	-1.07	-1.09	-1.05
Wage	*lna*	-0.33	-0.80	-1.18	-1.46	-1.68	-2.33	-2.70	-2.89	-2.90	-2.79
Consumption price	*pcp*	-0.15	-0.30	-0.44	-0.55	-0.65	-0.99	-1.24	-1.40	-1.47	-1.47
Terms of trade	*bpe*	-0.10	-0.21	-0.29	-0.36	-0.41	-0.60	-0.71	-0.77	-0.78	-0.76
						Percentage-point					
Consumption ratio	*bcp*	-0.12	-0.08	-0.10	0.03	0.11	0.06	-0.09	-0.18	-0.21	-0.21
Wage share	*byw*	-0.11	-0.24	-0.34	-0.39	-0.41	-0.41	-0.42	-0.41	-0.36	-0.31

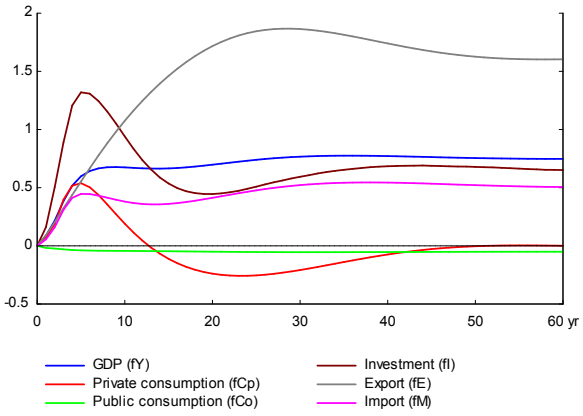
When working hours of existing workers increase potential production increases immediately. Compared to the previous experiment the initial reaction via the production function is stronger in the present experiment because the working hours of already employed people increases. In the short run, there is no change in demand, so layoffs are inevitable and employment falls. The rise in unemployment dampens wages and competitiveness improves. Consequently, exports increase and gradually unemployment falls and returns to its baseline.

The previous section 10 showed that private consumption falls in the long term when the positive shock to labor input is in number of workers. When working hours increase, there is no fall in private consumption in the long run. Public transfer income is adjusted with the income per worker. Thus, the fall in total real income is smaller than in the previous experiment because the real income of public transfer earners is adjusted upwards with the number of working hours per employed. Transfer income is not adjusted with the number of employed. In this way, the different impact on consumption in experiment 10 and 11 reflects the institutional setup. The marginal increase in disposable income is not enough to raise private consumption in the long run as there is also a fall in real wealth due to a fall in housing wealth. The higher investment raises imports in the long run.

There is a positive effect on the public budget in the long run, because the fall in public expenses is larger than the fall in revenues. Personal income taxes do not fall as much as annual incomes, as the higher working hours offset the fall in annual incomes. Corporate taxes also increase due to the increase in profits. And indirect taxes also contribute to revenue. However, the positive long term effect on the public budget is smaller than in experiment 10 due to the indexation of public transfers.

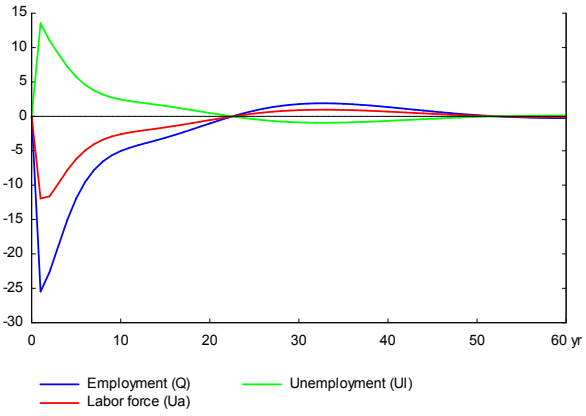
Figure 11. The effect of a permanent 1 percent increase in working hours

Supply-Use balance: Multiplier in pct.



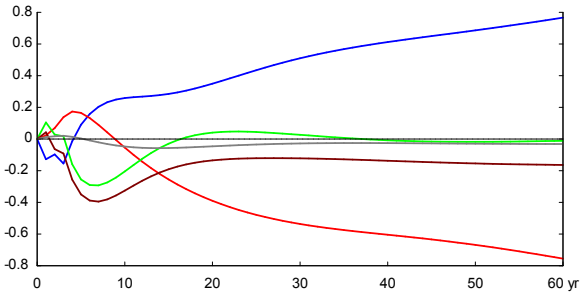
GDP (fY)
Private consumption (fCp)
Public consumption (fCo)
Investment (fI)
Export (fE)
Import (fM)

Labor market: Multiplier in 1000 people.



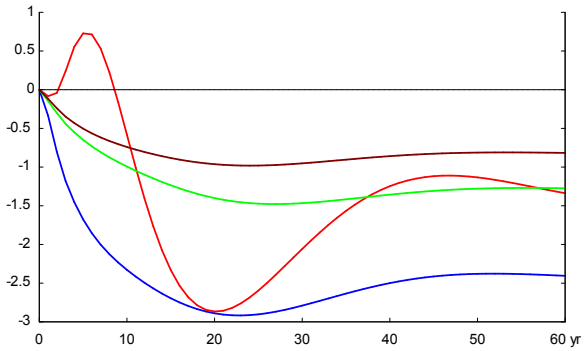
Employment (Q)
Labor force (Ua)
Unemployment (UI)

Saving balance: Percentage share of GDP



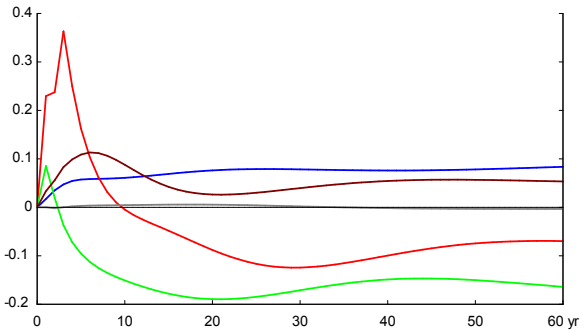
Government sector (Tfn_o/y)
Foreign sector (Tfn_e/y)
Private sector (Tfn_hc/y)
Households (Tfn_h/y)
Interest income, private sector (Tin_hc/y)

Wage and prices: Multiplier in pct.



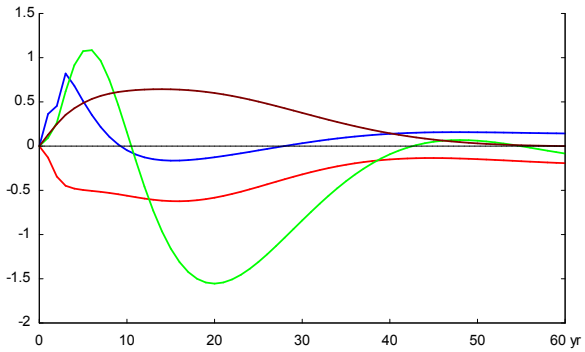
Hourly wage (lna)
House price (phk)
Consumption deflator (pcp)
Production price (pxn)

Taxes and income transfers: Percentage share of GDP



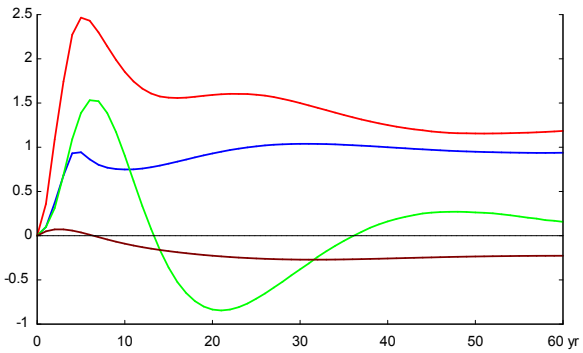
Corporation tax (Syc)
Transfer (Ty_o)
Personal tax (Syk+Sya)
Indirect tax (Spt)
Pension tax (Sywp)

Real income and wealth: Multiplier in pct.



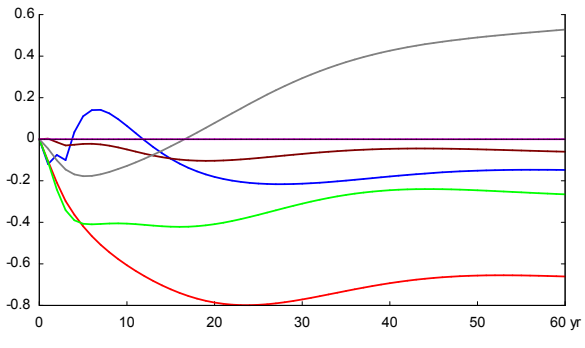
Income (Ydl_hc/pcp)
Wage bill (Yw/pcp)
Wealth (Wcp/pcp)
Pension wealth (Wp/pcp)

Private investment: Multiplier in pct.



Machinery (flmp)
Building (flbp)
Housing (flbh)
Labor productivity (kqyfn)

Different ratios and asset prices: Multiplier in pct.point



Consumption ratio (bcp)
Terms of trade (bpe)
Wage share (byw)
Tax burden (bsyp)
Share price (pws_kax)
Bond price (pwbs)

12. Productivity - labor efficiency

Increasing the efficiency of labor increases the supply of labor measured in efficiency units. An increase in labor efficiency means that the same amount of labor can produce higher output. It also reduces the demand for other factors through substitution effects. In this experiment, labor efficiency is increased permanently by 1 percent.

Table 12. The effect of a permanent increase in labor efficiency

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	439	1020	1799	2186	2279	286	-1738	-2530	-2456	-1917
Pub. consumption	*fCo*	-82	-107	-129	-147	-161	-201	-229	-260	-289	-313
Investment	*fI*	1181	2639	3359	3911	4196	3525	2453	2346	2822	3409
Export	*fE*	2532	3802	5169	6487	7820	13737	18288	21663	24005	25512
Import	*fM*	737	1818	2677	3278	3675	4124	4501	5400	6428	7319
GDP	*fY*	3227	5265	7100	8659	9900	12554	13562	15050	16815	18469
						1000 Persons					
Employment	*Q*	-13.85	-14.04	-12.66	-10.73	-8.74	-2.82	-1.00	0.35	1.37	1.71
Unemployment	*Ul*	7.36	6.91	6.16	5.19	4.21	1.36	0.48	-0.18	-0.68	-0.84
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.06	0.03	0.11	0.17	0.33	0.36	0.42	0.49	0.56
Priv. saving surplus	*Tfn_hc/Y*	0.02	-0.01	-0.11	-0.18	-0.22	-0.16	-0.02	0.03	0.03	0.01
Balance of payments	*Enl/Y*	-0.02	-0.06	-0.08	-0.07	-0.05	0.16	0.34	0.46	0.53	0.57
Foreign receivables	*Wnnb_e/Y*	0.30	0.35	0.34	0.32	0.31	0.81	2.10	3.74	5.46	7.13
Bond debt	*Wbd_os_z/Y*	0.25	0.33	0.30	0.22	0.07	-1.10	-2.38	-3.70	-5.10	-6.56
						Percent					
Capital intensity	*fKn/fX*	-0.23	-0.34	-0.42	-0.47	-0.50	-0.49	-0.50	-0.57	-0.62	-0.62
Labour intensity	*hq/fX*	-0.75	-0.91	-0.98	-1.02	-1.03	-1.01	-1.00	-0.99	-0.98	-0.98
User cost	*uim*	-0.44	-0.54	-0.63	-0.70	-0.76	-0.96	-1.06	-1.09	-1.07	-1.03
Wage	*Ina*	-0.36	-0.63	-0.86	-1.06	-1.23	-1.70	-1.87	-1.91	-1.84	-1.71
Consumption price	*pcp*	-0.44	-0.58	-0.69	-0.79	-0.88	-1.19	-1.36	-1.45	-1.47	-1.43
Terms of trade	*bpe*	-0.31	-0.39	-0.45	-0.51	-0.55	-0.70	-0.76	-0.78	-0.77	-0.74
						Percentage-point					
Consumption ratio	*bcp*	-0.06	-0.10	-0.01	0.03	0.06	0.00	-0.13	-0.20	-0.21	-0.20
Wage share	*byw*	-0.18	-0.32	-0.39	-0.44	-0.46	-0.44	-0.41	-0.37	-0.33	-0.28

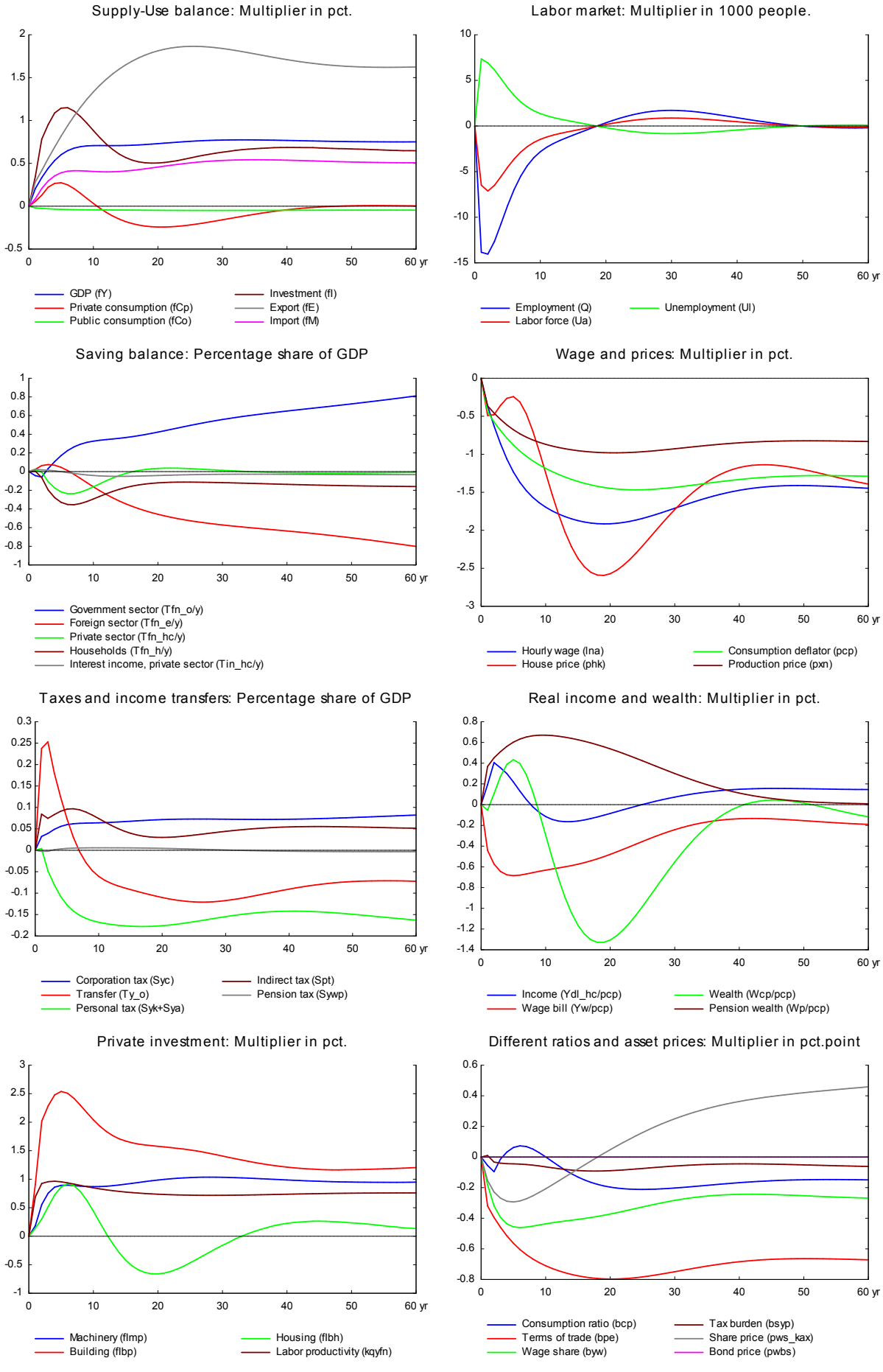
As the amount of output demanded can be produced by less labor, employment falls already in the first year, and due to lags in the labor demand relation the negative effect on employment peaks in the second year. The lower employment reduces wage growth and hence prices and unit costs fall relative to the baseline. Falling prices improve competitiveness so exports and production increase and over time employment returns to its baseline.

Compared to the previous two experiments - increase in number of workers and working hours, nominal hourly wages fall by a smaller percentage when labor efficiency improves, because production costs fall and make producer prices fall. Therefore, nominal wages do not have to decrease substantially to induce the fall in prices, that is necessary to make net exports increase and offset the initial fall in labor demand. This also explains the quicker response in exports in the present experiment, compared to the previous two experiments. Moreover, in the long run there is only a small negative effect on real hourly wages and there is no effect on private consumption in the long run.

Investments in machinery fall as the improvement in labor efficiency makes labor substitute for machinery. Capital intensity of production falls as production involves less capital and more labor. Due to this fall in capital intensity, output per working hour increases by less than 1 percent despite the 1 percent increase in labor efficiency.

Note that the higher unemployment in the short run raises unemployment benefits and worsens public finance temporarily. Later on the initial worsening in the government budget is reversed and the permanent budget effect is positive as employment rises and tax revenues increase. The improved competitiveness and the additional public savings also enhances the balance of payment.

Figure 12. The effect of a permanent 1 percent increase in labor efficiency



13. Productivity - machinery efficiency

We can also increase the output capacity of the economy by increasing the efficiency of machines. An increase in machinery efficiency reduces the need for capital. This will make production less capital intensive with the usual measure of capital. If, however, capital is measured in efficiency units, production will become more capital intensive, which raises productivity and production in the long run. In the following, machinery efficiency is increased by 1 percent permanently.

Table 13. The effect of a permanent increase in machinery efficiency

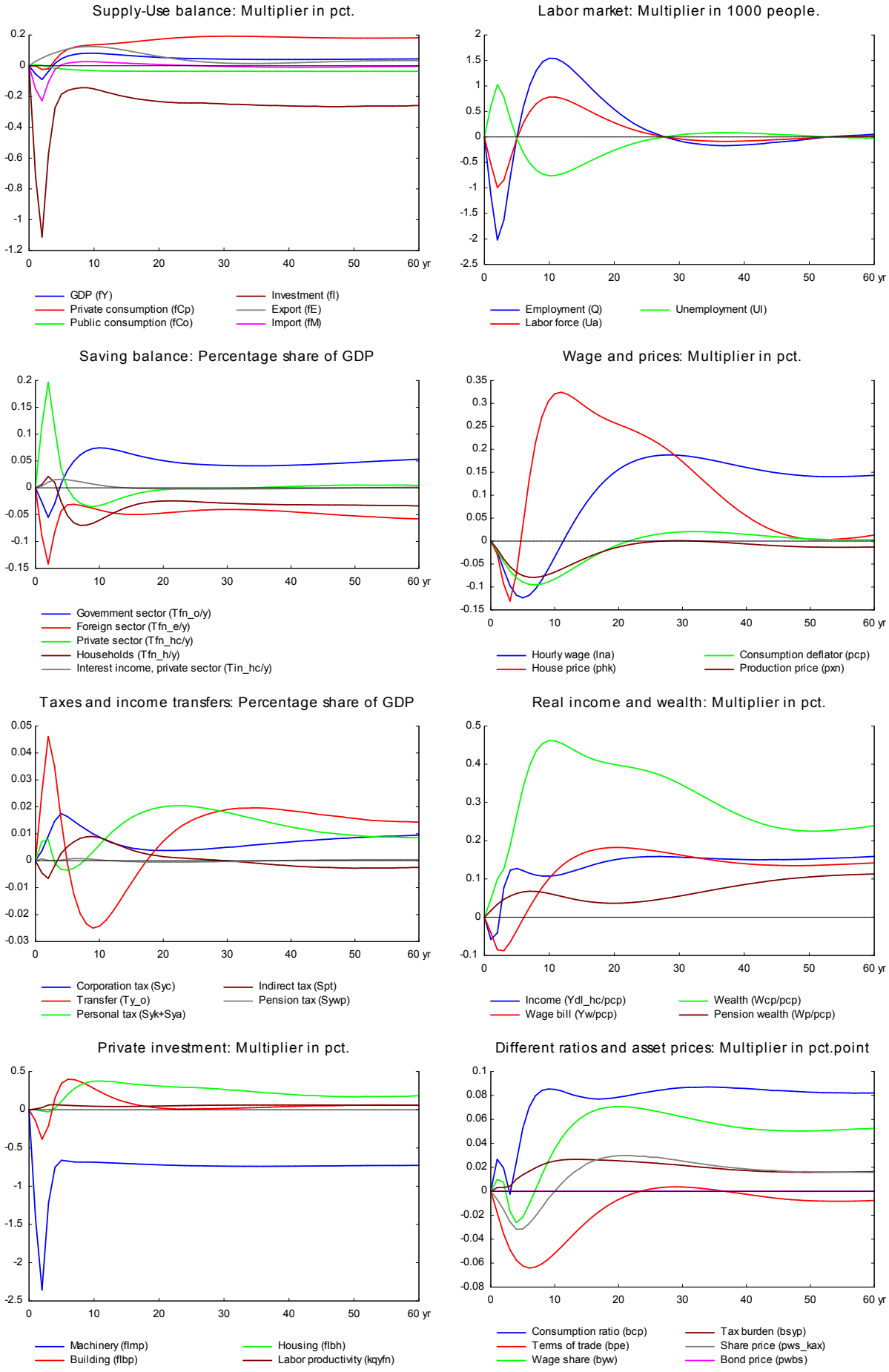
		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	-2	-193	-157	303	680	1223	1464	1795	2096	2320
Pub. consumption	*fCo*	26	12	-32	-65	-88	-150	-179	-196	-212	-227
Investment	*fI*	-2462	-3756	-2006	-983	-677	-601	-872	-1081	-1213	-1341
Export	*fE*	254	458	642	797	940	1287	1100	729	417	244
Import	*fM*	-1289	-2004	-952	-218	65	268	184	99	20	-51
GDP	*fY*	-848	-1411	-580	260	765	1445	1293	1123	1049	1032
						1000 Persons					
Employment	*Q*	-1.14	-2.02	-1.63	-0.78	0.00	1.54	1.14	0.54	0.13	-0.08
Unemployment	*Ul*	0.60	1.03	0.78	0.35	-0.03	-0.76	-0.56	-0.26	-0.06	0.04
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.03	-0.05	-0.03	0.01	0.03	0.07	0.06	0.05	0.04	0.04
Priv. saving surplus	*Tfn_hc/Y*	0.12	0.20	0.11	0.04	0.00	-0.03	-0.01	0.00	0.00	0.00
Balance of payments	*Enl/Y*	0.09	0.14	0.08	0.04	0.03	0.04	0.05	0.05	0.04	0.04
Foreign receivables	*Wnnb_e/Y*	0.14	0.32	0.38	0.39	0.40	0.46	0.57	0.69	0.78	0.84
Bond debt	*Wbd_os_z/Y*	0.05	0.13	0.14	0.12	0.08	-0.22	-0.49	-0.64	-0.74	-0.79
						Percent					
Capital intensity	*fKn/fX*	0.00	-0.03	-0.11	-0.16	-0.18	-0.18	-0.13	-0.10	-0.08	-0.07
Labour intensity	*hq/fX*	0.00	0.00	-0.04	-0.06	-0.06	-0.04	-0.03	-0.04	-0.04	-0.04
User cost	*uim*	-0.02	-0.05	-0.08	-0.09	-0.09	-0.07	-0.03	-0.01	0.01	0.01
Wage	*lna*	-0.02	-0.06	-0.10	-0.12	-0.12	-0.03	0.08	0.16	0.18	0.19
Consumption price	*pcp*	-0.02	-0.04	-0.07	-0.08	-0.09	-0.08	-0.04	-0.01	0.01	0.02
Terms of trade	*bpe*	-0.02	-0.03	-0.05	-0.06	-0.06	-0.05	-0.03	-0.01	0.00	0.00
						Percentage-point					
Consumption ratio	*bcp*	0.03	0.02	0.00	0.02	0.05	0.09	0.08	0.08	0.08	0.09
Wage share	*byw*	0.01	0.01	-0.02	-0.03	-0.02	0.04	0.06	0.07	0.07	0.06

As the efficiency of machines improves, the stock of machinery is reduced, and investment in machinery falls. The lower investment demand reduces production in the short run which further reduces machinery investment. Due to the high import content of machinery investments, imports also fall in the short run. The fall in machinery reduces capital cost and output prices, and the higher unemployment reduces wages. The combined effect is a fall in prices and the price effect occurs relatively quick due to the initial shock to efficiency. As prices fall competitiveness improves and hence exports and production rise. Over time employment returns to the baseline. It may be noted that output per man hour increases in the long term as the higher efficiency of machines makes machinery substitute for labor.

Private consumption falls initially but in the long run it rises. This is because real income falls at first before it permanently increases. It is noted that the higher machinery efficiency will also stimulate the real income of transfer recipients. There is a permanent fall in machinery investment since the lower machinery inventory requires lower reinvestment. In the long run there is a slight positive effect on the nominal wage and a negligible impact on exports.

Public finances deteriorate first as transfer payments to the unemployed increase in the short run. In the long run public finances improve.

Figure 13. The effect of a permanent 1 percent increase in machinery efficiency



14. Productivity - labor and capital efficiency

In this supply side shock the efficiency of all factors increases, and the demand for all factors fall. Here, there is no substitution between factors. The experiment produces a general reduction in production costs, therefore, a long run gain in foreign trade and domestic production. Table 14 presents the effect of a permanent 1 percent increase in the efficiency of all factors.

Table 14. The effect of a permanent increase in labor and capital efficiency

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	321	264	908	1900	2591	1785	222	27	680	1632
Pub. consumption	*fCo*	-42	-88	-172	-245	-302	-481	-592	-687	-774	-856
Investment	*fI*	-3772	-4627	-1533	773	1866	2237	906	466	709	1062
Export	*fE*	2920	4537	6272	7914	9560	16393	20736	23370	24984	26027
Import	*fM*	-1339	-1478	665	2415	3418	4745	5108	5873	6756	7492
GDP	*fY*	783	1456	4488	7469	9750	14479	15418	16515	17997	19470
						1000 Persons					
Employment	*Q*	-16.58	-18.75	-16.94	-13.65	-10.22	-0.22	1.49	1.74	1.87	1.67
Unemployment	*Ul*	8.81	9.31	8.24	6.57	4.88	0.07	-0.74	-0.85	-0.92	-0.82
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.09	-0.18	-0.06	0.07	0.18	0.45	0.48	0.52	0.57	0.63
Priv. saving surplus	*Tfn_hc/Y*	0.21	0.35	0.16	-0.03	-0.14	-0.20	-0.04	0.03	0.03	0.01
Balance of payments	*Enl/Y*	0.12	0.17	0.09	0.04	0.04	0.24	0.44	0.55	0.60	0.64
Foreign receivables	*Wnnb_e/Y*	0.54	0.91	1.05	1.09	1.12	1.75	3.24	5.09	6.95	8.70
Bond debt	*Wbd_os_z/Y*	0.36	0.59	0.65	0.57	0.40	-1.24	-3.04	-4.69	-6.28	-7.86
						Percent					
Capital intensity	*fKn/fX*	-0.17	-0.34	-0.57	-0.74	-0.85	-0.97	-0.93	-0.94	-0.96	-0.94
Labour intensity	*hq/fX*	-0.71	-0.87	-1.00	-1.08	-1.11	-1.06	-1.03	-1.02	-1.02	-1.02
User cost	*uim*	-0.48	-0.63	-0.76	-0.86	-0.94	-1.12	-1.14	-1.12	-1.07	-1.02
Wage	*lna*	-0.40	-0.75	-1.07	-1.34	-1.54	-1.91	-1.86	-1.73	-1.59	-1.43
Consumption price	*pcp*	-0.47	-0.65	-0.80	-0.93	-1.05	-1.37	-1.47	-1.49	-1.46	-1.41
Terms of trade	*bpe*	-0.34	-0.45	-0.53	-0.61	-0.67	-0.81	-0.83	-0.81	-0.77	-0.73
						Percentage-point					
Consumption ratio	*bcp*	0.02	-0.06	-0.04	0.04	0.11	0.12	-0.02	-0.09	-0.09	-0.08
Wage share	*byw*	-0.16	-0.30	-0.43	-0.50	-0.52	-0.42	-0.32	-0.26	-0.21	-0.18

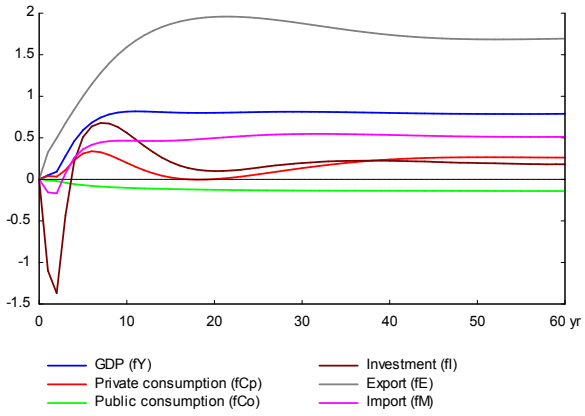
In this case all five factor inputs are made more efficient. Higher efficiency of factors means that factor inputs can be reduced, consequently investment and employment fall in the short term. The fall, particularly in machinery investment, reduces imports and depreciation, which increases gross operating surplus. As factors efficiency increases prices fall and net exports increase without relying on change in wages. Higher net exports increase production and employment. This offsets the initial fall in employment created by the increase in labor efficiency.

The initial fall in employment pushes wages and prices downward. This improves competitiveness and induce exports to rise even more. As in the previous experiment, the combined effect of higher efficiency and lower wages means that the short-term decrease in factor utilization disappears relatively quickly and the initial negative impact on employment is crowded out in year 5. In the long term, capital intensity and labor intensity fall by approximately 1 percent, excluding the housing sector. The 1 percent higher efficiency of material inputs implies a drop in the import content of demand, and the higher content of domestic value added increases the real wage in equilibrium. Consequently, the real wage rate increases by 2 percent in the long run in this experiment, while the real wage rate drops marginally in experiment 12 where only labor efficiency is increased.

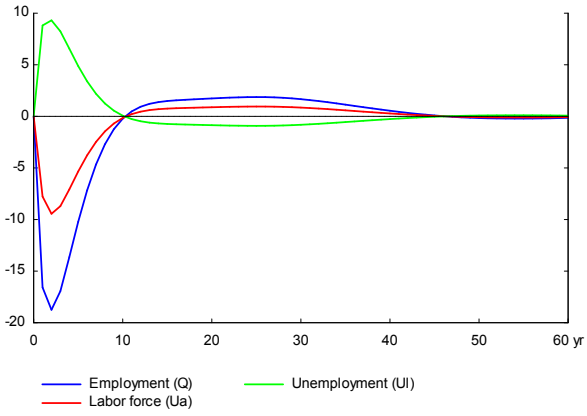
Private consumption increases in the long run, due to the permanent increase in real wages and real disposable income, which is stimulated as the higher productivity increases the real income of transfer recipients. The public budget improves in the long term. The experiment can be seen as a permanent supply shock that lifts the output produced by the employed labor, which is unaffected in the long term.

Figure 14. The effect of a permanent 1 percent increase in labor and capital efficiency

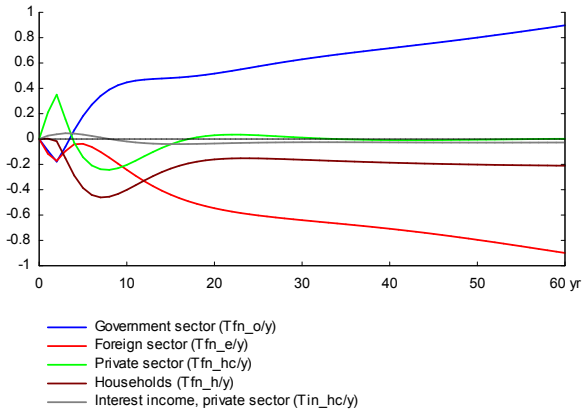
Supply-Use balance: Multiplier in pct.



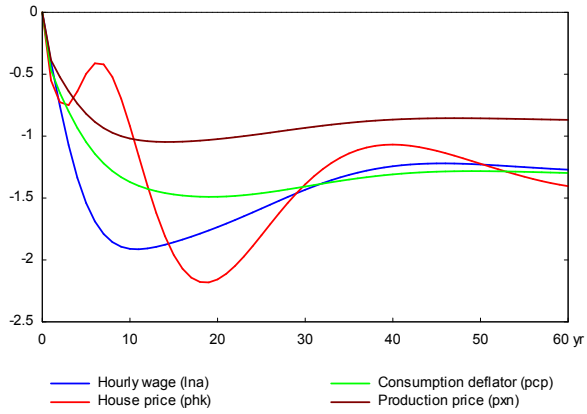
Labor market: Multiplier in 1000 people.



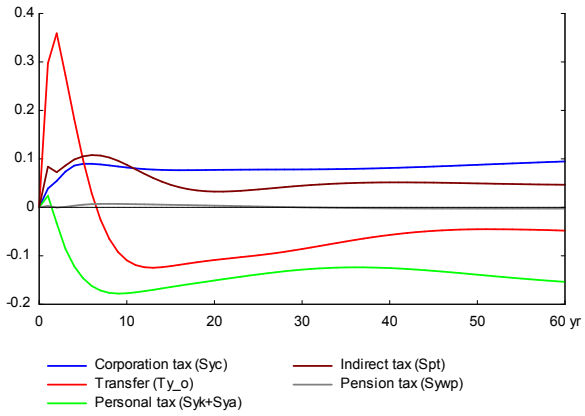
Saving balance: Percentage share of GDP



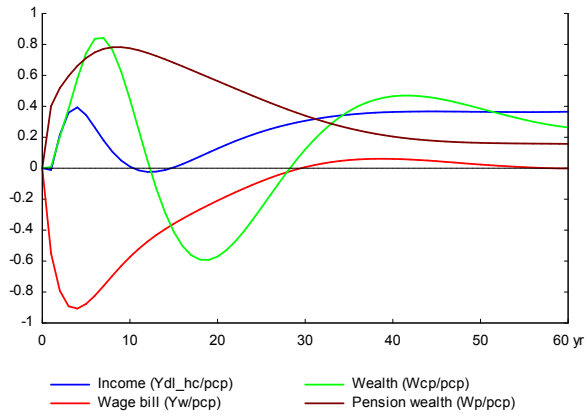
Wage and prices: Multiplier in pct.



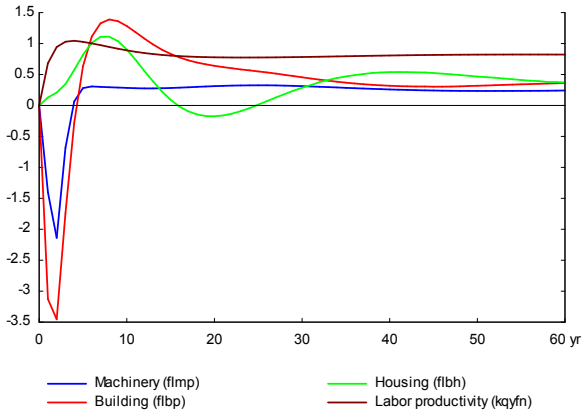
Taxes and income transfers: Percentage share of GDP



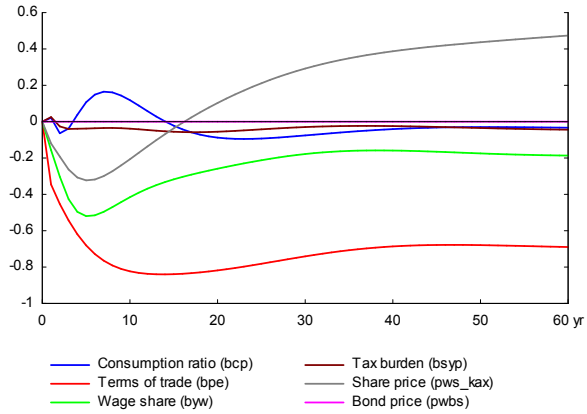
Real income and wealth: Multiplier in pct.



Private investment: Multiplier in pct.



Different ratios and asset prices: Multiplier in pct.point



15. Interest rates

Due to the fixed exchange rate policy, the Danish interest rates are largely determined by conditions abroad. They are basically exogenous like foreign prices and foreign demand. In the experiment, both the domestic and foreign interest rates in ADAM are permanently reduced by 1 percent i.e. from 3.5 percent in the baseline scenario to 2.5 percent. The experiment does not take into account that a general fall in foreign interest rates can stimulate foreign markets and foreign competitiveness . Thus, the experiment maybe interpreted as a 1 percent reduction in the interest rate differential to the Euro zone interest rates. For a broader discussion of the interest rate experiment see grh12912.

Table 15. The effect of a permanent fall in interest rates

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	551	15315	22491	25771	26714	25645	27560	29458	29552	28578
Pub. consumption	*fCo*	-83	-259	-336	-345	-330	-176	-56	-6	2	-13
Investment	*fI*	8040	20925	27116	28302	27813	20259	14585	12832	12288	12094
Export	*fE*	2353	2681	2943	2586	1990	-5702	-14424	-19261	-20001	-18099
Import	*fM*	4244	15653	20056	20470	19584	12978	9085	7410	6612	6527
GDP	*fY*	6359	22419	31321	34909	35648	26419	18285	15449	15080	15846
						1000 Persons					
Employment	*Q*	3.87	18.36	30.85	38.38	41.49	24.97	4.25	-4.80	-6.94	-6.02
Unemployment	*Ul*	-2.06	-9.60	-15.66	-19.15	-20.50	-12.05	-1.96	2.40	3.41	2.94
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.00	-0.41	0.18	0.48	0.60	0.07	-0.61	-0.94	-1.08	-1.15
Priv. saving surplus	*Tfn_hc/Y*	-0.39	-1.06	-1.89	-2.23	-2.33	-1.65	-1.08	-0.91	-0.83	-0.75
Balance of payments	*Enl/Y*	-0.39	-1.47	-1.71	-1.76	-1.73	-1.57	-1.69	-1.85	-1.91	-1.90
Foreign receivables	*Wnnb_e/Y*	-1.01	-3.11	-5.07	-6.86	-8.48	-14.95	-20.20	-25.24	-29.92	-33.95
Bond debt	*Wbd_os_z/Y*	2.59	2.13	1.36	0.49	-0.35	-2.41	-0.51	3.16	7.14	10.88
						Percent					
Capital intensity	*fKn/fX*	-0.28	-0.82	-0.90	-0.67	-0.30	1.72	2.80	3.13	3.13	2.99
Labour intensity	*hq/fX*	-0.27	-0.62	-0.67	-0.59	-0.48	-0.32	-0.44	-0.53	-0.56	-0.56
User cost	*uim*	-5.26	-5.34	-5.29	-5.18	-5.04	-4.34	-4.03	-4.06	-4.25	-4.46
Wage	*lna*	0.01	0.13	0.52	1.09	1.74	4.73	5.87	5.72	5.12	4.48
Consumption price	*pcp*	-0.05	-0.43	-0.69	-0.82	-0.85	-0.41	-0.09	-0.14	-0.40	-0.72
Terms of trade	*bpe*	-0.06	-0.11	-0.09	-0.01	0.09	0.66	0.93	0.91	0.77	0.61
						Percentage-point					
Consumption ratio	*bcp*	-0.08	0.12	0.72	1.04	1.15	0.76	0.50	0.47	0.42	0.34
Wage share	*byw*	-0.10	-0.04	0.28	0.68	1.07	2.07	2.09	1.91	1.75	1.65

The lower interest rates have an expansionary effect on both investment and private consumption. The effect on consumption comes primarily from the effect on the housing market. Lower interest rates reduce the cost of capital and the demand for capital increases. The demand for capital including housing capital also increases due to the substitution effect. The higher capital demand increases investment and house prices. A rise in house price increases housing wealth, and since housing wealth is part of the the total private wealth, private consumption increases. However, there is a delay in the response of private consumption to wealth. The decrease in the cost of capital also reduces prices and improves competitiveness, so exports increase in the short run. Thus, the short-run effect is positive on both domestic demand and exports.

The strong demand is met by increased domestic production and increased imports, and employment increases and drives wages upward. Despite the rise in wages, output prices fall at first as the cost of capital falls. This immediate positive effect on competitiveness reflects that the interest rate reduction works like a drop in the interest rate differential vis-a-vis the exogenous foreign interest rates. Later on, the wage effects on prices dominate and prices rise, this worsens competitiveness and exports starts to decline. Over time employment falls and returns to the baseline, while exports end up being permanently lower than its baseline.

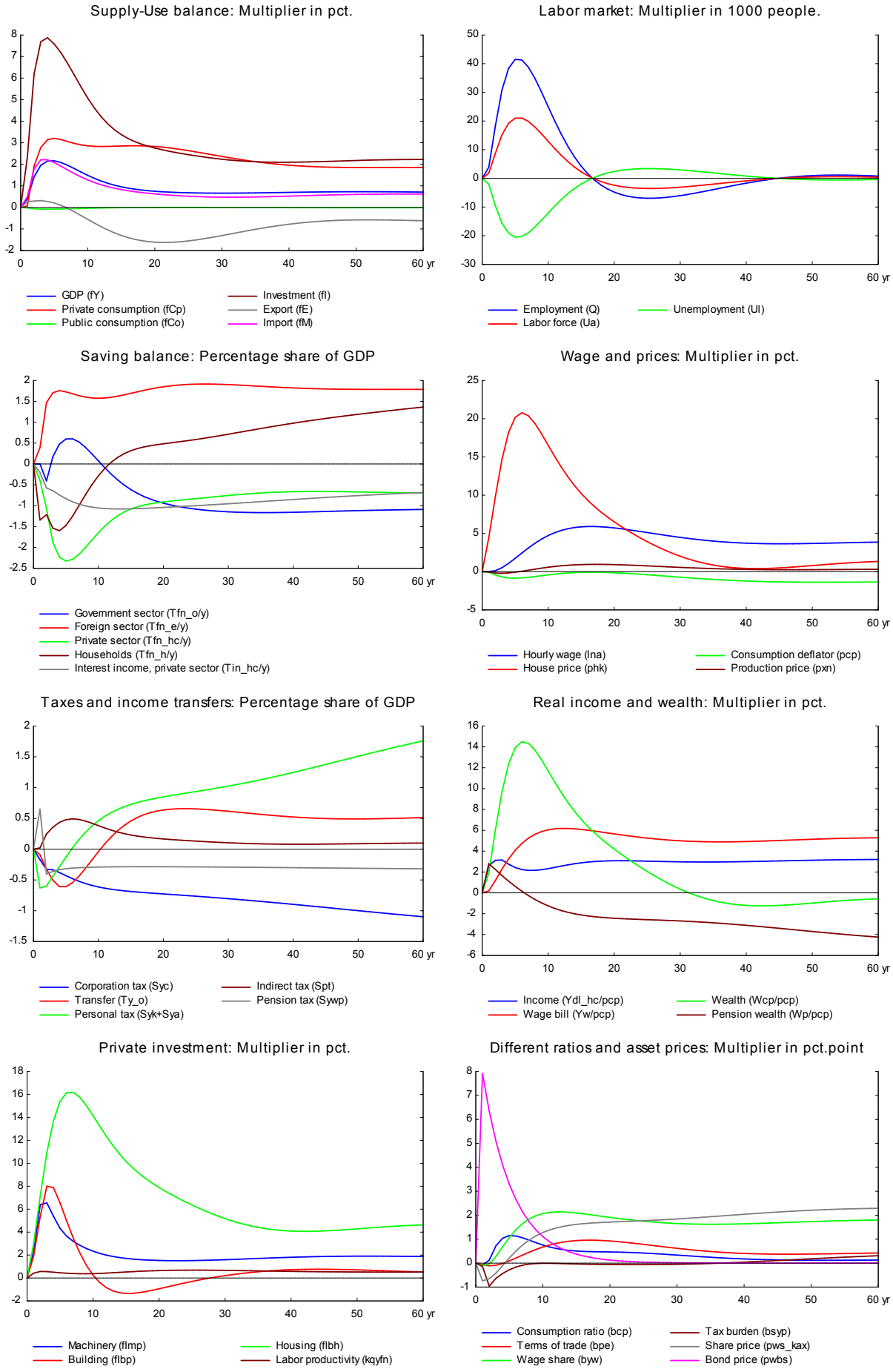
Private consumption increases permanently due to the increase in real wages and real disposable income. More basically, the long term positive effect on disposable income and private consumption reflects that the interest rate after tax is lower than the growth rate implying that lower private net assets do not harm consumption, see the discussion in the ADAM book. The lower private financial net assets reflect two mechanisms: 1) a decrease in total private wealth

due to the decrease in pension savings that follows from the lower return on pension assets and more basically 2) the increase in the housing stock and hence in housing wealth. The desired private financial net assets equal total desired private wealth minus housing wealth. Total desired wealth of the private sector is determined in the long term by the consumption function and income, as income minus consumption represents private savings.

The long-term effect on total investment remains positive. The permanent fall in interest rates and the permanent rise in wages imply that capital stocks remain relatively cheaper than labor. So that the capital stock and investments increase permanently. The effect is strongest on housing investment and smallest on businesses building investment. The user cost is based on smaller depreciation rate for buildings than for machinery, so the user cost of business buildings falls more in percentage terms. However, the higher substitution possibility in machinery than in buildings implies that machinery investments rise by more than building investments.

The public budget deteriorates in the long term due to lower revenues from the taxation of private net financial income. A tax increase in order to keep the budget balance constant will almost eliminate the positive long-term effect on consumption. In general, the lower interest rate acts as a positive demand shock increasing the demand for capital through lower user costs and increasing the propensity to consume through the negative impact on institutional pension savings.

Figure 15. The effect of a permanent fall in interest rates



16. Private consumption

All the previous sections have highlighted the role that consumption and wage equations play in ADAM in achieving stability after the economy have been displaced from equilibrium. In the present and subsequent section, we introduce a shock to these equations one by one. This section presents the effect of a temporary increase in the propensity to consume. The shock to private consumption is made by a one off change in the constant of the consumption function, which directly influences consumption. Private consumption is increased in year one by a 1000 million kroner, in 2005 prices. (See experiment)

Table 16. The effect of a temporary exogenous increase in private consumption

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	1230	668	427	201	62	-76	-84	-107	-123	-111
Pub. consumption	*fCo*	-9	-8	-2	1	2	2	1	0	-1	-1
Investment	*fI*	475	620	222	19	-61	-147	-70	-28	-6	14
Export	*fE*	-58	-99	-120	-139	-156	-163	-59	47	109	116
Import	*fM*	682	459	159	-19	-93	-134	-74	-35	-11	9
GDP	*fY*	951	712	368	108	-49	-233	-124	-42	1	21
						1000 Persons					
Employment	*Q*	0.75	0.86	0.63	0.33	0.06	-0.41	-0.23	-0.04	0.04	0.07
Unemployment	*Ul*	-0.40	-0.43	-0.30	-0.15	-0.02	0.20	0.11	0.02	-0.02	-0.04
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.03	0.03	0.02	0.01	0.00	-0.01	-0.01	0.00	0.00	0.00
Priv. saving surplus	*Tfn_hc/Y*	-0.08	-0.07	-0.04	-0.02	0.00	0.01	0.01	0.00	0.00	0.00
Balance of payments	*Enl/Y*	-0.05	-0.03	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
Foreign receivables	*Wnnb_e/Y*	-0.08	-0.11	-0.12	-0.12	-0.11	-0.08	-0.07	-0.07	-0.05	-0.04
Bond debt	*Wbd_os_z/Y*	-0.05	-0.08	-0.09	-0.10	-0.09	-0.03	0.02	0.04	0.04	0.03
						Percent					
Capital intensity	*fKn/fX*	-0.04	-0.02	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Labour intensity	*hq/fX*	-0.02	-0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
User cost	*uim*	0.01	0.01	0.02	0.02	0.02	0.01	0.00	-0.01	-0.01	0.00
Wage	*lna*	0.01	0.03	0.04	0.04	0.05	0.02	-0.01	-0.02	-0.02	-0.01
Consumption price	*pcp*	0.01	0.01	0.01	0.02	0.02	0.01	0.00	-0.01	-0.01	-0.01
Terms of trade	*bpe*	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
						Percentage-point					
Consumption ratio	*bcp*	0.08	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00
Wage share	*byw*	-0.01	0.00	0.01	0.02	0.02	0.00	-0.01	-0.01	0.00	0.00

The shock to private consumption initially works in the same way as a shock to public consumption. Higher private consumption boosts domestic demand; hence private production and employment increase. This creates additional demand for consumption and investment. Imports also increase in the short run as part of the higher domestic demand is met through imports. The higher employment stimulates wage growth and prices and competitiveness fall, leading to a fall in exports.

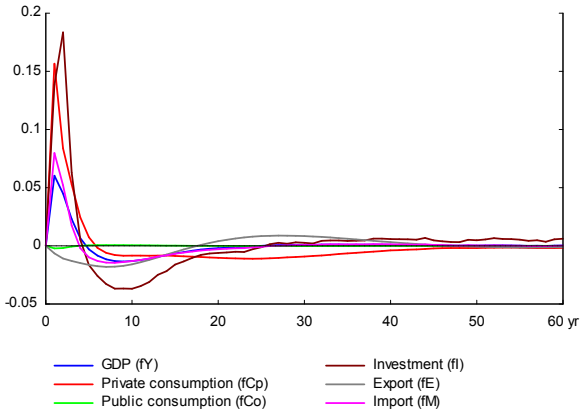
The effect on employment, production, private and public saving balances, etc is temporary reflecting that it is a temporary demand shock and the consumption function is an error correction equation that adjusts back to the long term value. Consumption keeps adjusting until the ratio between wealth and income is back to the baseline value. The adjustment of consumption, however, takes a long time. Consumption remains above the baseline for a few years followed by a long period below the baseline. The latter period restores wealth and the ratio between income and wealth will return to the equilibrium value, and consumption will return to the baseline. The initial stimulus to economic activity is sufficient to stimulate wages and hence prices, and it takes time for the higher wage rate to return to the baseline. The crowding out process is illustrated by the fluctuation in unemployment. Unemployment falls initially and this pushes up the wage rate slightly. In year 2, the consumption shock disappears and the higher wage pulls unemployment up. Unemployment has to be above the baseline for a while in order to pull the wage rate back down to the baseline. Basically, wages fall relative to the baseline as long as unemployment is above the baseline. So that both unemployment and wage will fluctuate around the baseline on their way back to the baseline. This reflects that the link between unemployment and wage change makes unemployment fluctuate, while the area between unemployment and the baseline converges to zero. It is noted that the basic adjustment process is similar to the adjustment after

an overheating of the economy.

The experiment also makes the housing market fluctuate. In the first year, house prices increase sharply because of the higher consumption and this raises housing wealth. Higher housing wealth in turn expands private consumption. The immediate positive impact on house prices triggers a higher Tobin's q and housing investment increases. Later on, the higher housing capital reduces house price and Tobin's q after the initial increase in consumption has disappeared. The lower house price drives housing investment and hence housing capital down. In this way, housing capital returns to the baseline and the area between Tobin's q and the baseline converges to zero just like the area between investments and its baseline. In general, the temporary shock to consumption starts an adjustment process with fluctuations.

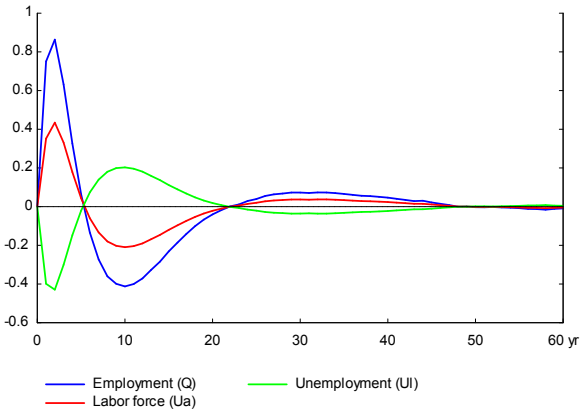
Figure 16. The effect of a temporary exogenous increase in private consumption

Supply-Use balance: Multiplier in pct.



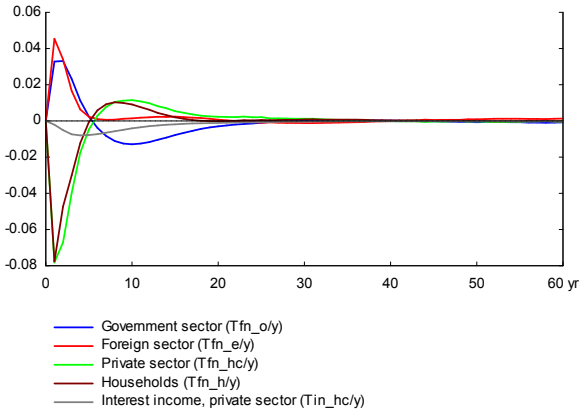
GDP (fY)
Private consumption (fCp)
Public consumption (fCo)
Investment (fI)
Export (fE)
Import (fM)

Labor market: Multiplier in 1000 people.



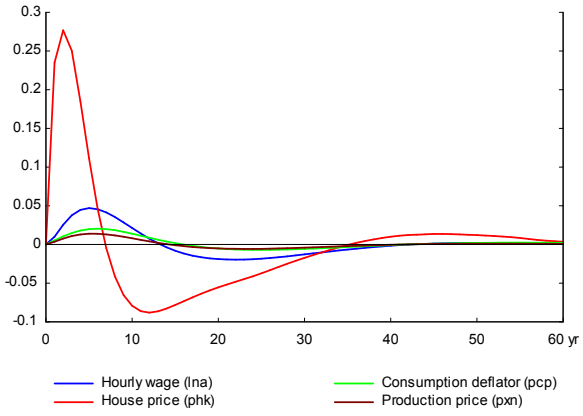
Employment (Q)
Labor force (Ua)
Unemployment (UI)

Saving balance: Percentage share of GDP



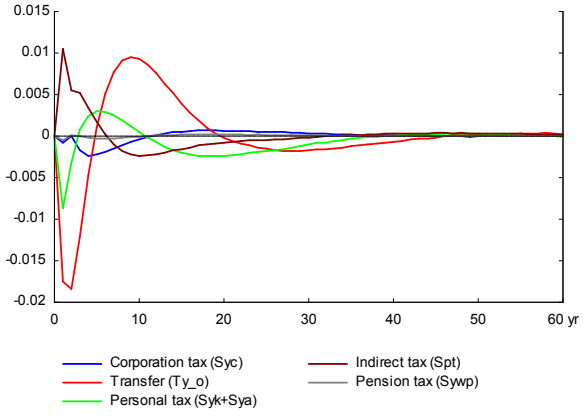
Government sector (Tfn_o/y)
Foreign sector (Tfn_e/y)
Private sector (Tfn_hc/y)
Households (Tfn_h/y)
Interest income, private sector (Tin_hc/y)

Wage and prices: Multiplier in pct.



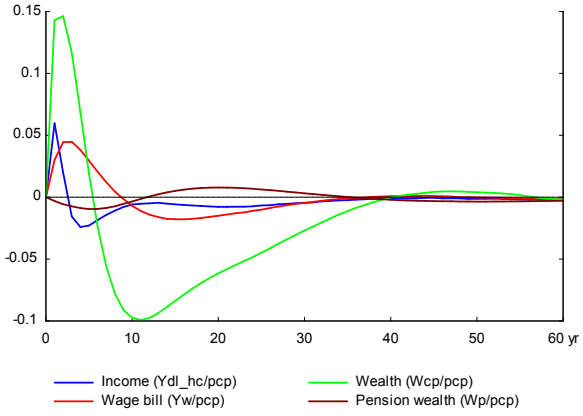
Hourly wage (lna)
House price (phk)
Consumption deflator (pcp)
Production price (pxn)

Taxes and income transfers: Percentage share of GDP



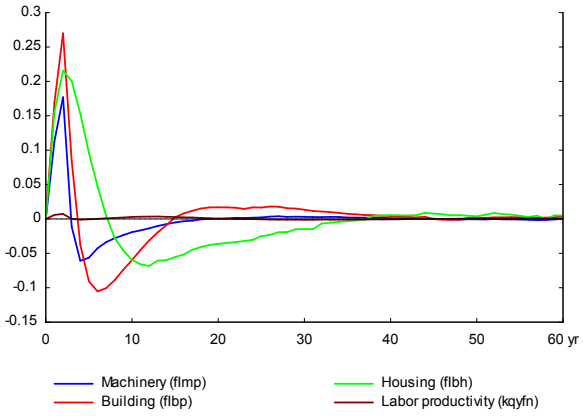
Corporation tax (Syc)
Transfer (Ty_o)
Personal tax (Syk+Sya)
Indirect tax (Spt)
Pension tax (Sywp)

Real income and wealth: Multiplier in pct.



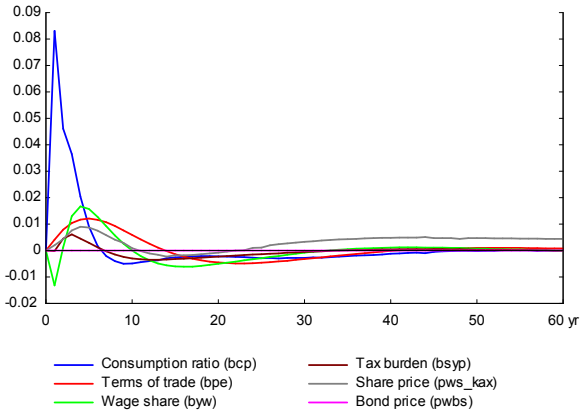
Income (Ydl_hc/pcp)
Wage bill (Yw/pcp)
Wealth (Wcp/pcp)
Pension wealth (Wp/pcp)

Private investment: Multiplier in pct.



Machinery (flmp)
Building (flbp)
Housing (flbh)
Labor productivity (kqyfn)

Different ratios and asset prices: Multiplier in pct.point



Consumption ratio (bcp)
Terms of trade (bpe)
Wage share (byw)
Tax burden (bsyp)
Share price (pws_kax)
Bond price (pwbs)

17. Hourly wages

Here, we will introduce a shock to the wage equation. Table 17 presents the effect of a one off 1 percent shock to the constant in the Phillips curve of ADAM. After the shock the wage level is 1 percent above its equilibrium and it is up to the crowding out mechanism of ADAM to make the wage rate return to its baseline.

Table 17. The effect of a temporary increase in wage

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	551	-581	203	1011	1517	1869	1058	215	-412	-747
Pub. consumption	*fCo*	25	38	36	27	21	14	12	6	-3	-11
Investment	*fI*	-570	-1464	-1352	-563	-26	478	136	-201	-307	-253
Export	*fE*	-1985	-2402	-2743	-3030	-3261	-3408	-2691	-1603	-511	297
Import	*fM*	-81	-1112	-866	-296	-14	-118	-483	-598	-482	-260
GDP	*fY*	-1820	-3116	-2741	-2004	-1481	-683	-752	-732	-498	-198
						1000 Persons					
Employment	*Q*	-2.54	-4.73	-5.34	-5.10	-4.63	-2.96	-2.37	-1.72	-0.87	-0.11
Unemployment	*Ul*	1.35	2.41	2.65	2.49	2.26	1.44	1.16	0.84	0.42	0.05
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.04	-0.01	-0.21	-0.18	-0.15	-0.08	-0.08	-0.08	-0.07	-0.06
Priv. saving surplus	*Tfn_hc/Y*	-0.05	0.04	0.21	0.12	0.05	-0.06	-0.04	0.00	0.01	0.02
Balance of payments	*Enl/Y*	-0.01	0.04	-0.01	-0.06	-0.10	-0.14	-0.12	-0.09	-0.06	-0.04
Foreign receivables	*Wnnb_e/Y*	-0.28	-0.23	-0.23	-0.30	-0.39	-0.90	-1.26	-1.45	-1.50	-1.47
Bond debt	*Wbd_os_z/Y*	-0.21	-0.16	0.05	0.21	0.34	0.74	0.99	1.20	1.34	1.40
						Percent					
Capital intensity	*fKn/fX*	0.15	0.21	0.17	0.13	0.10	0.09	0.10	0.07	0.03	-0.01
Labour intensity	*hq/fX*	0.06	0.06	0.02	0.00	-0.02	-0.01	-0.01	-0.01	-0.01	0.00
User cost	*uim*	0.34	0.33	0.30	0.28	0.27	0.19	0.11	0.04	-0.01	-0.03
Wage	*Ina*	1.13	1.03	0.90	0.82	0.74	0.44	0.21	0.02	-0.09	-0.14
Consumption price	*pcp*	0.34	0.35	0.33	0.32	0.31	0.25	0.16	0.08	0.01	-0.03
Terms of trade	*bpe*	0.25	0.24	0.21	0.20	0.19	0.13	0.07	0.02	-0.01	-0.03
						Percentage-point					
Consumption ratio	*bcp*	0.08	0.01	-0.14	-0.07	-0.02	0.07	0.06	0.03	0.00	-0.01
Wage share	*byw*	0.31	0.27	0.20	0.15	0.11	0.03	-0.01	-0.04	-0.04	-0.04

The higher wage has both a positive and negative effect on the economy. The former is due to the positive effect on domestic demand. Wages increase more than consumption prices, as the latter include import prices that are exogenous. This raises real wage and private consumption increases. Two years after the wage increase, income transfers from the government increase, because the equation for the rate of income transfers depends on wages with a lag of two years. This worsens public finance and raises disposable income and consumption.

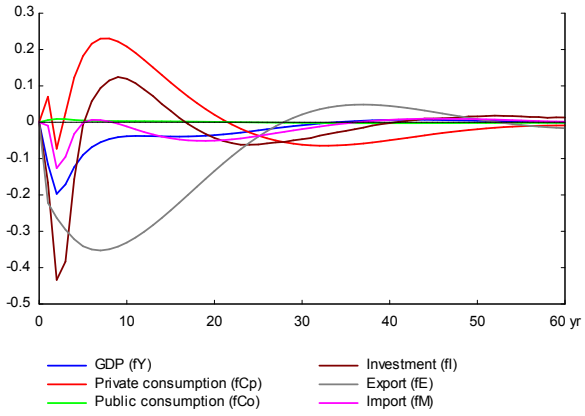
The negative demand effect arises due to a negative effect on the market share of Danish exports. The higher wage raises prices and worsens competitiveness, which leads to a fall in net exports. Consequently, production and employment fall. The lower production also drags investments down. In the short run, the negative effect is stronger and unemployment increases, i.e. the wage increase creates an economic downturn.

In the long run, the higher unemployment reduces wage and price growths, and exports recover as competitiveness starts to improves. Investments rise due to the substitution of capital for labor. Over time, the effect on employment disappears and wages return to the baseline. In the long run, all variables return to their baseline except for a permanent negative impact on public and foreign debt, reflecting the accumulated budget impact in the transition period before the equilibrium is reestablished.

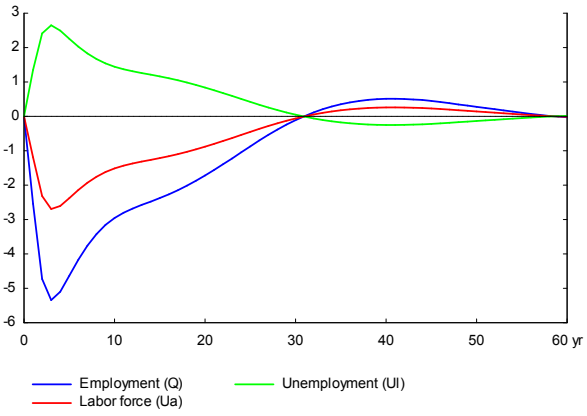
Note the symmetry of the model responses in the present experiment and the foreign price shock in section 8. A permanent 1 percent fall in foreign prices will trigger a similar adjustment process as the baseline wage will be 1 percent above its equilibrium after such a foreign price shock, cf. chapter 11 of the ADAM book.

Figure 17. The effect of a temporary increase in wage

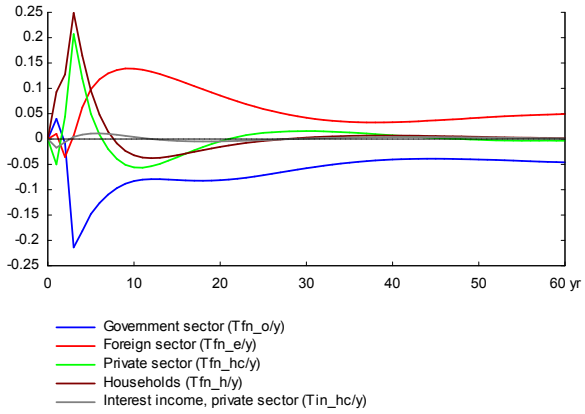
Supply-Use balance: Multiplier in pct.



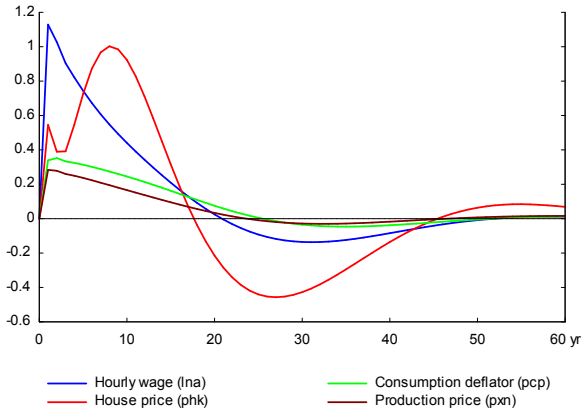
Labor market: Multiplier in 1000 people.



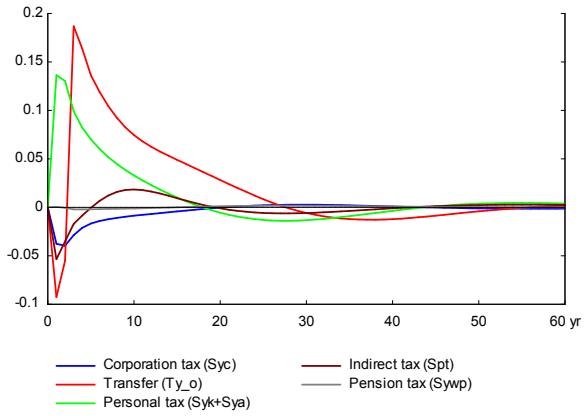
Saving balance: Percentage share of GDP



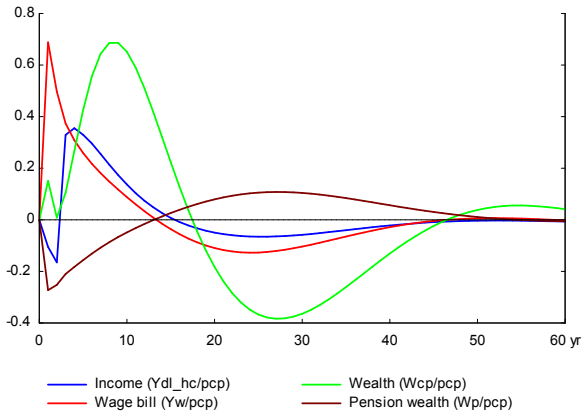
Wage and prices: Multiplier in pct.



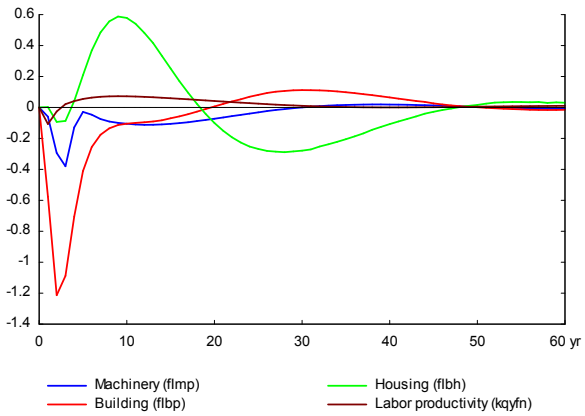
Taxes and income transfers: Percentage share of GDP



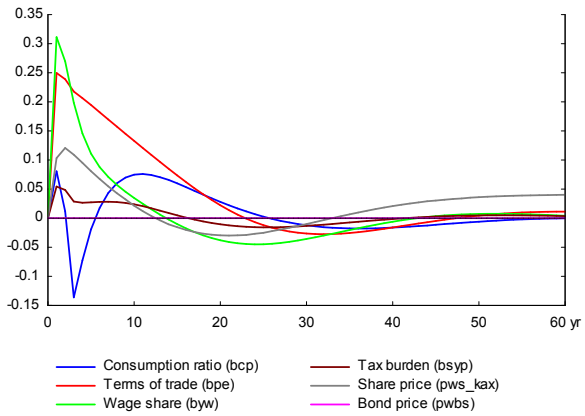
Real income and wealth: Multiplier in pct.



Private investment: Multiplier in pct.



Different ratios and asset prices: Multiplier in pct.point



18. General government purchase of goods, balanced budget

The experiments above have demonstrated that the public budget could either end up in deficit or in surplus depending on the effect on public revenues or expenditures. This happens because there is no fiscal reaction function in ADAM that can be activated in order to keep the public budget in balance. The following two experiments show the effects of a demand shock and a supply shock, respectively, when the public budget is kept in balance in the long term through a change in the income tax rates.

Table 18 presents the effect of a permanent increase in government purchases of goods, financed by higher income taxes. The public purchase of goods and services is increased by 1000 million, in 2005 prices. The central government income tax rates are permanently raised by 1.1 percent and the capital tax is temporarily raised by a lump sum of 0.17 percent of GDP in the first year only.

Table 18. The effect of a permanent increase in public spending, balanced budget

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	-435	-762	-996	-1224	-1378	-1590	-1638	-1683	-1722	-1762
Pub. consumption	*fCo*	1038	1051	1069	1086	1102	1182	1270	1368	1476	1593
Investment	*fI*	131	100	-314	-541	-632	-568	-345	-239	-199	-187
Export	*fE*	-34	-43	-44	-38	-26	121	286	326	246	104
Import	*fM*	262	154	-105	-258	-312	-197	-21	68	96	96
GDP	*fY*	474	231	-128	-400	-558	-592	-345	-233	-228	-272
						1000 Persons					
Employment	*Q*	0.47	0.45	0.17	-0.14	-0.38	-0.47	0.02	0.27	0.27	0.18
Unemployment	*Ul*	-0.25	-0.22	-0.07	0.08	0.20	0.23	-0.01	-0.13	-0.13	-0.09
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.17	0.02	0.00	-0.01	-0.02	-0.02	-0.01	0.00	0.00	0.00
Priv. saving surplus	*Tfn_hc/Y*	-0.19	-0.03	0.00	0.02	0.04	0.04	0.02	0.01	0.01	0.01
Balance of payments	*Enl/Y*	-0.02	-0.01	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01
Foreign receivables	*Wnnb_e/Y*	-0.04	-0.04	-0.03	0.00	0.03	0.13	0.18	0.20	0.22	0.22
Bond debt	*Wbd_os_z/Y*	-0.16	-0.17	-0.16	-0.14	-0.11	0.02	0.07	0.06	0.04	0.02
						Percent					
Capital intensity	*fKn/fX*	-0.06	-0.05	-0.03	-0.03	-0.03	-0.08	-0.11	-0.12	-0.11	-0.11
Labour intensity	*hq/fX*	-0.05	-0.03	-0.02	-0.02	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02
User cost	*uim*	0.00	0.01	0.01	0.00	0.00	-0.02	-0.02	-0.02	-0.01	0.00
Wage	*lna*	0.01	0.01	0.02	0.02	0.01	-0.04	-0.06	-0.04	-0.02	0.01
Consumption price	*pcp*	0.00	0.01	0.01	0.01	0.00	-0.02	-0.03	-0.03	-0.02	-0.01
Terms of trade	*bpe*	0.00	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.01	-0.01	0.00
						Percentage-point					
Consumption ratio	*bcp*	0.02	0.00	-0.01	-0.02	-0.03	-0.04	-0.04	-0.03	-0.03	-0.03
Wage share	*byw*	-0.01	0.00	0.01	0.01	0.01	-0.01	0.00	0.01	0.01	0.02

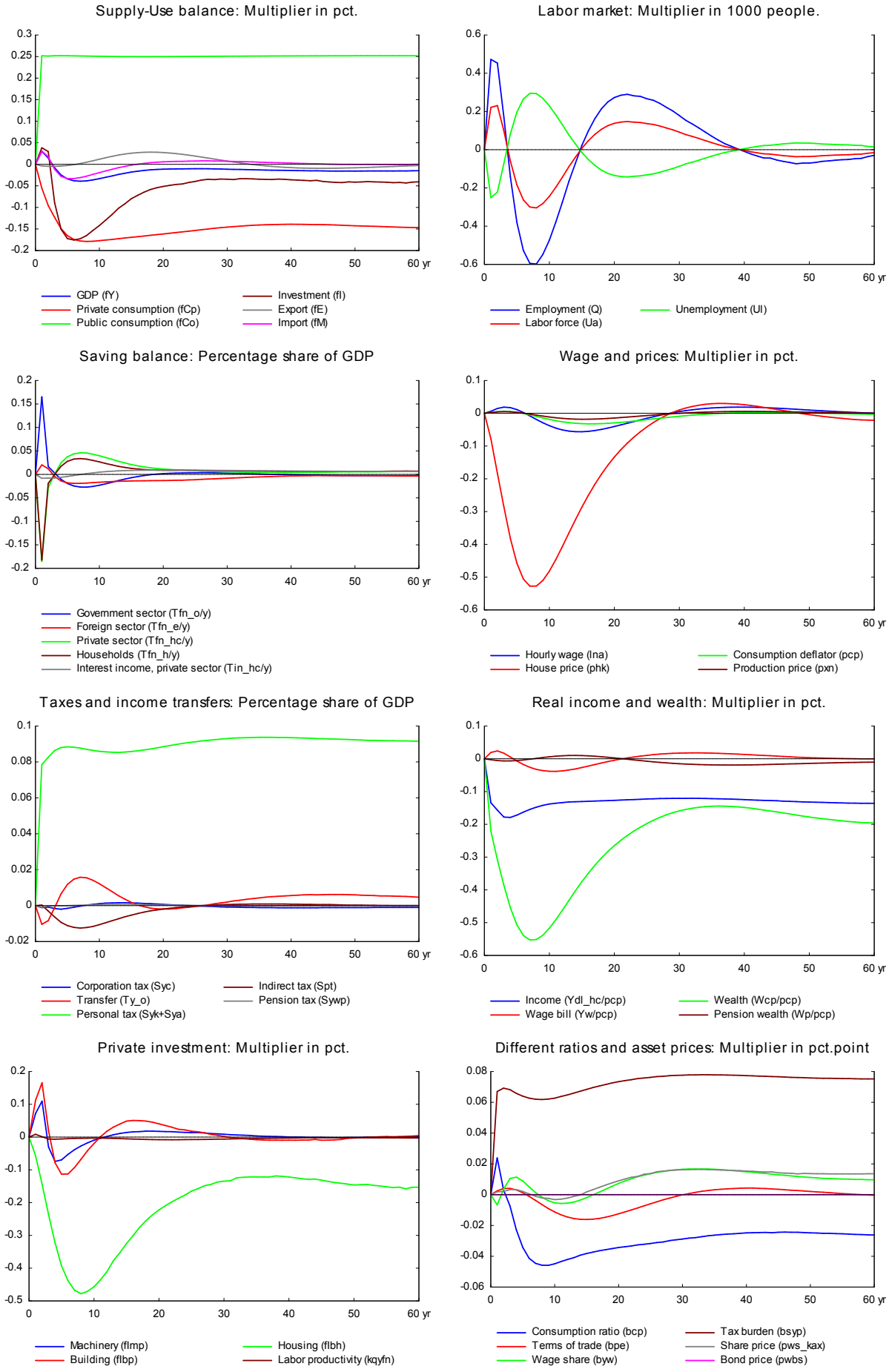
In contrast to the unfinanced experiment in section 1, the long-term effect on government debt is now zero. There are two opposing effects - expansionary and contractionary effects. The former is due to the increase in public expenditures that increases domestic demand, production and employment. The contractionary effect is due to the increase in income tax rates which reduces disposable income and there by private consumption. In the very short term the expansionary effects are stronger so production and employment expand. Investments also expand reflecting the increase in business investments in machinery and buildings.

The overall positive effect in year 1 occurs because private consumption reacts to the tax increase with a delay. In the following year, the tax increase reduces consumption as disposable income falls. As a result, employment falls. With a financed public purchase, it takes only 4 years for the initial increase in employment to disappear and it takes almost the same number of years for employment to return to the baseline. The fall in private consumption reduces the demand for housing, and investment in housing and house prices fall. In the long run, private consumption and investment fall due to the permanent fall in disposable income. Investments also fall permanently in the long run due to the fall in residential investment.

The effect on unemployment oscillates before reaching equilibrium reflecting the fluctuation in the

housing market and labor market. In general, with an unfinanced increase in public purchase it is exports that fall and make room for the public purchase of goods and services. With a tax-financed public purchase increase, it is the private domestic demand that falls to make room for the public purchase of goods and services. The public budget can be financed in various ways, and the outcome depends on the choice of financing instrument. Actually, the outcome of the unfinanced shock in section 1 is equivalent to the outcome of an increase in public purchasing financed by reduced public transfers to abroad. Public transfer vis-a-vis the foreign sector has no impact on the private sector in ADAM.

Figure 18. The effect of a permanent increase in public spending, balanced budget



19. Labor supply - early retirement scheme, balanced budget

Increasing the labor supply has a positive effect on the public savings balance. The additional public savings can be used to increase spending or income tax rates can be reduced to create expansionary effects in the economy. Table 19 presents the effect of a permanent increase in labor supply accompanied by a permanent decrease in income tax rates. The number of people in early retirement scheme is reduced by 10000 and at the same time the central government income tax rates are reduced permanently by 2.3 percent to balance the public budget in the long run.

Table 19. The effect of a permanent increase in labor supply, balanced budget

		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	1230	2592	3470	3915	4065	3452	2876	2650	2655	2869
Pub. consumption	*fCo*	-13	-31	-43	-49	-52	-53	-55	-63	-74	-84
Investment	*fI*	587	1677	2443	2744	2815	2146	1455	1281	1394	1601
Export	*fE*	230	466	702	942	1184	2256	3256	4316	5304	6068
Import	*fM*	735	1717	2324	2542	2569	2125	1935	2124	2476	2869
GDP	*fY*	1282	2924	4139	4877	5295	5511	5434	5882	6601	7361
						1000 Persons					
Employment	*Q*	1.18	3.13	5.01	6.48	7.51	8.62	8.19	8.45	9.01	9.48
Unemployment	*Ul*	4.69	3.30	2.37	1.67	1.18	0.68	0.89	0.76	0.48	0.25
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.18	-0.13	-0.07	-0.02	0.01	0.02	-0.01	-0.02	-0.01	0.00
Priv. saving surplus	*Tfn_hc/Y*	0.13	0.02	-0.07	-0.13	-0.16	-0.11	-0.04	-0.01	0.00	0.00
Balance of payments	*Enl/Y*	-0.04	-0.11	-0.14	-0.15	-0.15	-0.09	-0.05	-0.03	-0.01	0.00
Foreign receivables	*Wnnb_e/Y*	-0.04	-0.17	-0.32	-0.47	-0.61	-1.03	-1.12	-1.07	-0.96	-0.83
Bond debt	*Wbd_os_z/Y*	0.16	0.26	0.31	0.31	0.29	0.13	0.12	0.16	0.16	0.11
						Percent					
Capital intensity	*fKn/fX*	-0.07	-0.14	-0.17	-0.18	-0.16	-0.04	0.02	0.00	-0.03	-0.05
Labour intensity	*hq/fX*	-0.03	-0.06	-0.06	-0.05	-0.04	-0.01	-0.01	-0.02	-0.02	-0.01
User cost	*uim*	-0.05	-0.08	-0.10	-0.11	-0.12	-0.16	-0.19	-0.23	-0.25	-0.26
Wage	*lna*	-0.11	-0.23	-0.31	-0.37	-0.40	-0.48	-0.56	-0.66	-0.71	-0.71
Consumption price	*pcp*	-0.05	-0.09	-0.11	-0.14	-0.15	-0.19	-0.24	-0.29	-0.33	-0.35
Terms of trade	*bpe*	-0.03	-0.06	-0.07	-0.09	-0.09	-0.12	-0.14	-0.17	-0.18	-0.19
						Percentage-point					
Consumption ratio	*bcp*	-0.14	-0.06	0.02	0.07	0.10	0.08	0.03	0.00	-0.01	-0.01
Wage share	*byw*	-0.05	-0.09	-0.11	-0.11	-0.10	-0.08	-0.10	-0.11	-0.11	-0.10

Compared to section 10, where labor supply increases without change in the income tax rates, there are two opposing effects on public saving balance. We reduce the number of people outside the labor force receiving transfers from the government and this will have a positive impact on public savings as expenditures on transfers fall. At the same time the lower income tax rates reduce government revenues and public savings fall. In the short run, the negative effect dominates and public savings deteriorate but in the long term public debt as a ratio of GDP remains unchanged.

The higher labor supply is not automatically employed, so unemployment increases immediately. The higher unemployment exerts a downward pressure on wages and prices, which improves competitiveness. Accordingly, exports start to expand so production and employment increase. The expansionary effect is reinforced by the higher private consumption, which peaks after five years. The higher consumption reflects that the lower income tax rates increase disposable income. The stronger domestic demand makes unemployment fall more sharply compared to section 10. Employment increases until the additional labor force is employed and the rate of unemployment returns to the baseline. The higher production increases investments permanently. Imports also increase to meet the higher domestic demand.

In the long run, the need for higher competitiveness and lower wages moderates the increase in private consumption. The initial consumption boom raises the demand for housing, and housing investment and house price increase, and the higher housing wealth in turn stimulates private consumption. The initial expansion of the housing capital is stronger than the long run effect, and the excess supply of houses reduces house price and investment in housing undergoes a

negative adjustment process before the housing market reaches equilibrium.

Figure 19. The effect of a permanent increase in labor supply, balanced budget