Danmarks Statistik
MODELGRUPPEN

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ADAM multipliers - june 2014

Resumé:

A series of multiplier analyses that illustrate the properties of ADAM are presented below. The calculations are made with the model version june 2014 using the baseline lang14.

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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 june 2014 using the baseline lang14.

The model version june 2014 replaces the previous model version from july 2013. The changes in the current model are described in tmk250614 and other papers that can be found on www.dst.dk/adam. A number of other papers - such as estimations, data construction or model analysis - can also be found on the homepage.

All the multiplier analyses are based on a baseline. The baseline represents a solution with respect to the endogenous variables given a stylized projection of the exogenous variables. The present baseline, lang14, is based on the historical data bank from june 2014 that contains annual historical data up to and including 2013. The baseline is based on a scenario with steady-state growth driven by domestic growth in productivity.

The chosen growth rates 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 assumed 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 into 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 scenario see chapter 10 in the ADAM book, which is also available for download.

The different 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 and this creates a new solution called an alternative scenario. The multipliers for the endogenous variables are calculated as the difference between the values in the alternative scenario and the baseline scenario. The multipliers reported in graphs and tables are calculated either as a simple or relative differences depending on the nature of the variables. A word of caution is necessary when reading the texts, when a certain endogenous variable is said to increase or decrease following a given shock it should be interpreted as increase or decrease compared to the baseline values.

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 ensure the sustainability of public finances. Without a reaction function the government budget balance can become permanently negative or positive depending on the experiment. It may be appropriate to accompany shocks to the model by say a tax change to balance the public budget.

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 labor and capital
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

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 or little effect on employment. A long-term employment effect of zero is a general result for a small open economy with fixed exchange rate and a Phillips curve. 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.

In the first half of the analysis, 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 approximately 133 million Euro, which is close to 0.06 percent of GDP in 2005 price. 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 16-19 are somewhat different from the other experiments. 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 of 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 produce 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, july 2013, can be found **l" target="_blank" styleclass="Normal" translate="true">here**.

1. General government purchase of goods

More government purchase increases the demand for private output. Consequently, private-sector employment rises in the short run. In the long run, there is no effect on private-sector employment. In the following, the public expenditure is increased permanently by 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*	27	221	298	314	320	474	712	899	1005	1050
Pub. consumption	*fCo*	892	901	915	930	944	1020	1102	1190	1285	1386
Investment	*fI*	270	531	390	272	224	156	177	202	191	174
Export	*fE*	-45	-91	-149	-216	-291	-738	-1173	-1520	-1765	-1917
Import	*fM*	469	655	572	494	454	378	354	333	305	291
GDP	*fY*	710	938	919	847	787	594	534	518	499	496
						1000 Persons					
Employment	*Q*	0.66	1.07	1.22	1.21	1.14	0.62	0.25	0.05	-0.08	-0.15
Unemployment	*Ul*	-0.39	-0.61	-0.68	-0.67	-0.63	-0.34	-0.14	-0.02	0.05	0.08
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.03	-0.02	-0.02	-0.03	-0.03	-0.05	-0.07	-0.08	-0.09	-0.10
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*	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.07	-0.08	-0.09	-0.10
Foreign receivables	*Wnnb_e/Y*	-0.06	-0.12	-0.17	-0.21	-0.24	-0.43	-0.64	-0.90	-1.17	-1.44
Bond debt	*Wbd_os_z/Y*	0.02	0.03	0.05	0.07	0.09	0.26	0.48	0.72	0.98	1.25
						Percent					
Capital intensity	*fKn/fX*	-0.07	-0.07	-0.06	-0.05	-0.04	-0.02	0.00	0.01	0.01	0.02
Labour intensity	*hq/fX*	-0.05	-0.04	-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	0.03	0.06	0.07	0.08	0.08	0.08
Wage	*Ina*	0.01	0.02	0.04	0.07	0.09	0.16	0.20	0.22	0.22	0.21
Consumption price	*pcp*	0.00	0.01	0.02	0.02	0.03	0.07	0.09	0.10	0.11	0.11
Terms of trade	*bpe*	0.00	0.01	0.01	0.02	0.02	0.04	0.05	0.06	0.06	0.06
						Percentage-point					
Consumption ratio	*bcp*	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Wage ratio	*byw*	-0.01	0.00	0.00	0.01	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. This is the ***wage-driven crowding out*** process in ADAM.

The short run effect is closely related with the Keynesian income multiplier. The ***income multiplier*** refers to the final change in income as compared to the injection of capital deposits or investments which originally fueled the growth. It is usually used as a measurement of the effects of government spending on income. In the present experiment, the income multiplier can be seen as the ratio between the effects on final demand 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 costs. 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, henceforth referred as a ***real wage effect***.

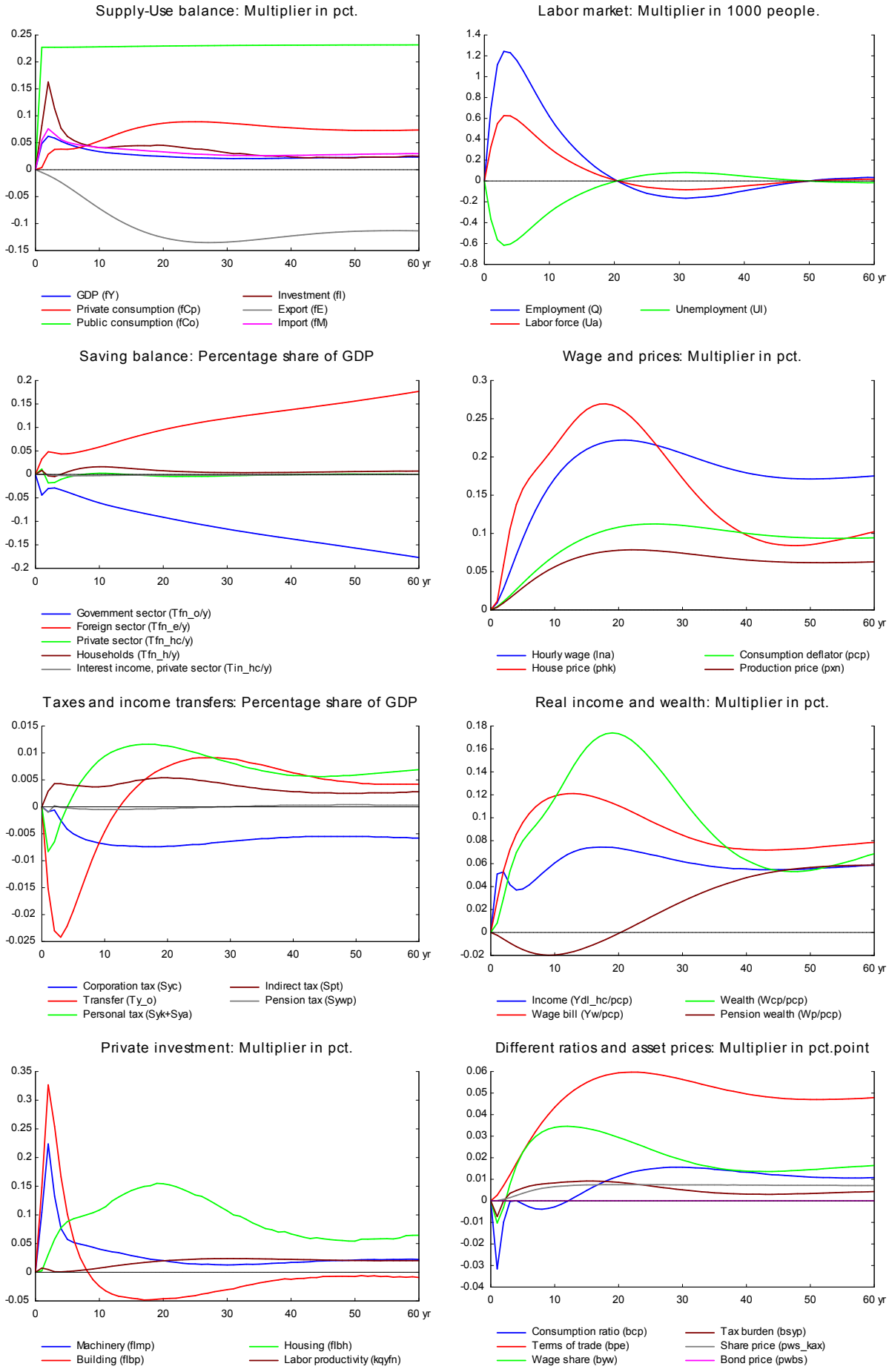
The real wage effect also translates into a long-run effect on the ***terms of trade***. In the new equilibrium employment returns to its baseline while wages and prices increase permanently, which results in a permanent change in the long-run terms of trade.

The composition of GDP changes permanently towards higher public and private consumption and lower net exports relative to the baseline. That is, the composition of aggregate demand shifts from exports toward domestic consumption and investment and the composition of aggregate supply shifts from domestic production to imports.

The experiment also creates a permanent change in the distribution of income. There is a permanent increase in the wage share defined as the share of value added which is payed out to workers. This is because wages have increased permanently higher than capital costs or more appropriately user costs. The effect on user costs is smaller because interest rates are fixed and investment prices change less than wages.

The consumption equation stabilizes the saving surplus of the private sector in the long run. Thus the private sector saving surplus returns to its 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. If the higher public consumptions are financed, for example, by higher income taxes, there would be no permanent positive effect on private consumption, for a balanced budget experiment see section 18.

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



2. General government employment

Salaries are a major part of general government expenditures. In this experiment, general government employment is raised permanently. Higher employment increases income and stimulates consumption. 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 2331 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*	112	261	346	429	518	1103	1693	2122	2361	2452
Pub. consumption	*fCo*	1161	1176	1195	1214	1233	1334	1443	1560	1684	1816
Investment	*fI*	123	235	179	121	104	147	215	221	156	75
Export	*fE*	-85	-201	-339	-495	-670	-1680	-2701	-3552	-4159	-4526
Import	*fM*	228	307	259	214	189	106	-5	-155	-316	-441
GDP	*fY*	1121	1205	1169	1110	1060	885	762	633	500	414
						1000 Persons					
Employment	*Q*	2.59	2.68	2.63	2.49	2.33	1.45	0.72	0.16	-0.21	-0.39
Unemployment	*Ul*	-1.55	-1.49	-1.45	-1.38	-1.28	-0.80	-0.39	-0.09	0.12	0.22
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.02	-0.02	-0.02	-0.03	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14
Priv. saving surplus	*Tfn_hc/Y*	0.01	0.00	0.00	0.00	0.01	0.01	0.00	-0.01	-0.01	-0.01
Balance of payments	*Enl/Y*	-0.02	-0.02	-0.02	-0.02	-0.03	-0.05	-0.08	-0.11	-0.13	-0.15
Foreign receivables	*Wnnb_e/Y*	-0.07	-0.12	-0.16	-0.19	-0.23	-0.44	-0.73	-1.09	-1.50	-1.92
Bond debt	*Wbd_os_z/Y*	-0.01	0.00	0.01	0.03	0.05	0.24	0.52	0.87	1.26	1.68
						Percent					
Capital intensity	*fKn/fX*	-0.05	-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*	0.01	0.03	0.04	0.06	0.07	0.13	0.17	0.19	0.19	0.18
Wage	*lna*	0.03	0.08	0.12	0.17	0.21	0.38	0.48	0.52	0.52	0.50
Consumption price	*pcp*	0.01	0.03	0.05	0.06	0.08	0.16	0.22	0.25	0.26	0.26
Terms of trade	*bpe*	0.01	0.02	0.03	0.04	0.05	0.10	0.13	0.14	0.14	0.14
						Percentage-point					
Consumption ratio	*bcp*	-0.02	-0.01	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.04
Wage ratio	*byw*	0.02	0.04	0.05	0.06	0.07	0.09	0.09	0.09	0.08	0.07

An increase in public sector employment lifts total employment and the overall wage bill. More personal income creates higher domestic demand. Higher demand expands domestic production and employment further. The ***income multiplier*** reinforces itself to create higher demand and higher employment.?

Compared to the public purchase of goods experiment, the effect on employment and income is stronger 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. Consequently, short term effects - like the effect on GDP- are also larger in the present experiment.

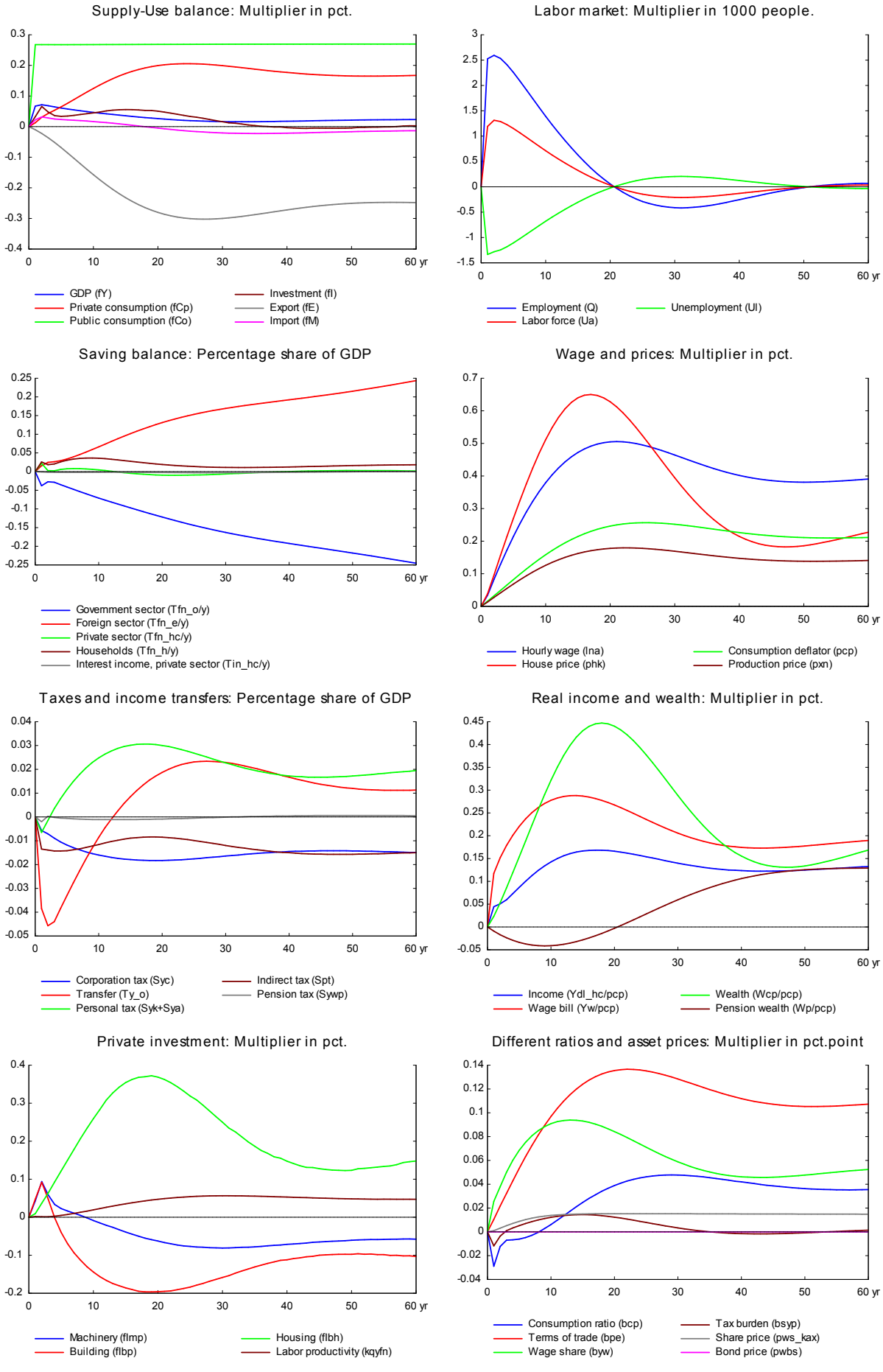
A rapid increase in employment produces a sharp fall in unemployment, which necessitates a strong increase in wages leading to a significant deterioration of competitiveness. As a result, the fall in exports is more pronounced. Thus, the expansionary effect of the shock is stronger in the short run, 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.

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 ***real wage effect*** and real disposable income and private consumption increases permanently.? The consumption equation stabilizes the saving balance of the private sector in the long run, but the public finance deteriorates permanently.?

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



3. General government investment in buildings

Government investment in buildings, and capital in general, are often used to boost demand in a weak economy due to the high labor content. Government investment in buildings are increased permanently by 5 percent of the baseline, which corresponds to 1000 million kroner in 2005 prices in the first year. Section 4 presents a similar scenario of more government investment 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*	28	185	249	272	293	511	772	947	1013	994
Pub. consumption	*fCo*	-7	48	103	156	207	428	606	749	863	954
Investment	*fI*	1278	1419	1342	1264	1230	1200	1228	1239	1205	1165
Export	*fE*	-51	-106	-177	-255	-342	-834	-1298	-1647	-1857	-1933
Import	*fM*	407	508	453	395	363	297	258	205	142	95
GDP	*fY*	807	1002	1035	1020	1009	1013	1070	1113	1122	1132
						1000 Persons					
Employment	*Q*	0.84	1.15	1.25	1.23	1.15	0.63	0.24	-0.02	-0.20	-0.29
Unemployment	*Ul*	-0.50	-0.65	-0.70	-0.68	-0.64	-0.35	-0.13	0.01	0.11	0.16
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.03	-0.03	-0.03	-0.05	-0.06	-0.07	-0.08	-0.09
Priv. saving surplus	*Tfn_hc/Y*	0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
Balance of payments	*Enl/Y*	-0.03	-0.04	-0.03	-0.03	-0.03	-0.05	-0.06	-0.08	-0.09	-0.09
Foreign receivables	*Wnnb_e/Y*	-0.06	-0.12	-0.16	-0.20	-0.23	-0.41	-0.62	-0.86	-1.12	-1.37
Bond debt	*Wbd_os_z/Y*	0.01	0.03	0.05	0.07	0.10	0.27	0.48	0.71	0.96	1.20
						Percent					
Capital intensity	*fKn/fX*	-0.03	-0.01	0.01	0.03	0.05	0.13	0.18	0.21	0.23	0.24
Labour intensity	*hq/fX*	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
User cost	*uim*	0.01	0.01	0.02	0.03	0.04	0.07	0.08	0.09	0.08	0.08
Wage	*Ina*	0.01	0.03	0.05	0.07	0.09	0.17	0.21	0.22	0.21	0.19
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	0.01	0.02	0.03	0.05	0.06	0.06	0.06	0.06
						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 ratio	*byw*	-0.01	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.00	-0.01

The higher public investment raises private sector production and employment in the short run. The ***income multiplier*** expands final demand more than the initial change in investments.? 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. In the medium term, the higher employment increases wage growth and the ***wage-driven crowding out*** returns unemployment to its baseline in the long run.?

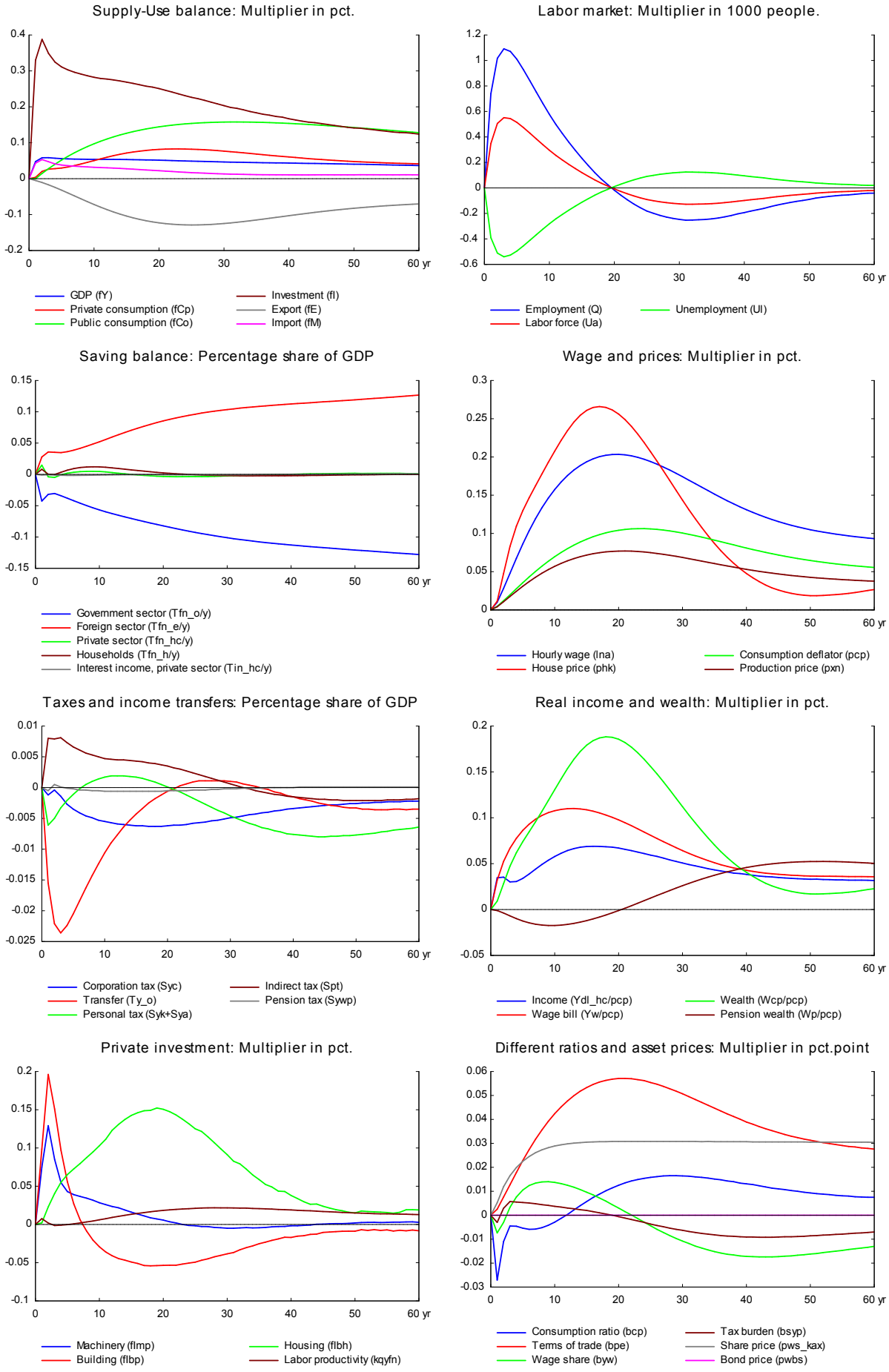
The expansionary nature of public investment raises production in the short run. The higher production requires an equivalent increase in capital. A given change in capital requires a more than proportional change in investment because capital stock is far larger than annual investment. As a result, the impact on investment peaks strongly in the short run. This is the ***accelerator effect***.

Private consumption increases permanently relative to the baseline due to the positive ***real wage effect***.?

There is a small positive effect on production in the long run due to a ***substitution effect***. A substitution effect arises when a change in the relative prices of factors induces producers to use more of a relatively cheaper factor and less of a relatively more expensive factor. In the present case, the relative price of capital falls due to the import content in investments. This leads to an increase in the capital intensity of production and hence labor productivity increases. 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 supply side experiments from section 10 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 investments 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*	3	57	75	84	90	184	315	413	452	441
Pub. consumption	*fCo*	-9	142	269	376	466	740	854	903	923	932
Investment	*fI*	856	920	889	847	825	786	793	802	786	767
Export	*fE*	-34	-63	-100	-140	-186	-452	-709	-904	-1022	-1063
Import	*fM*	481	526	506	483	468	433	409	379	341	311
GDP	*fY*	321	519	626	688	737	853	884	878	845	816
						1000 Persons					
Employment	*Q*	0.31	0.51	0.59	0.61	0.59	0.36	0.14	0.00	-0.11	-0.16
Unemployment	*Ul*	-0.18	-0.29	-0.33	-0.34	-0.33	-0.20	-0.08	0.00	0.06	0.09
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.03	-0.03	-0.03	-0.03	-0.04	-0.05	-0.06	-0.06	-0.07	-0.07
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	-0.04	-0.06	-0.06	-0.07	-0.08
Foreign receivables	*Wnnb_e/Y*	-0.05	-0.10	-0.14	-0.18	-0.21	-0.39	-0.57	-0.77	-0.97	-1.16
Bond debt	*Wbd_os_z/Y*	0.02	0.04	0.07	0.09	0.12	0.28	0.47	0.66	0.84	1.03
						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	0.25	0.31	0.37	0.41	0.53	0.55	0.54	0.51	0.47
Wage	*lna*	0.00	0.01	0.02	0.03	0.04	0.09	0.11	0.12	0.11	0.10
Consumption price	*pcp*	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	0.06	0.06
Terms of trade	*bpe*	0.00	0.00	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 ratio	*byw*	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

Like building investments, machinery investments have expansionary effects on the economy in the short run. In the long run, the effect on unemployment is zero due to the ***wage-driven crowding out***.? The short-term employment effect of machinery investments is smaller because the import content of machinery investments is higher than that of building investments. The smaller domestic activity effect implies that the pressure on wages and prices is also smaller. The resulting ***real wage effect*** on consumption is also smaller.?

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

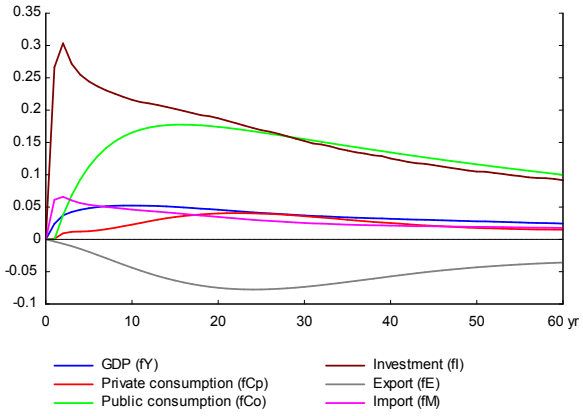
Note that the smaller impact on domestic production and income implies a stronger deterioration of public budget in the short run than when public building investments or the public purchase of goods and services increase. This is, however, not evident from the tables above because the public demand 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.? 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. 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.

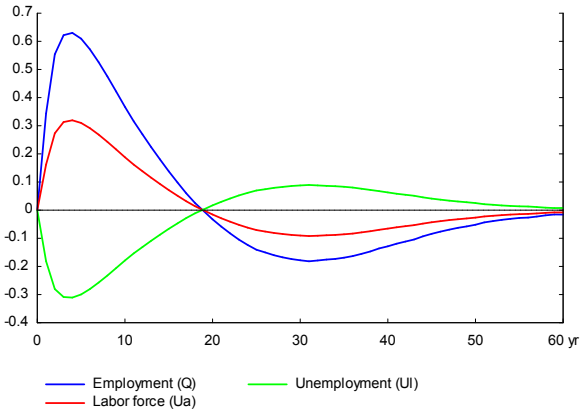
Figure 4. The effect of a permanent increase in public investment in machinery

Supply-Use balance: Multiplier in pct.



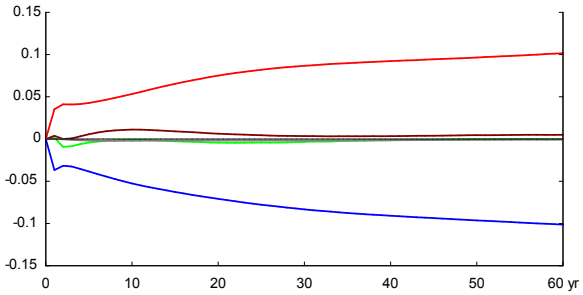
GDP (fY)
Private consumption (fCp)
Public consumption (fCo)
Investment (fI)
Export (fE)
Import (fM)

Labor market: Multiplier in 1000 people.



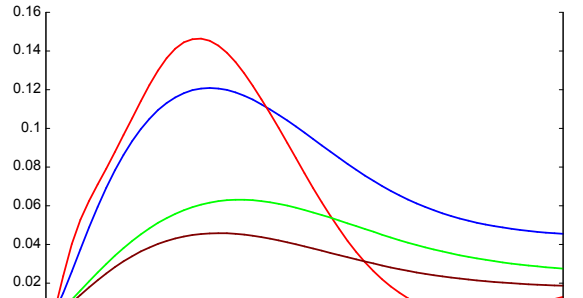
Employment (Q)
Labor force (Ua)
Unemployment (Ul)

Saving balance: Percentage share of GDP



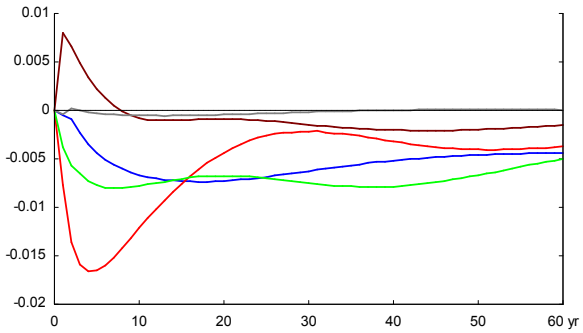
Government sector (Tfn_o/y)
Foreign sector (Tfn_e/y)
Private sector (Tfn_hc/y)
Households (Tfn_h/y)
Interest income, private sector (Tin_hc/y)

Wage and prices: Multiplier in pct.



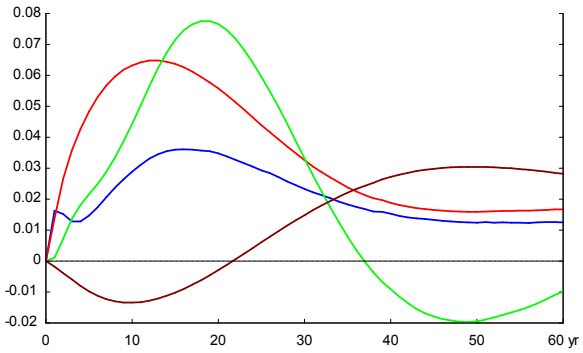
Hourly wage (lna)
House price (phk)
Consumption deflator (pcp)
Production price (pxn)

Taxes and income transfers: Percentage share of GDP



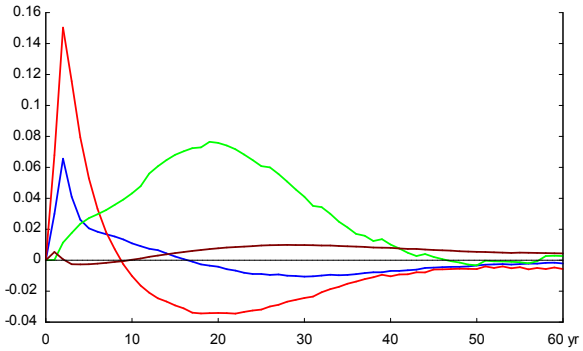
Corporation tax (Syc)
Transfer (Ty_o)
Personal tax (Syk+Sya)
Indirect tax (Spt)
Pension tax (Sywp)

Real income and wealth: Multiplier in pct.



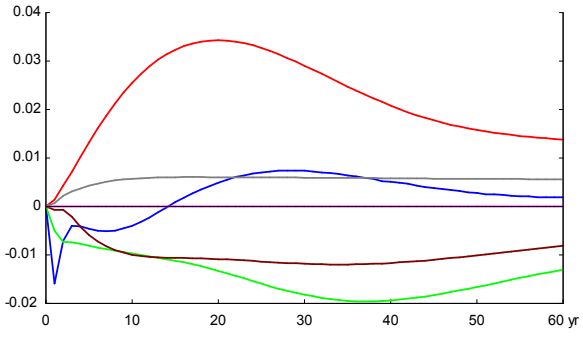
Income (Ydl_hc/pcp)
Wage bill (Yw/pcp)
Wealth (Wcp/pcp)
Pension wealth (Wp/pcp)

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)

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 creates a positive impact on employment 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 effect 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*	36	171	223	233	234	318	481	615	688	714
Pub. consumption	*fCo*	-8	-10	-9	-8	-7	-4	-3	-1	-1	-1
Investment	*fI*	290	490	363	285	236	150	154	176	173	165
Export	*fE*	839	796	802	765	735	484	240	70	-16	-26
Import	*fM*	650	780	728	680	656	609	614	629	640	662
GDP	*fY*	496	652	639	585	535	341	266	241	217	204
						1000 Persons					
Employment	*Q*	0.51	0.85	0.97	0.97	0.93	0.49	0.18	0.03	-0.07	-0.11
Unemployment	*Ul*	-0.30	-0.49	-0.54	-0.54	-0.51	-0.27	-0.10	-0.01	0.04	0.06
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.01	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
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	0.02	0.01	0.01	0.00	0.00
Foreign receivables	*Wnnb_e/Y*	-0.01	-0.02	-0.01	-0.01	0.01	0.07	0.11	0.12	0.12	0.12
Bond debt	*Wbd_os_z/Y*	-0.02	-0.05	-0.08	-0.10	-0.12	-0.17	-0.18	-0.18	-0.16	-0.14
						Percent					
Capital intensity	*fKn/fX*	-0.04	-0.04	-0.03	-0.02	-0.02	0.00	0.02	0.02	0.03	0.03
Labour intensity	*hq/fX*	-0.02	-0.02	-0.01	-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	0.05	0.05
Wage	*lna*	0.01	0.02	0.03	0.05	0.07	0.13	0.16	0.17	0.17	0.16
Consumption price	*pcp*	0.00	0.01	0.01	0.02	0.03	0.05	0.07	0.08	0.09	0.08
Terms of trade	*bpe*	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.05
						Percentage-point					
Consumption ratio	*bcp*	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Wage ratio	*byw*	-0.01	0.00	0.00	0.01	0.02	0.03	0.03	0.02	0.02	0.02

Exports immediately increase relative to the baseline reflecting the positive shock 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 make domestic production and employment expand, see more on the ***income multiplier*** process in section 1. As production expands the demand for capital and other factors of production increases, and hence investment increases relative to the baseline. This is reflected on the higher ***accelerator effect*** on investment.? Investments increase also due to the ***substitution effect***.?

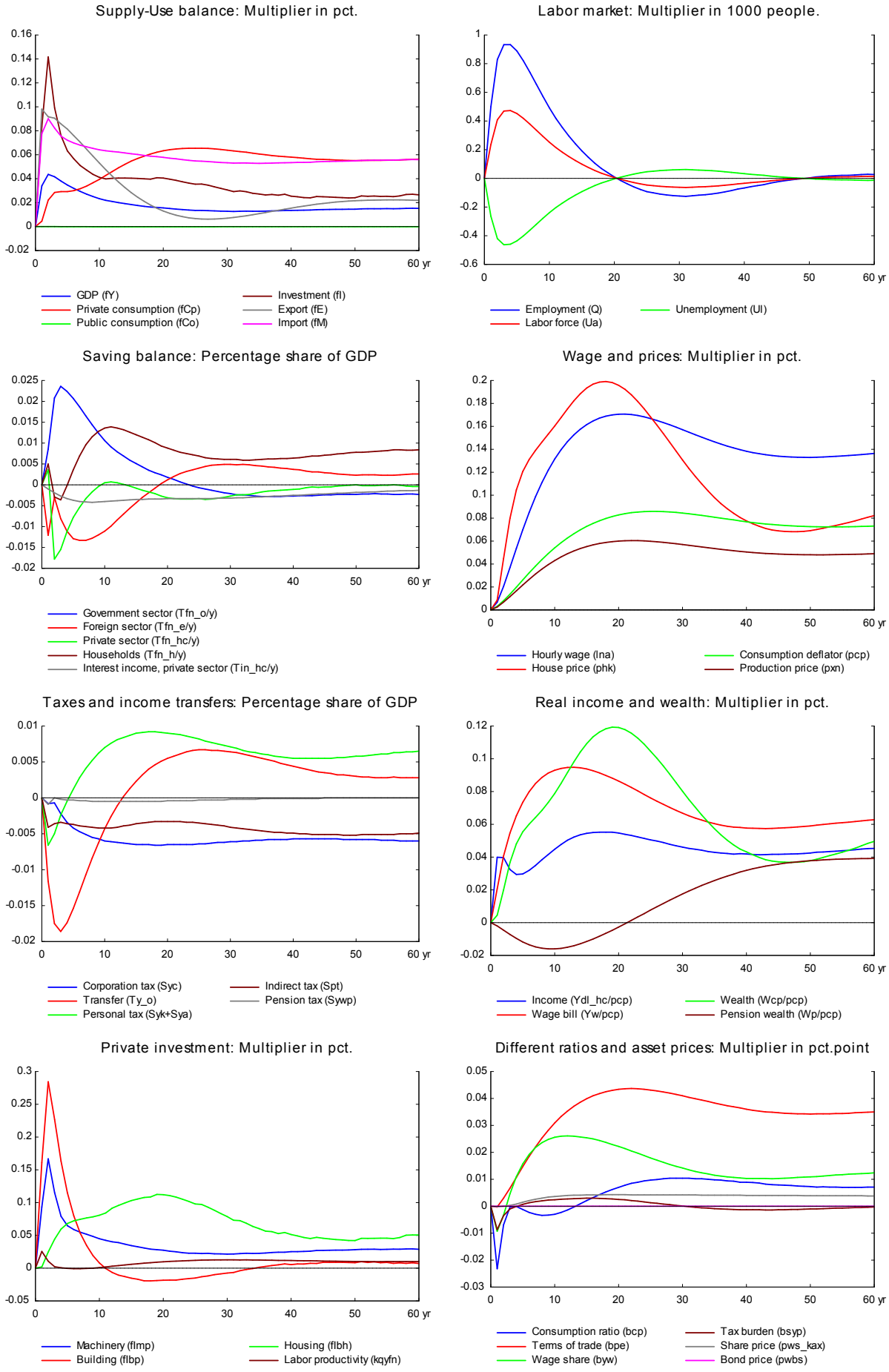
The expansion of the domestic economy increases the export prices relative to the baseline. This is because export prices reflect production cost and the higher employment puts upward pressure on wages and hence on the cost of production. As prices grow relative to the baseline, competitiveness worsens, 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. Private consumption increases permanently due to the positive ***real wage effect***.?

Imports also expand 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 effect 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 0.78 percent. The shock corresponds to an immediate loss in tax revenue of 1000 million kroner in 2005 prices, which corresponds to 0.084 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*	362	686	905	1067	1186	1550	1823	2039	2176	2256
Pub. consumption	*fCo*	-3	-6	-7	-8	-8	-5	-1	2	3	3
Investment	*fI*	134	350	490	543	574	542	431	368	326	306
Export	*fE*	-16	-45	-89	-141	-206	-658	-1152	-1516	-1707	-1761
Import	*fM*	203	404	507	544	554	460	328	241	191	179
GDP	*fY*	274	577	786	909	983	968	783	669	628	647
						1000 Persons					
Employment	*Q*	0.21	0.53	0.81	1.00	1.11	0.90	0.31	-0.08	-0.25	-0.27
Unemployment	*Ul*	-0.13	-0.31	-0.46	-0.56	-0.62	-0.49	-0.17	0.05	0.14	0.15
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.04	-0.03	-0.02	-0.02	-0.02	-0.02	-0.04	-0.06	-0.08	-0.09
Priv. saving surplus	*Tfn_hc/Y*	0.03	0.01	-0.01	-0.02	-0.03	-0.03	-0.02	-0.01	-0.01	-0.01
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*	-0.02	-0.07	-0.11	-0.16	-0.20	-0.42	-0.62	-0.85	-1.09	-1.33
Bond debt	*Wbd_os_z/Y*	0.03	0.05	0.07	0.08	0.08	0.14	0.28	0.49	0.73	0.98
						Percent					
Capital intensity	*fKn/fX*	-0.01	-0.02	-0.02	-0.02	-0.01	0.03	0.07	0.09	0.10	0.10
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	0.00	0.01	0.02	0.02	0.06	0.08	0.08	0.08	0.07
Wage	*lna*	0.00	0.01	0.02	0.04	0.06	0.15	0.21	0.22	0.20	0.18
Consumption price	*pcp*	0.00	0.00	0.01	0.02	0.02	0.07	0.10	0.11	0.11	0.10
Terms of trade	*bpe*	0.00	0.00	0.01	0.01	0.02	0.04	0.06	0.06	0.06	0.05
						Percentage-point					
Consumption ratio	*bcp*	-0.03	-0.01	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.03
Wage ratio	*byw*	0.00	-0.01	0.00	0.00	0.01	0.03	0.03	0.02	0.01	0.01

The immediate effect of a fall in income taxes is a fall in public revenues and (real) disposable income increases relative to the baseline, 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 to long term, the ***wage-driven crowding out*** returns unemployment to its baseline.?

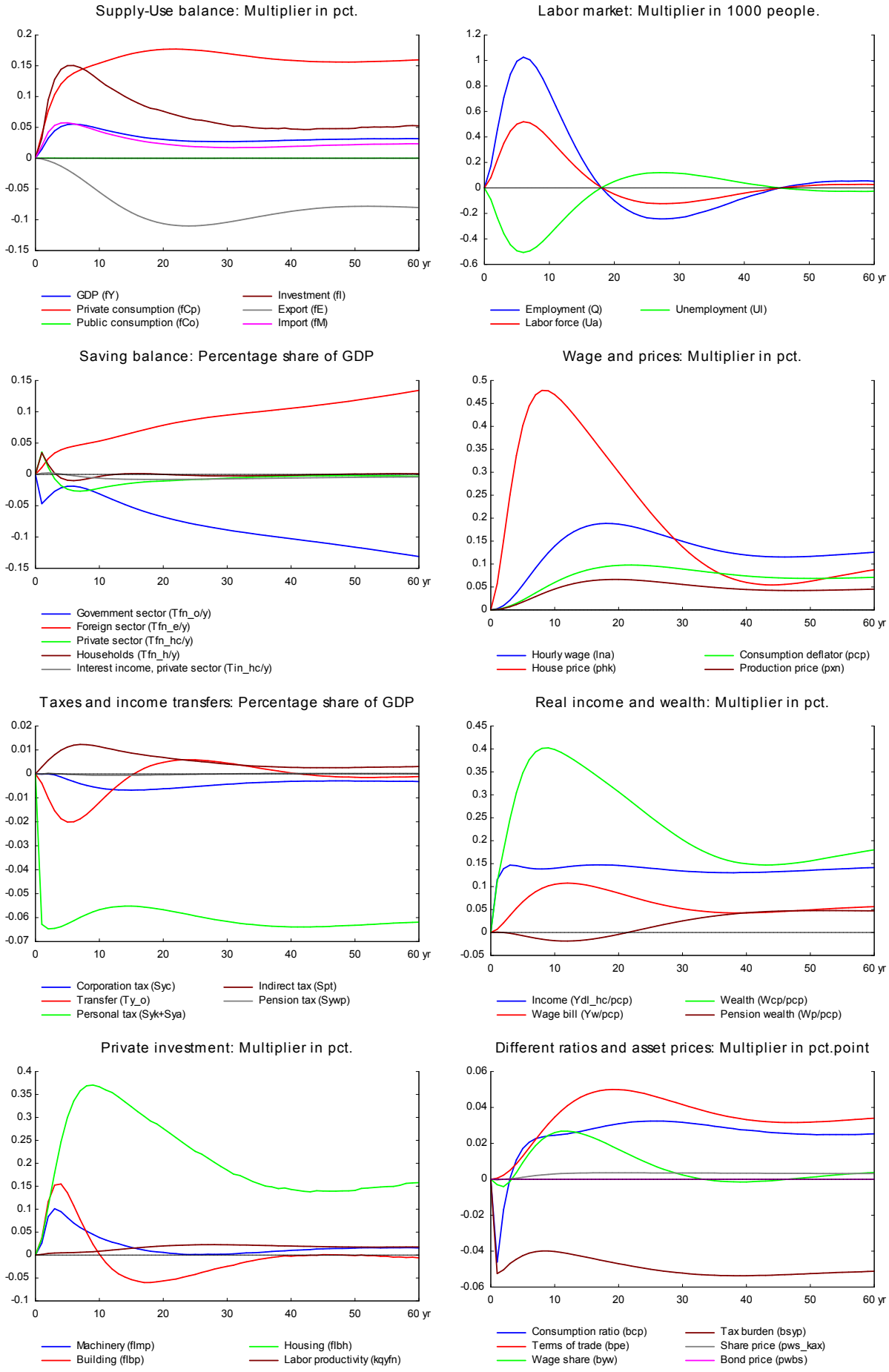
Compared to the previous demand shocks, the effect on private consumption is larger. Because the shock directly affects disposable income and hence private consumption. The higher private consumption raises investment in housing and house prices and the impact on housing is strong as the initial impact on consumption is strong. 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.?

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*	314	606	816	973	1088	1450	1747	2002	2179	2292
Pub. consumption	*fCo*	-3	-7	-8	-9	-10	-8	-4	-1	1	1
Investment	*fI*	164	392	514	562	594	568	469	420	390	376
Export	*fE*	39	33	12	-23	-71	-481	-983	-1383	-1625	-1726
Import	*fM*	209	410	505	543	558	477	353	270	217	197
GDP	*fY*	302	607	811	938	1018	1027	860	758	720	737
						1000 Persons					
Employment	*Q*	0.23	0.56	0.84	1.04	1.17	1.00	0.42	0.01	-0.19	-0.23
Unemployment	*Ul*	-0.14	-0.32	-0.48	-0.59	-0.65	-0.55	-0.23	0.00	0.10	0.13
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.05	-0.03	-0.03	-0.02	-0.02	-0.02	-0.04	-0.06	-0.08	-0.09
Priv. saving surplus	*Tfn_hc/Y*	0.04	0.01	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	0.00	0.00
Balance of payments	*Enl/Y*	-0.01	-0.03	-0.03	-0.03	-0.04	-0.04	-0.06	-0.07	-0.08	-0.09
Foreign receivables	*Wnnb_e/Y*	0.01	-0.02	-0.06	-0.11	-0.15	-0.35	-0.54	-0.75	-0.98	-1.23
Bond debt	*Wbd_os_z/Y*	0.06	0.08	0.09	0.10	0.11	0.16	0.29	0.49	0.73	0.97
						Percent					
Capital intensity	*fKn/fX*	-0.01	-0.02	-0.03	-0.02	-0.02	0.03	0.06	0.09	0.09	0.10
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	-0.02	0.02	0.04	0.05	0.05	0.04
Wage	*lna*	0.00	0.01	0.02	0.04	0.06	0.16	0.22	0.24	0.23	0.21
Consumption price	*pcp*	-0.08	-0.08	-0.07	-0.07	-0.06	-0.03	0.01	0.02	0.03	0.02
Terms of trade	*bpe*	-0.01	-0.01	0.00	0.00	0.01	0.03	0.05	0.06	0.06	0.05
						Percentage-point					
Consumption ratio	*bcp*	-0.04	-0.02	-0.01	0.00	0.00	0.01	0.01	0.02	0.02	0.02
Wage ratio	*byw*	0.00	0.00	0.00	0.00	0.01	0.03	0.04	0.03	0.03	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.

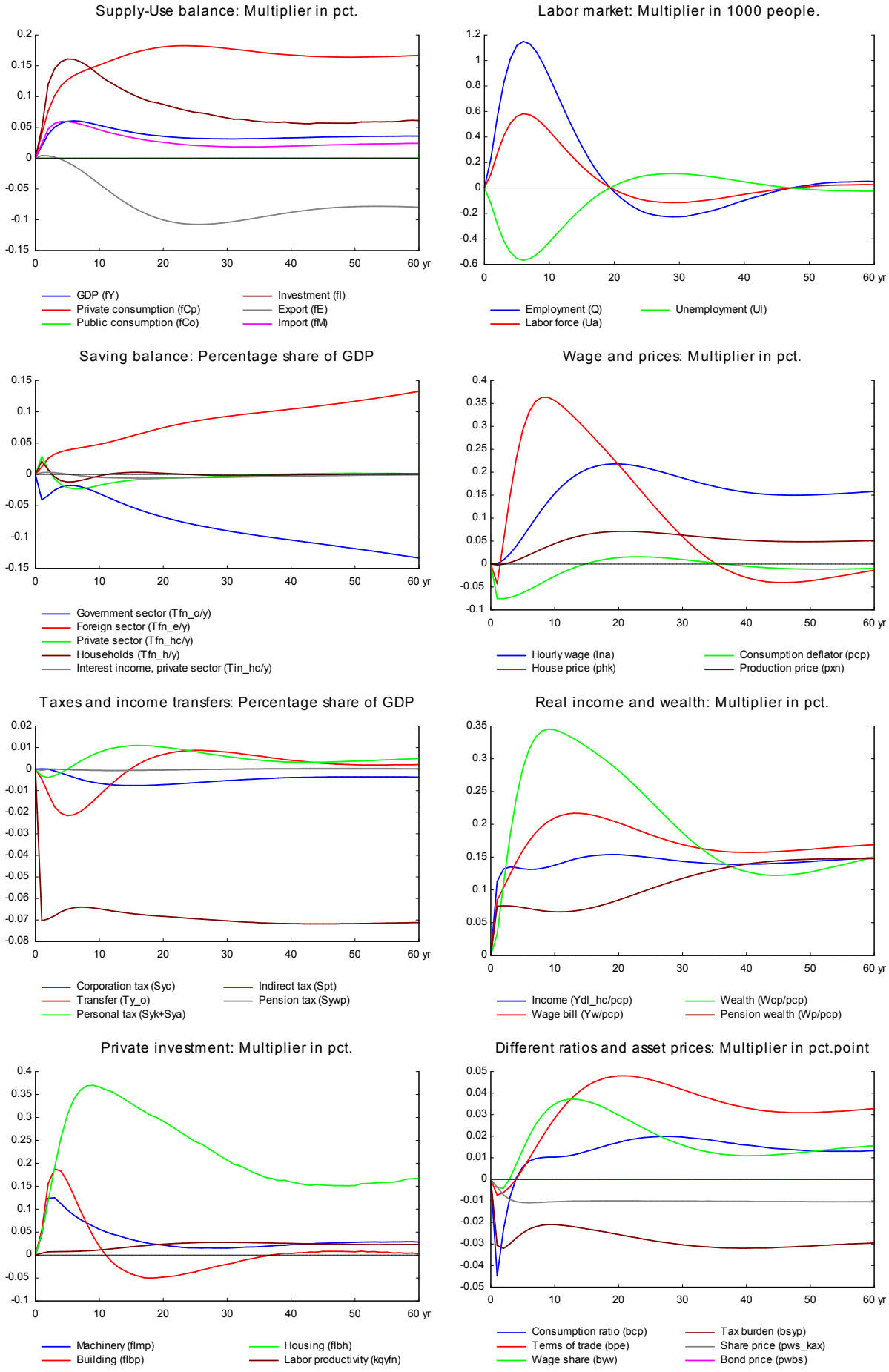
The VAT reduction affects the relationship between production costs and final market prices. Despite the rise in wages and output prices, consumption prices fall when VAT rates are reduced. Like a lower income tax, the lower VAT has a positive long-term effect on real income, which gives rise to a change 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 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*	-970	-1180	-1573	-1937	-2176	-2091	-1231	-400	168	436
Pub. consumption	*fCo*	-22	-26	-24	-21	-19	-14	-11	-6	1	8
Investment	*fI*	531	847	346	-33	-301	-536	-147	172	254	189
Export	*fE*	2264	2809	3209	3414	3554	3324	2416	1312	298	-417
Import	*fM*	349	574	340	147	53	180	405	415	242	9
GDP	*fY*	1379	1741	1427	1064	780	263	370	400	211	-69
						1000 Persons					
Employment	*Q*	2.18	3.44	3.72	3.61	3.39	2.34	1.86	1.34	0.63	-0.01
Unemployment	*Ul*	-1.30	-1.96	-2.08	-2.00	-1.87	-1.29	-1.03	-0.74	-0.34	0.01
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.07	0.12	0.11	0.09	0.08	0.06	0.07	0.08	0.08	0.07
Priv. saving surplus	*Tfn_hc/Y*	-0.13	-0.13	-0.08	-0.03	0.00	0.06	0.03	0.00	-0.02	-0.02
Balance of payments	*Enl/Y*	-0.06	-0.02	0.03	0.06	0.09	0.12	0.10	0.07	0.06	0.05
Foreign receivables	*Wnnb_e/Y*	-0.18	-0.30	-0.30	-0.26	-0.19	0.28	0.67	0.92	1.06	1.12
Bond debt	*Wbd_os_z/Y*	-0.15	-0.29	-0.39	-0.46	-0.53	-0.69	-0.80	-0.91	-0.97	-0.97
						Percent					
Capital intensity	*fKn/fX*	-0.14	-0.15	-0.13	-0.11	-0.11	-0.11	-0.11	-0.08	-0.03	0.00
Labour intensity	*hq/fX*	-0.07	-0.04	-0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
User cost	*uim*	0.59	0.63	0.66	0.69	0.72	0.82	0.90	0.96	1.00	1.02
Wage	*lna*	0.08	0.15	0.22	0.29	0.36	0.62	0.82	0.97	1.06	1.10
Consumption price	*pcp*	0.36	0.43	0.47	0.51	0.55	0.70	0.82	0.92	0.99	1.03
Terms of trade	*bpe*	-0.33	-0.29	-0.26	-0.24	-0.21	-0.13	-0.07	-0.02	0.01	0.02
						Percentage-point					
Consumption ratio	*bcp*	0.06	0.04	0.01	-0.02	-0.05	-0.09	-0.06	-0.02	0.01	0.02
Wage ratio	*byw*	-0.06	-0.05	-0.03	-0.01	0.00	0.02	0.03	0.04	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 in the short run. 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.

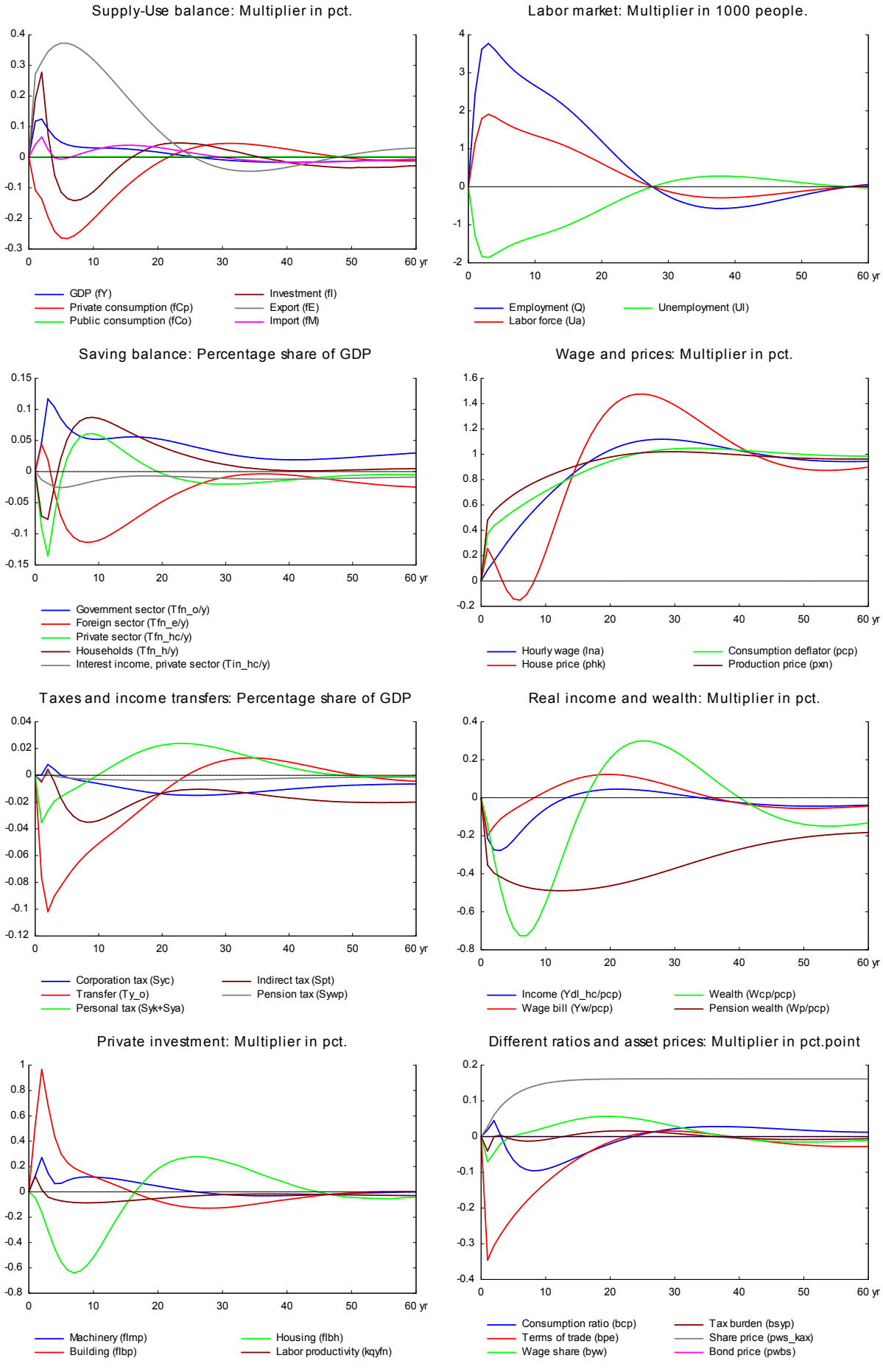
In the long run, the foreign price increase works like a monetary shock and affects only domestic price levels. Thus, both the foreign and domestic prices increase by 1 percent in relation to the baseline implying that relative prices and hence quantity variables are unaffected in the long run. This 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 a 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 on foreign prices. A change in world oil prices affects all countries in the world and hence foreign markets and foreign prices will be affected. However, the experiment here does not take the international spillover into account.

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

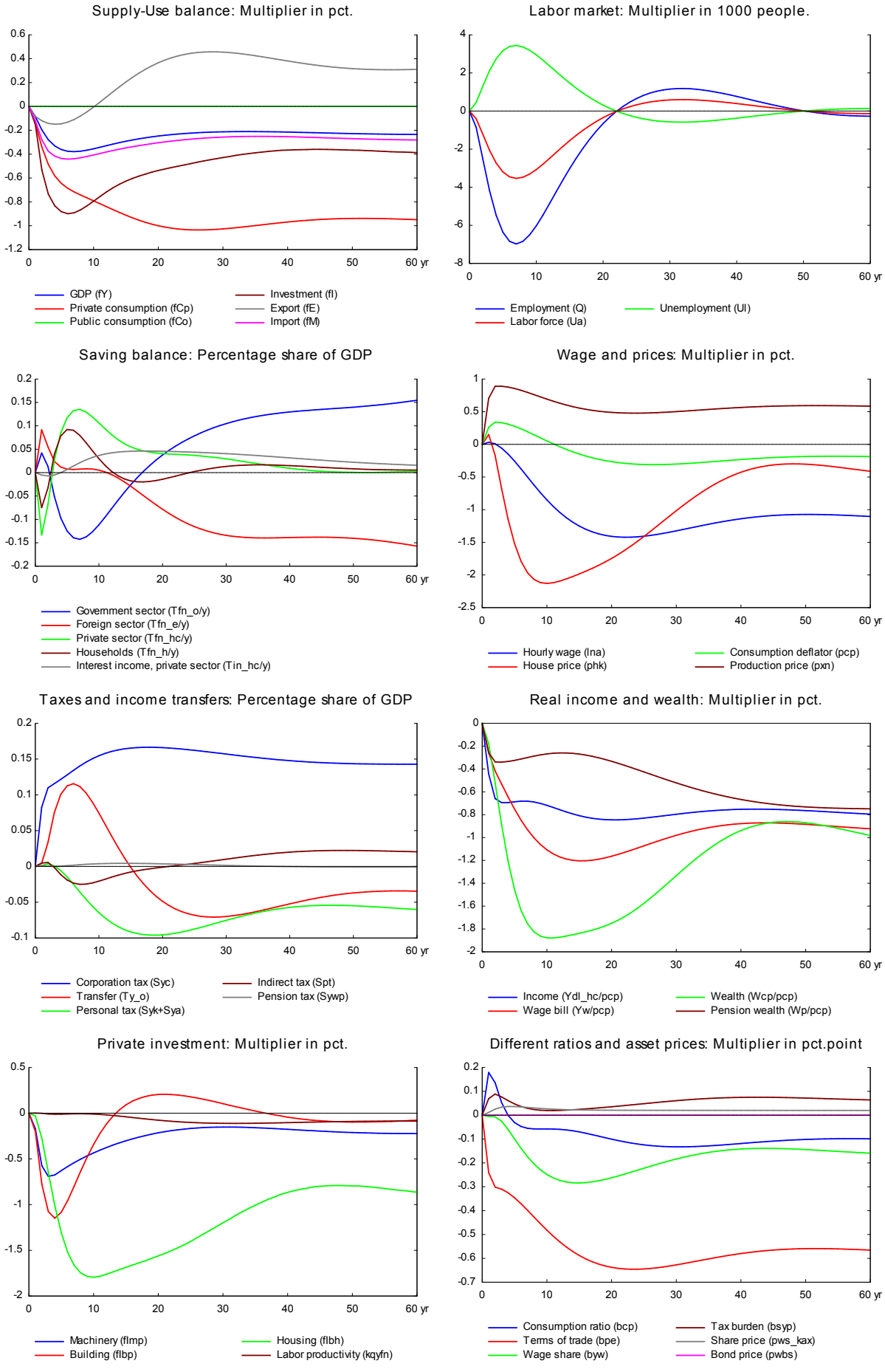
		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	-1226	-2884	-4225	-5295	-6156	-8993	-11243	-13255	-14779	-15804
Pub. consumption	*fCo*	15	36	51	60	66	64	39	16	1	-6
Investment	*fI*	-555	-1887	-2660	-3137	-3512	-3888	-3360	-3027	-2870	-2742
Export	*fE*	-760	-977	-1147	-1179	-1126	729	3957	6995	9090	10160
Import	*fM*	-1532	-3050	-3788	-4159	-4441	-4567	-3997	-3505	-3196	-3082
GDP	*fY*	-999	-2669	-4262	-5481	-6394	-7690	-6850	-6068	-5712	-5701
						1000 Persons					
Employment	*Q*	-0.84	-2.62	-4.45	-6.01	-7.20	-7.87	-4.39	-1.23	0.62	1.39
Unemployment	*Ul*	0.50	1.53	2.55	3.40	4.04	4.35	2.41	0.66	-0.35	-0.77
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.06	0.03	-0.05	-0.10	-0.15	-0.19	-0.11	-0.04	0.02	0.05
Priv. saving surplus	*Tfn_hc/Y*	-0.15	-0.08	0.01	0.06	0.11	0.14	0.09	0.06	0.05	0.04
Balance of payments	*Enl/Y*	-0.09	-0.06	-0.04	-0.04	-0.04	-0.05	-0.03	0.02	0.06	0.09
Foreign receivables	*Wnnb_e/Y*	-0.08	-0.08	-0.04	-0.01	0.03	0.04	-0.03	0.03	0.26	0.60
Bond debt	*Wbd_os_z/Y*	-0.07	-0.06	0.03	0.16	0.32	1.15	1.53	1.42	1.02	0.48
						Percent					
Capital intensity	*fKn/fX*	0.10	0.19	0.23	0.24	0.23	-0.01	-0.28	-0.45	-0.54	-0.58
Labour intensity	*hq/fX*	0.08	0.13	0.15	0.15	0.15	0.12	0.12	0.13	0.15	0.15
User cost	*uim*	0.20	0.24	0.22	0.19	0.15	-0.08	-0.27	-0.36	-0.38	-0.36
Wage	*lna*	0.03	0.01	-0.05	-0.15	-0.26	-0.98	-1.52	-1.77	-1.79	-1.70
Consumption price	*pcp*	0.27	0.36	0.35	0.33	0.30	0.04	-0.22	-0.39	-0.45	-0.45
Terms of trade	*bpe*	-0.26	-0.36	-0.38	-0.41	-0.43	-0.61	-0.75	-0.82	-0.84	-0.82
						Percentage-point					
Consumption ratio	*bcp*	0.16	0.14	0.07	0.02	-0.02	-0.09	-0.10	-0.13	-0.16	-0.16
Wage ratio	*byw*	-0.02	-0.01	-0.02	-0.05	-0.08	-0.24	-0.31	-0.30	-0.26	-0.21

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 reduces 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 increase in world market price of oil



10. Labor supply - number of workers

The focus now 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 experiments in 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*	901	1780	2350	2420	2152	-1310	-4956	-7369	-8478	-8590
Pub. consumption	*fCo*	-14	-34	-51	-65	-76	-114	-149	-190	-229	-260
Investment	*fI*	511	1470	2291	2738	2910	2126	963	714	1173	1894
Export	*fE*	639	1544	2572	3703	4926	11552	18031	23649	27920	30699
Import	*fM*	724	1657	2390	2782	2976	3206	3733	4902	6297	7545
GDP	*fY*	1291	3029	4615	5792	6661	8642	9697	11382	13497	15538
						1000 Persons					
Employment	*Q*	1.37	3.75	6.40	8.86	11.00	17.46	20.83	23.88	26.44	27.92
Unemployment	*Ul*	15.66	13.15	11.65	10.30	9.13	5.59	3.74	2.05	0.63	-0.18
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.17	-0.15	-0.08	0.00	0.07	0.22	0.28	0.36	0.47	0.57
Priv. saving surplus	*Tfn_hc/Y*	0.13	0.05	-0.04	-0.13	-0.18	-0.15	-0.01	0.06	0.07	0.05
Balance of payments	*Enl/Y*	-0.04	-0.09	-0.13	-0.13	-0.11	0.07	0.27	0.43	0.54	0.62
Foreign receivables	*Wnnb_e/Y*	0.04	0.03	-0.02	-0.07	-0.11	0.19	1.27	2.88	4.77	6.77
Bond debt	*Wbd_os_z/Y*	0.21	0.38	0.48	0.50	0.46	-0.27	-1.36	-2.68	-4.29	-6.11
						Percent					
Capital intensity	*fKn/fX*	-0.08	-0.17	-0.25	-0.29	-0.32	-0.38	-0.49	-0.66	-0.80	-0.86
Labour intensity	*hq/fX*	-0.03	-0.07	-0.08	-0.08	-0.07	-0.03	-0.01	0.00	0.01	0.02
User cost	*uim*	-0.11	-0.23	-0.34	-0.43	-0.52	-0.85	-1.08	-1.21	-1.24	-1.21
Wage	*lna*	-0.25	-0.67	-1.03	-1.33	-1.60	-2.55	-3.12	-3.42	-3.48	-3.35
Consumption price	*pcp*	-0.12	-0.25	-0.38	-0.49	-0.60	-1.06	-1.40	-1.63	-1.73	-1.74
Terms of trade	*bpe*	-0.08	-0.18	-0.26	-0.33	-0.40	-0.66	-0.83	-0.92	-0.95	-0.92
						Percentage-point					
Consumption ratio	*bcp*	-0.12	-0.08	-0.02	0.05	0.08	0.03	-0.13	-0.23	-0.28	-0.28
Wage ratio	*byw*	-0.08	-0.20	-0.28	-0.33	-0.37	-0.46	-0.50	-0.49	-0.44	-0.37

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 due to the negative ***real wage effect***.?

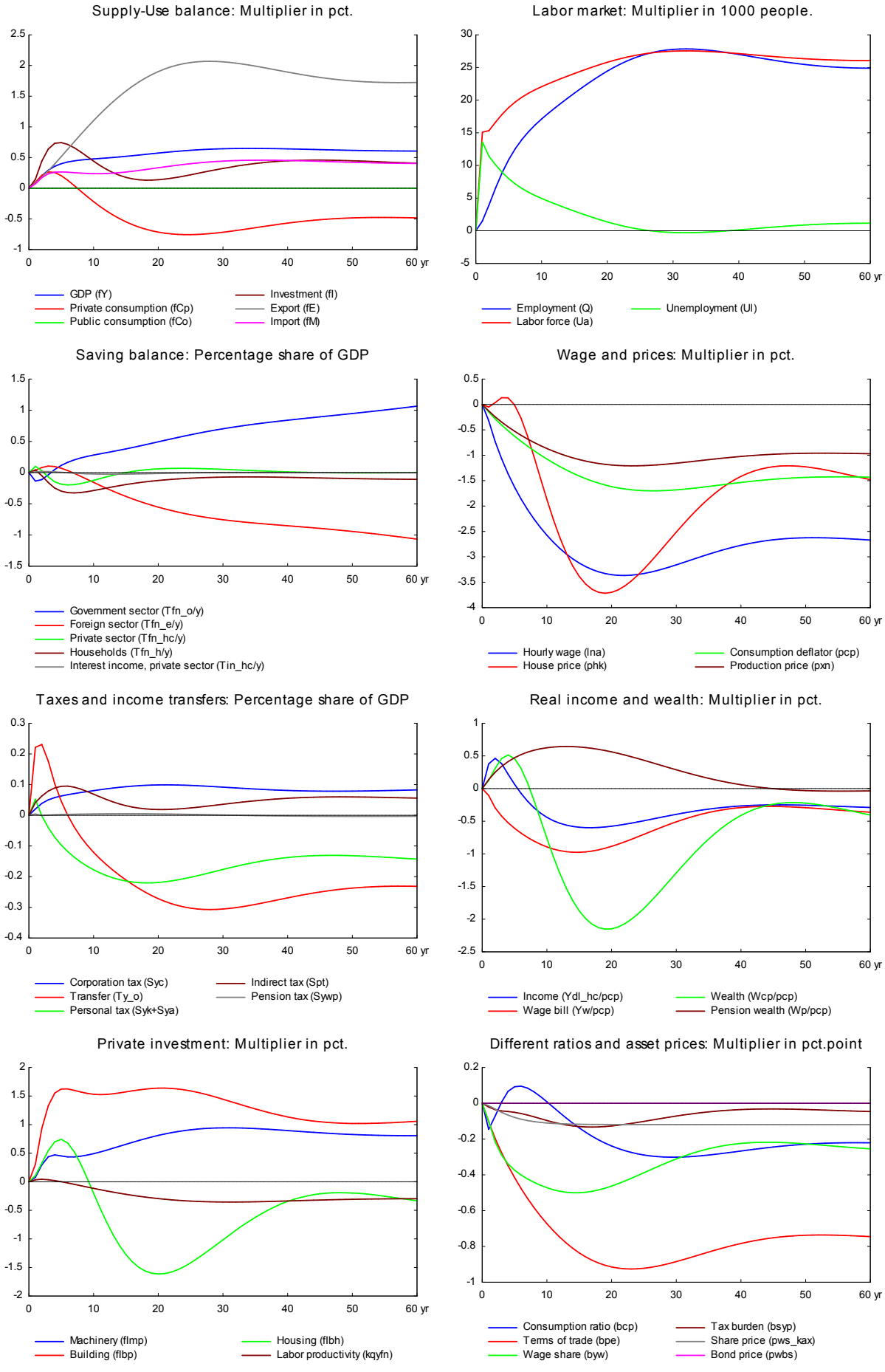
Overall, there is a positive effect on production in the long run because of the permanent increase in employment. At the same time, there is also a change in the relative prices of production factors, and labor has become relatively cheaper. This creates a ***substitution effect***.? Consequently, the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

In contrast to section 1, here the wage share falls permanently, i.e. the distribution of income changes permanently in favor of capital. Wage relative to user cost falls in the long run because investment prices fall less than wages due to the deadweight from import prices.

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*	712	1426	3107	3983	4233	1735	-1508	-3533	-4336	-4233
Pub. consumption	*fCo*	-66	-86	-115	-139	-156	-202	-233	-272	-315	-352
Investment	*fI*	451	1338	2607	3731	4248	3658	2130	1645	2022	2727
Export	*fE*	700	1749	2931	4117	5373	11744	17496	22446	26358	29073
Import	*fM*	627	1503	2946	3935	4403	4701	4919	5884	7203	8465
GDP	*fY*	1145	2842	5406	7495	8965	11760	12453	13837	15895	18048
						1000 Persons					
Employment	*Q*	-26.06	-23.69	-20.24	-16.75	-13.74	-5.93	-3.65	-1.67	0.38	1.75
Unemployment	*Ul*	15.55	13.05	11.07	9.15	7.50	3.26	2.01	0.91	-0.23	-0.98
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.15	-0.13	-0.21	-0.08	0.02	0.21	0.23	0.28	0.36	0.44
Priv. saving surplus	*Tfn_hc/Y*	0.11	0.05	0.05	-0.11	-0.21	-0.22	-0.05	0.04	0.05	0.04
Balance of payments	*Enl/Y*	-0.04	-0.08	-0.16	-0.19	-0.19	-0.01	0.18	0.32	0.41	0.48
Foreign receivables	*Wnnb_e/Y*	0.06	0.09	-0.01	-0.15	-0.29	-0.44	0.30	1.57	3.09	4.72
Bond debt	*Wbd_os_z/Y*	0.20	0.36	0.57	0.65	0.63	-0.10	-1.07	-2.10	-3.33	-4.75
						Percent					
Capital intensity	*fKn/fX*	-0.07	-0.17	-0.29	-0.37	-0.41	-0.40	-0.42	-0.53	-0.65	-0.71
Labour intensity	*hq/fX*	-0.03	-0.07	-0.10	-0.11	-0.10	-0.04	-0.02	-0.01	-0.01	0.00
User cost	*uim*	-0.12	-0.26	-0.39	-0.48	-0.56	-0.84	-1.02	-1.13	-1.16	-1.14
Wage	*lna*	-0.27	-0.76	-1.17	-1.48	-1.74	-2.53	-2.95	-3.20	-3.27	-3.19
Consumption price	*pcp*	-0.13	-0.28	-0.43	-0.55	-0.66	-1.06	-1.33	-1.53	-1.63	-1.64
Terms of trade	*bpe*	-0.09	-0.20	-0.29	-0.37	-0.43	-0.65	-0.78	-0.86	-0.89	-0.87
						Percentage-point					
Consumption ratio	*bcp*	-0.10	-0.08	-0.11	0.01	0.09	0.08	-0.07	-0.18	-0.23	-0.23
Wage ratio	*byw*	-0.09	-0.22	-0.33	-0.39	-0.42	-0.46	-0.47	-0.46	-0.43	-0.38

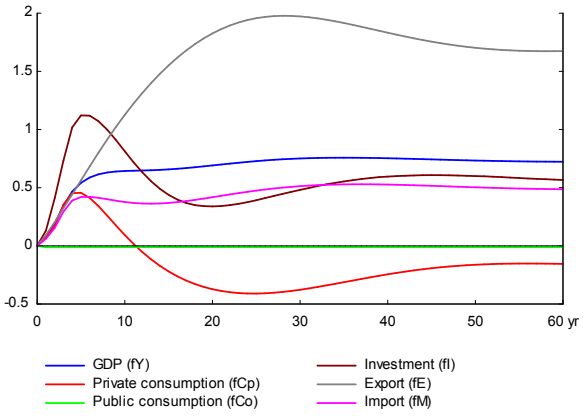
When working hours of existing workers increase potential production increases immediately. Compared to the previous experiment the initial reaction via the production function is stronger in the present experiment because the working hours of already employed people increases. In the short run, there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

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.

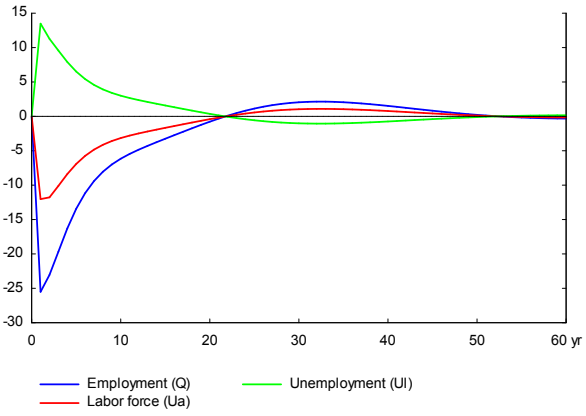
There is a positive effect on the public budget in the long run, because the fall in public expenses is larger than the fall in revenues. Personal income taxes do not fall as much as annual incomes, as the higher working hours offset the fall in annual incomes. Corporate taxes also increase due to the increase in profits. 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

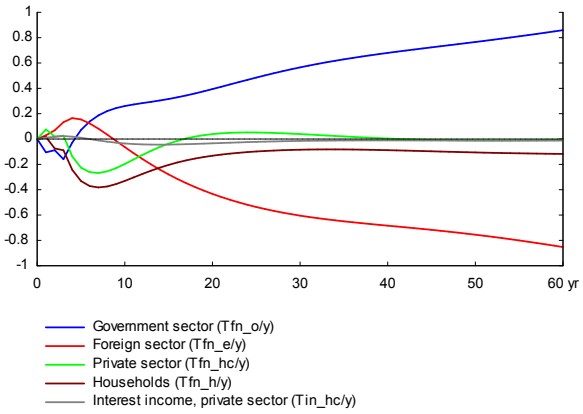
Supply-Use balance: Multiplier in pct.



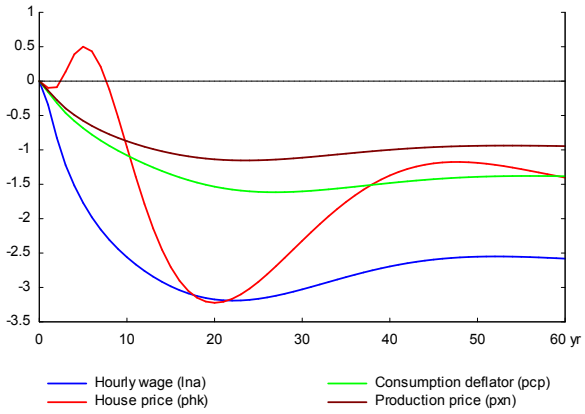
Labor market: Multiplier in 1000 people.



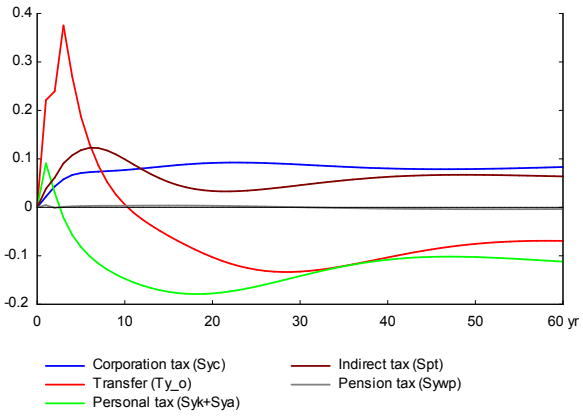
Saving balance: Percentage share of GDP



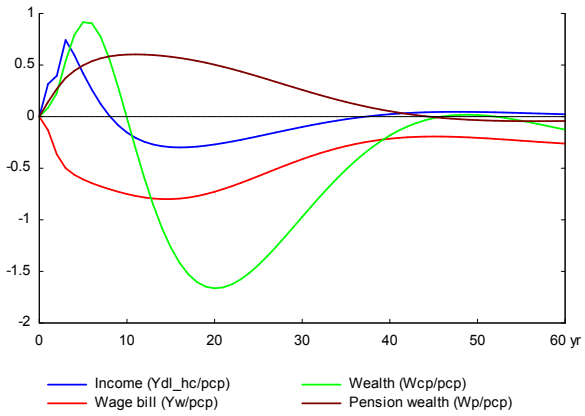
Wage and prices: Multiplier in pct.



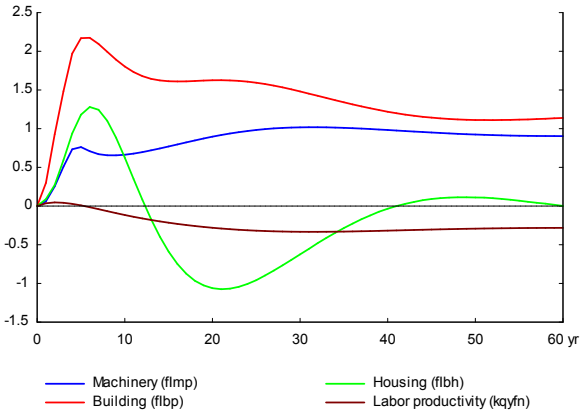
Taxes and income transfers: Percentage share of GDP



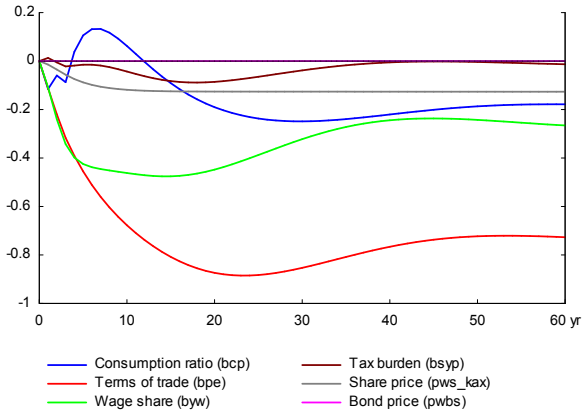
Real income and wealth: Multiplier in pct.



Private investment: Multiplier in pct.



Different ratios and asset prices: Multiplier in pct.point



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*	483	798	1424	1810	1936	6	-2491	-3831	-4092	-3675
Pub. consumption	*fCo*	-70	-91	-113	-132	-148	-198	-229	-261	-295	-323
Investment	*fI*	843	1909	2700	3314	3662	3345	2206	1914	2329	2977
Export	*fE*	2446	3744	5163	6563	7995	14588	19840	23865	26791	28743
Import	*fM*	1077	1940	2863	3573	4077	4994	5485	6430	7577	8624
GDP	*fY*	2544	4250	6011	7590	8904	12116	13158	14515	16342	18211
						1000 Persons					
Employment	*Q*	-14.85	-15.61	-14.55	-12.74	-10.74	-3.85	-1.51	-0.05	1.22	1.90
Unemployment	*Ul*	8.86	8.70	8.02	6.99	5.87	2.10	0.82	0.02	-0.69	-1.06
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.10	-0.11	-0.04	0.03	0.09	0.26	0.30	0.35	0.42	0.50
Priv. saving surplus	*Tfn_hc/Y*	0.04	0.03	-0.06	-0.13	-0.18	-0.18	-0.04	0.04	0.04	0.02
Balance of payments	*Enl/Y*	-0.06	-0.09	-0.10	-0.11	-0.09	0.09	0.27	0.39	0.47	0.52
Foreign receivables	*Wnnb_e/Y*	0.28	0.32	0.28	0.23	0.19	0.40	1.39	2.83	4.43	6.06
Bond debt	*Wbd_os_z/Y*	0.29	0.42	0.46	0.44	0.35	-0.62	-1.85	-3.12	-4.50	-5.98
						Percent					
Capital intensity	*fKn/fX*	-0.19	-0.29	-0.37	-0.43	-0.47	-0.51	-0.53	-0.61	-0.68	-0.70
Labour intensity	*hq/fX*	-0.73	-0.89	-0.97	-1.01	-1.03	-1.02	-1.00	-0.99	-0.99	-0.98
User cost	*uim*	-0.41	-0.52	-0.61	-0.69	-0.76	-0.99	-1.11	-1.16	-1.15	-1.11
Wage	*lna*	-0.33	-0.62	-0.89	-1.13	-1.34	-1.94	-2.19	-2.27	-2.23	-2.10
Consumption price	*pcp*	-0.42	-0.56	-0.68	-0.80	-0.90	-1.27	-1.48	-1.59	-1.63	-1.61
Terms of trade	*bpe*	-0.31	-0.39	-0.46	-0.52	-0.58	-0.76	-0.85	-0.88	-0.88	-0.85
						Percentage-point					
Consumption ratio	*bcp*	-0.05	-0.09	-0.04	0.01	0.05	0.02	-0.12	-0.20	-0.23	-0.22
Wage ratio	*byw*	-0.17	-0.31	-0.40	-0.45	-0.48	-0.50	-0.47	-0.43	-0.39	-0.34

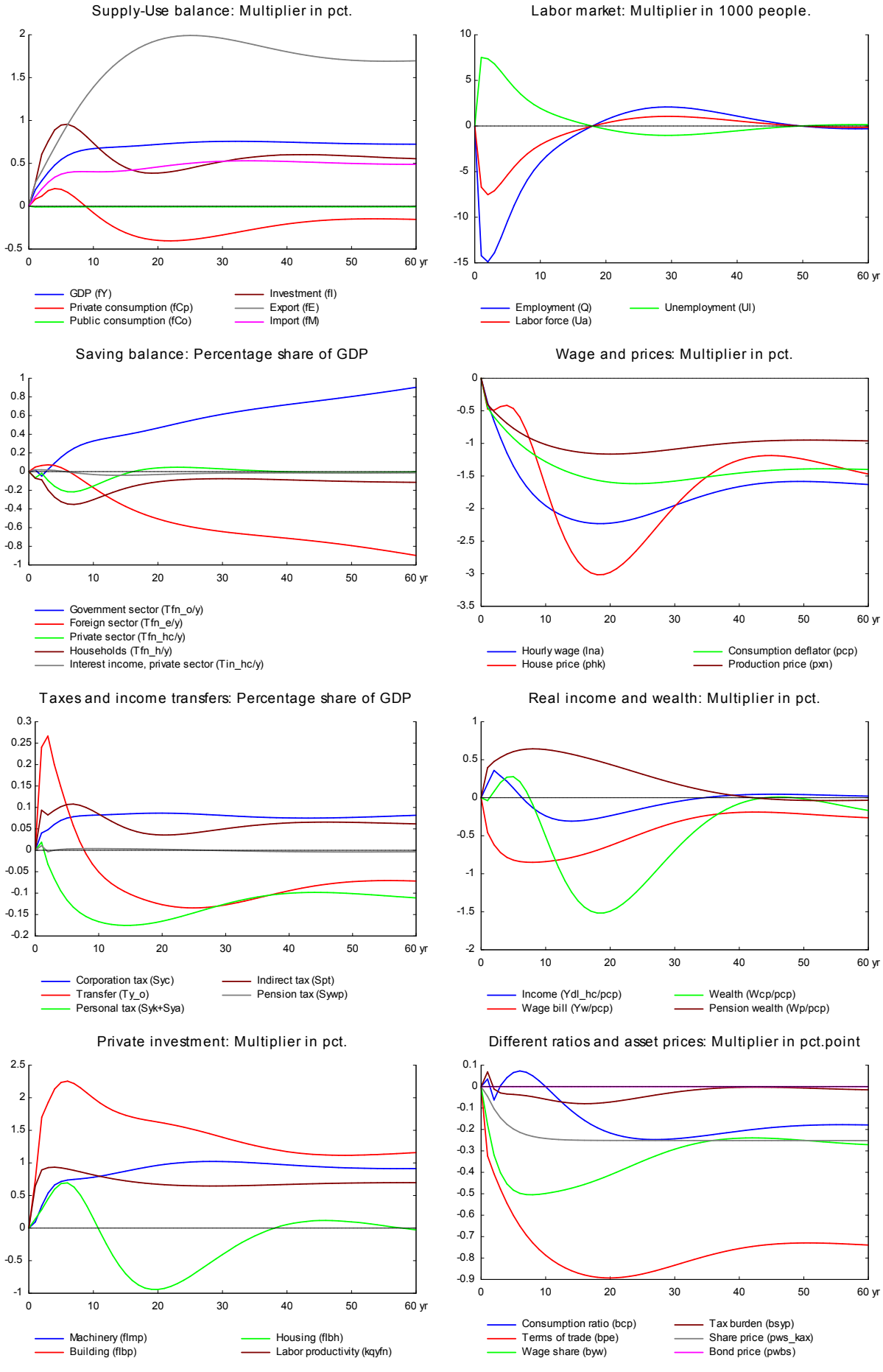
As the amount of output demanded can be produced by less labor, employment falls already in the first year, and due to lags in the labor demand relation, due to for example labor hoarding, the negative effect on employment peaks in the second year. The lower employment reduces wage growth and the ***wage-driven crowding out*** returns employment 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.

The long term impact on investments is positive as there is a long term positive impact on production. Both capital intensity and labor intensity of production fall with the usual measure of intensity, and the fall in the latter is stronger as a result labor productivity increases. Note the efficiency corrected labor intensity increases relative to the baseline and production involves less capital and more labor in efficiency units. Due to this, 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

The output capacity of the economy can increase if the efficiency of machines increases. 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

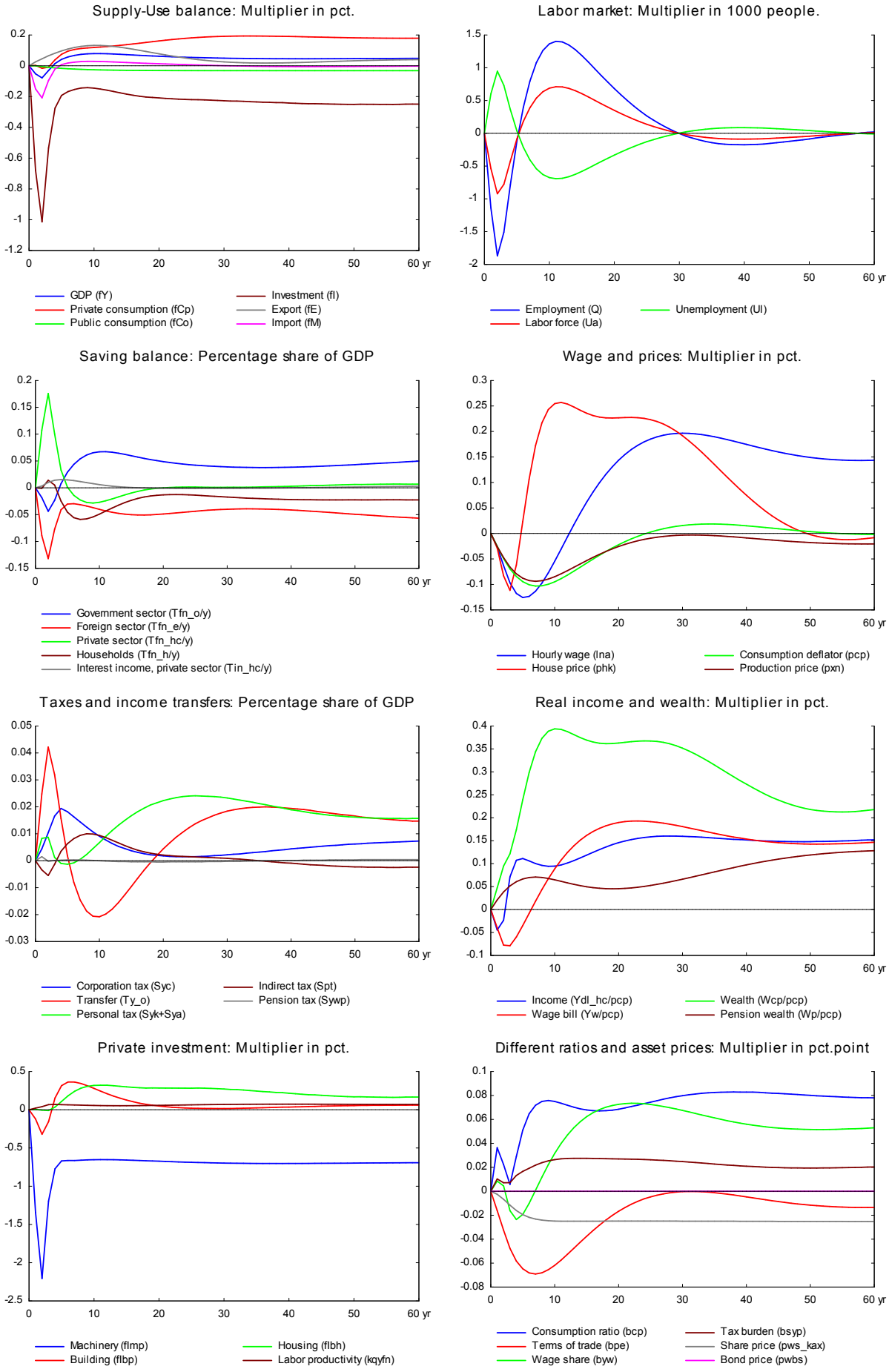
		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	4	-158	-135	246	566	1160	1436	1785	2136	2412
Pub. consumption	*fCo*	25	14	-26	-55	-74	-132	-158	-173	-186	-199
Investment	*fI*	-2512	-3757	-1965	-1056	-806	-619	-848	-1060	-1206	-1334
Export	*fE*	254	452	641	809	970	1414	1274	874	484	230
Import	*fM*	-1364	-2024	-869	-199	39	311	232	125	31	-52
GDP	*fY*	-829	-1374	-598	138	595	1461	1424	1260	1163	1130
						1000 Persons					
Employment	*Q*	-1.15	-2.00	-1.66	-0.92	-0.23	1.47	1.30	0.71	0.26	-0.01
Unemployment	*Ul*	0.68	1.15	0.90	0.48	0.10	-0.82	-0.71	-0.39	-0.14	0.01
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.03	-0.06	-0.03	0.00	0.02	0.07	0.07	0.06	0.05	0.05
Priv. saving surplus	*Tfn_hc/Y*	0.12	0.19	0.11	0.04	0.01	-0.03	-0.02	0.00	0.00	0.00
Balance of payments	*Enl/Y*	0.09	0.14	0.07	0.04	0.03	0.04	0.05	0.05	0.05	0.05
Foreign receivables	*Wnnb_e/Y*	0.13	0.31	0.35	0.36	0.37	0.43	0.56	0.70	0.82	0.90
Bond debt	*Wbd_os_z/Y*	0.06	0.13	0.14	0.13	0.10	-0.18	-0.46	-0.65	-0.76	-0.82
						Percent					
Capital intensity	*fKn/fX*	0.00	-0.04	-0.10	-0.15	-0.17	-0.19	-0.14	-0.11	-0.09	-0.07
Labour intensity	*hq/fX*	0.00	0.00	-0.04	-0.05	-0.06	-0.04	-0.04	-0.04	-0.04	-0.04
User cost	*uim*	-0.02	-0.04	-0.07	-0.09	-0.09	-0.07	-0.04	-0.01	0.01	0.02
Wage	*Ina*	-0.02	-0.06	-0.09	-0.12	-0.13	-0.06	0.06	0.15	0.19	0.20
Consumption price	*pcp*	-0.02	-0.04	-0.06	-0.08	-0.09	-0.09	-0.06	-0.02	0.01	0.02
Terms of trade	*bpe*	-0.02	-0.03	-0.05	-0.06	-0.06	-0.06	-0.03	-0.01	0.00	0.01
						Percentage-point					
Consumption ratio	*bcp*	0.02	0.02	0.00	0.02	0.05	0.08	0.08	0.08	0.08	0.08
Wage ratio	*byw*	0.01	0.01	-0.01	-0.02	-0.02	0.03	0.06	0.07	0.07	0.07

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 through the ***wage-driven crowding out***.? It may be noted that output per man hour increases in the long term as the higher efficiency of machines induces the substitute of machinery 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 and improves in the long run.

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



14. Productivity - efficiency of all factors

Here, the efficiency of capital and labor is increased and the demand for both factors falls. 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 labor and capital.

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

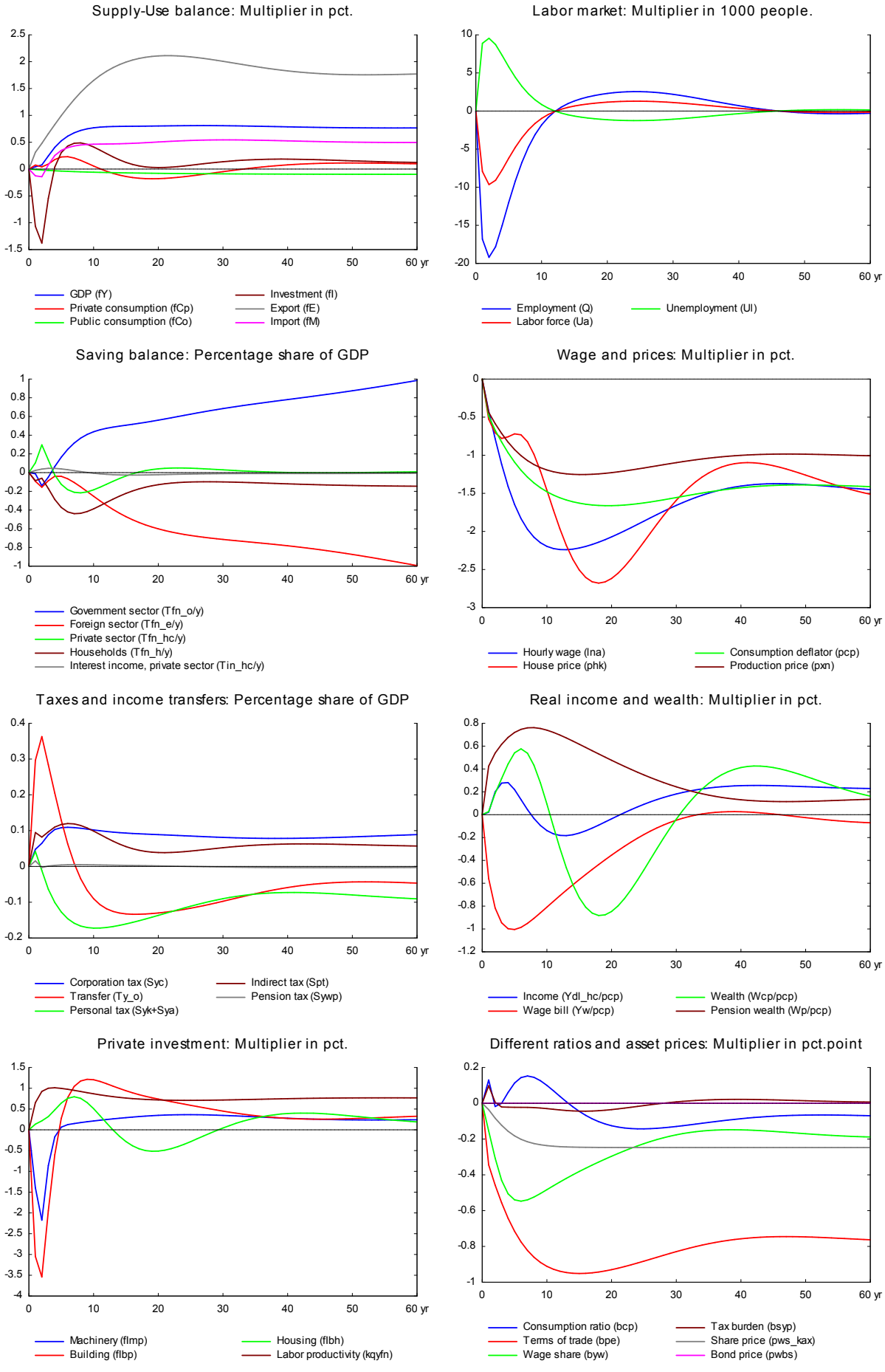
		1. yr	2. yr	3. yr	4. yr	5. yr	10. yr	15. yr	20. yr	25. yr	30. yr
						Million 2005-kr.					
Priv. consumption	*fCp*	388	157	647	1498	2098	1309	-697	-1435	-1054	-127
Pub. consumption	*fCo*	-31	-69	-148	-216	-270	-451	-561	-653	-739	-819
Investment	*fI*	-4146	-5304	-2114	86	1130	1945	663	44	221	648
Export	*fE*	2830	4458	6246	7986	9759	17469	22675	25973	28068	29403
Import	*fM*	-1075	-1308	1040	2807	3832	5690	6200	6973	7946	8824
GDP	*fY*	138	517	3380	6201	8435	13905	15148	16175	17705	19368
						1000 Persons					
Employment	*Q*	-17.61	-20.29	-18.85	-15.87	-12.61	-1.57	1.14	1.64	1.98	2.02
Unemployment	*Ul*	10.51	11.37	10.39	8.68	6.86	0.81	-0.64	-0.91	-1.10	-1.12
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.16	-0.24	-0.14	-0.02	0.08	0.37	0.42	0.46	0.51	0.58
Priv. saving surplus	*Tfn_hc/Y*	0.24	0.37	0.19	0.01	-0.10	-0.22	-0.06	0.03	0.04	0.02
Balance of payments	*Enl/Y*	0.08	0.14	0.05	-0.01	-0.02	0.16	0.36	0.49	0.55	0.60
Foreign receivables	*Wnnb_e/Y*	0.55	0.88	0.95	0.94	0.93	1.25	2.45	4.14	5.95	7.71
Bond debt	*Wbd_os_z/Y*	0.41	0.69	0.81	0.81	0.71	-0.68	-2.44	-4.09	-5.71	-7.34
						Percent					
Capital intensity	*fKn/fX*	-0.13	-0.29	-0.51	-0.69	-0.81	-0.99	-0.98	-1.00	-1.04	-1.04
Labour intensity	*hq/fX*	-0.69	-0.85	-0.99	-1.07	-1.10	-1.07	-1.04	-1.03	-1.02	-1.02
User cost	*uim*	-0.44	-0.59	-0.73	-0.84	-0.93	-1.16	-1.21	-1.19	-1.15	-1.09
Wage	*lna*	-0.36	-0.73	-1.09	-1.39	-1.65	-2.21	-2.23	-2.13	-1.98	-1.81
Consumption price	*pcp*	-0.45	-0.63	-0.79	-0.94	-1.07	-1.47	-1.62	-1.66	-1.64	-1.59
Terms of trade	*bpe*	-0.33	-0.44	-0.54	-0.63	-0.70	-0.89	-0.93	-0.91	-0.88	-0.84
						Percentage-point					
Consumption ratio	*bcp*	0.02	-0.06	-0.05	0.02	0.09	0.13	-0.01	-0.10	-0.12	-0.10
Wage ratio	*byw*	-0.14	-0.29	-0.42	-0.50	-0.54	-0.49	-0.39	-0.32	-0.27	-0.23

Higher efficiency of labor and capital means that both 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 reversed quickly. In the long term, capital intensity and labor intensity fall by approximately 1 percent, excluding the housing sector.

There is a small positive impact on private consumption in the long run, due to the positive impact on 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.

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



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*	-1582	12360	17257	19799	20590	19315	19405	19825	18739	16271
Pub. consumption	*fCo*	-63	-218	-283	-295	-293	-179	-60	-2	12	2
Investment	*fI*	7069	18525	23663	24651	24675	18797	12881	10709	10055	9718
Export	*fE*	2622	3254	3946	4052	3929	-1674	-9278	-13604	-13859	-11206
Import	*fM*	3307	14157	17137	17203	16552	10661	6313	4427	3676	3540
GDP	*fY*	4515	19298	26768	30221	31519	24966	16298	12311	11128	11109
						1000 Persons					
Employment	*Q*	2.32	15.00	25.63	32.39	35.77	24.47	5.13	-4.65	-7.36	-6.85
Unemployment	*Ul*	-1.38	-8.85	-14.67	-18.25	-19.98	-13.40	-2.71	2.63	4.09	3.79
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.34	-0.20	0.32	0.61	0.76	0.52	0.02	-0.16	-0.14	-0.03
Priv. saving surplus	*Tfn_hc/Y*	-0.65	-1.20	-1.81	-2.10	-2.20	-1.63	-1.03	-0.84	-0.77	-0.72
Balance of payments	*Enl/Y*	-0.31	-1.40	-1.50	-1.49	-1.44	-1.11	-1.01	-1.00	-0.91	-0.75
Foreign receivables	*Wnnb_e/Y*	-1.13	-3.14	-4.76	-6.19	-7.47	-12.02	-14.80	-17.04	-18.75	-19.64
Bond debt	*Wbd_os_z/Y*	2.81	2.11	1.21	0.24	-0.71	-3.66	-2.90	-0.29	2.62	5.22
						Percent					
Capital intensity	*fKn/fX*	-0.19	-0.69	-0.74	-0.57	-0.29	1.44	2.45	2.75	2.72	2.56
Labour intensity	*hq/fX*	-0.23	-0.58	-0.63	-0.57	-0.51	-0.36	-0.42	-0.49	-0.52	-0.52
User cost	*uim*	-5.27	-5.38	-5.37	-5.31	-5.22	-4.63	-4.33	-4.35	-4.54	-4.76
Wage	*lna*	-0.02	0.01	0.29	0.73	1.27	3.98	5.20	5.12	4.51	3.83
Consumption price	*pcp*	-0.06	-0.48	-0.78	-0.96	-1.04	-0.82	-0.53	-0.57	-0.81	-1.14
Terms of trade	*bpe*	-0.07	-0.15	-0.16	-0.11	-0.04	0.47	0.74	0.74	0.60	0.42
						Percentage-point					
Consumption ratio	*bcp*	0.16	0.32	0.72	0.97	1.05	0.68	0.36	0.29	0.25	0.18
Wage ratio	*byw*	-0.07	-0.03	0.25	0.59	0.92	1.92	2.05	1.91	1.76	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 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 the ***wage-driven crowding out*** brings employment back to the baseline.?

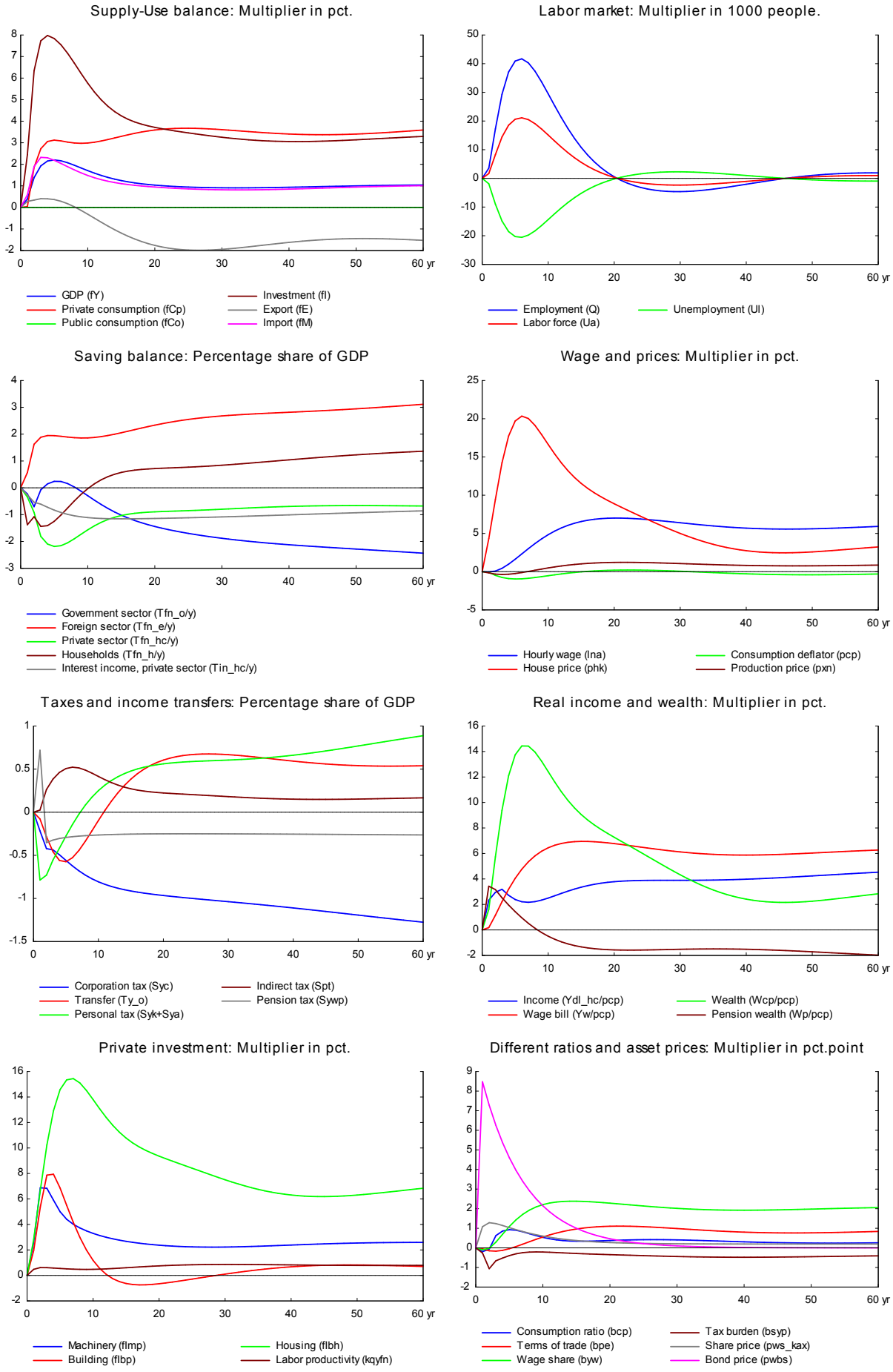
Private consumption increases permanently due to the positive ***real wage effect***.? More basically, the long term positive effect on disposable income and private consumption reflects that the interest rate after tax is lower than the growth rate implying that lower private net assets do not harm 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*	1228	700	480	280	145	-58	-87	-116	-137	-134
Pub. consumption	*fCo*	-9	-8	-3	-1	1	3	2	0	-1	-2
Investment	*fI*	457	600	259	81	1	-144	-98	-45	-25	-7
Export	*fE*	-52	-92	-117	-140	-164	-204	-106	27	119	154
Import	*fM*	690	457	173	14	-62	-149	-96	-42	-10	12
GDP	*fY*	933	736	446	212	54	-237	-177	-78	-22	11
						1000 Persons					
Employment	*Q*	0.73	0.87	0.69	0.43	0.19	-0.41	-0.32	-0.11	0.02	0.08
Unemployment	*Ul*	-0.44	-0.49	-0.38	-0.23	-0.09	0.23	0.17	0.06	-0.01	-0.04
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.04	0.03	0.03	0.02	0.01	-0.01	-0.01	-0.01	0.00	0.00
Priv. saving surplus	*Tfn_hc/Y*	-0.08	-0.07	-0.04	-0.02	-0.01	0.01	0.01	0.00	0.00	0.00
Balance of payments	*Enl/Y*	-0.04	-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	-0.12	-0.09	-0.08	-0.08	-0.07	-0.06
Bond debt	*Wbd_os_z/Y*	-0.05	-0.08	-0.10	-0.10	-0.10	-0.05	0.01	0.04	0.05	0.04
						Percent					
Capital intensity	*fKn/fX*	-0.04	-0.02	0.00	0.01	0.02	0.02	0.01	0.00	-0.01	-0.01
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*	0.00	0.01	0.02	0.02	0.02	0.01	0.00	-0.01	-0.01	-0.01
Wage	*lna*	0.01	0.02	0.04	0.05	0.05	0.03	0.00	-0.02	-0.02	-0.02
Consumption price	*pcp*	0.00	0.01	0.01	0.02	0.02	0.02	0.00	0.00	-0.01	-0.01
Terms of trade	*bpe*	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	-0.01	-0.01
						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 ratio	*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.

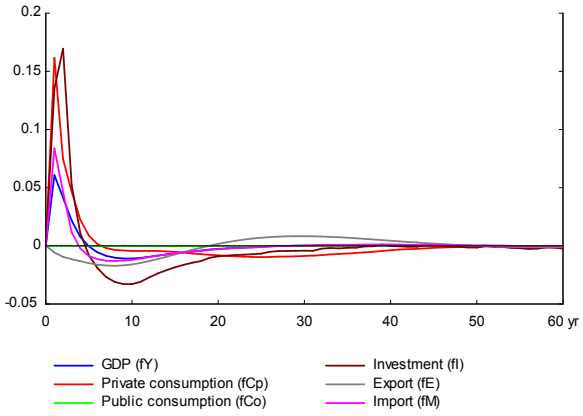
The crowding out process is illustrated by the fluctuation in unemployment. Unemployment falls initially and this pushes up the wage rate slightly. In year 2, the consumption shock disappears and the higher wage pulls unemployment up. Unemployment has to be above the baseline for a while in order to 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.

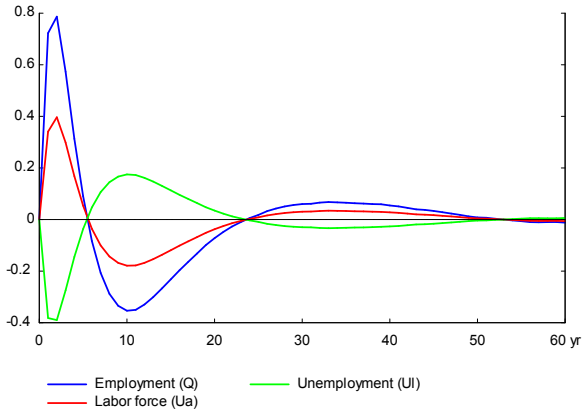
Figure 16. The effect of a temporary exogenous increase in private consumption

Supply-Use balance: Multiplier in pct.



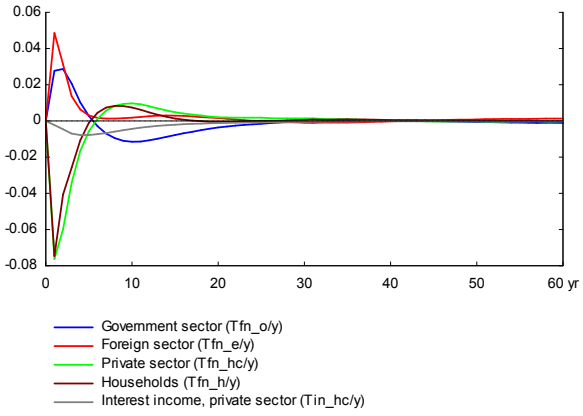
GDP (fY)
Private consumption (fCp)
Public consumption (fCo)
Investment (fI)
Export (fE)
Import (fM)

Labor market: Multiplier in 1000 people.



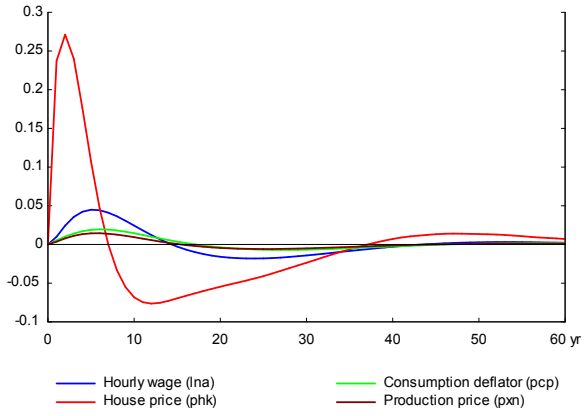
Employment (Q)
Labor force (Ua)
Unemployment (Ul)

Saving balance: Percentage share of GDP



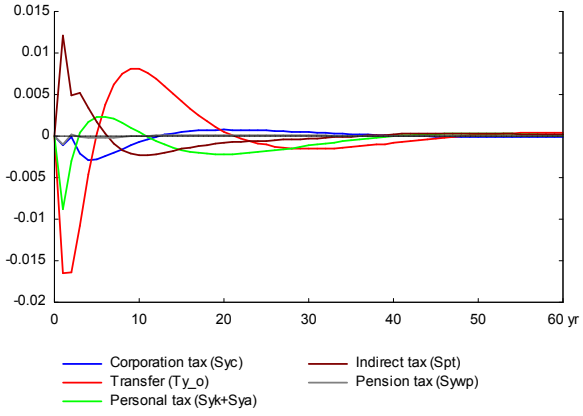
Government sector (Tfn_o/y)
Foreign sector (Tfn_e/y)
Private sector (Tfn_hc/y)
Households (Tfn_h/y)
Interest income, private sector (Tin_hc/y)

Wage and prices: Multiplier in pct.



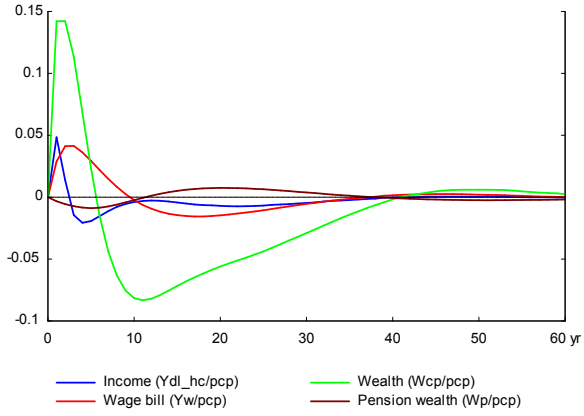
Hourly wage (lna)
House price (phk)
Consumption deflator (pcp)
Production price (pxn)

Taxes and income transfers: Percentage share of GDP



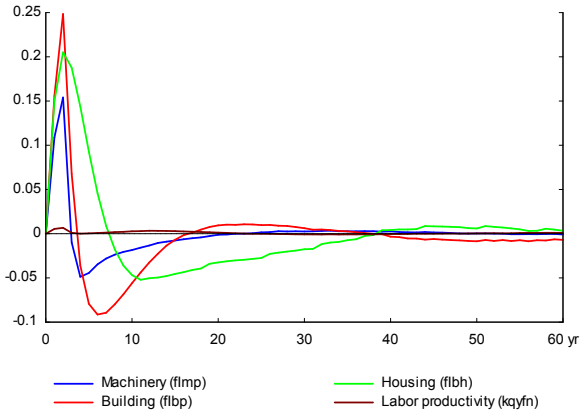
Corporation tax (Syc)
Transfer (Ty_o)
Personal tax (Syk+Sya)
Indirect tax (Spt)
Pension tax (Sywp)

Real income and wealth: Multiplier in pct.



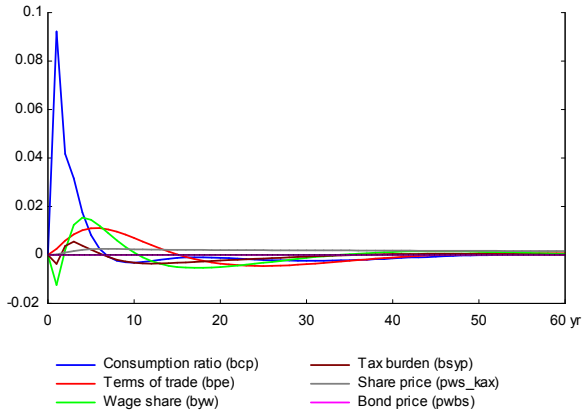
Income (Ydl_hc/pcp)
Wage bill (Yw/pcp)
Wealth (Wcp/pcp)
Pension wealth (Wp/pcp)

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)

17. Hourly wages

Here, we 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*	594	-299	590	1208	1616	2129	1459	567	-184	-659
Pub. consumption	*fCo*	18	29	30	24	21	15	13	8	0	-8
Investment	*fI*	-309	-968	-1022	-456	-65	487	215	-157	-341	-329
Export	*fE*	-1973	-2431	-2809	-3127	-3383	-3645	-2993	-1910	-733	253
Import	*fM*	-311	-1102	-865	-462	-268	-235	-496	-597	-490	-264
GDP	*fY*	-1298	-2452	-2168	-1692	-1336	-564	-592	-671	-542	-254
						1000 Persons					
Employment	*Q*	-2.03	-3.92	-4.52	-4.50	-4.28	-3.00	-2.42	-1.90	-1.16	-0.38
Unemployment	*Ul*	1.21	2.26	2.53	2.49	2.36	1.66	1.34	1.05	0.64	0.21
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.08	0.02	-0.18	-0.15	-0.13	-0.08	-0.07	-0.08	-0.08	-0.07
Priv. saving surplus	*Tfn_hc/Y*	-0.07	0.02	0.18	0.11	0.06	-0.05	-0.04	-0.01	0.01	0.02
Balance of payments	*Enl/Y*	0.02	0.04	0.00	-0.04	-0.07	-0.12	-0.11	-0.09	-0.07	-0.05
Foreign receivables	*Wnnb_e/Y*	-0.28	-0.22	-0.21	-0.27	-0.33	-0.77	-1.16	-1.41	-1.54	-1.56
Bond debt	*Wbd_os_z/Y*	-0.24	-0.22	-0.04	0.11	0.23	0.65	0.92	1.15	1.33	1.42
						Percent					
Capital intensity	*fKn/fX*	0.12	0.18	0.15	0.13	0.11	0.10	0.11	0.09	0.05	0.00
Labour intensity	*hq/fX*	0.05	0.05	0.02	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
User cost	*uim*	0.33	0.32	0.30	0.28	0.27	0.19	0.12	0.05	-0.01	-0.03
Wage	*Ina*	1.14	1.05	0.95	0.88	0.81	0.50	0.27	0.07	-0.07	-0.14
Consumption price	*pcp*	0.34	0.35	0.34	0.33	0.33	0.26	0.18	0.09	0.02	-0.03
Terms of trade	*bpe*	0.25	0.24	0.22	0.21	0.20	0.14	0.09	0.03	-0.01	-0.03
						Percentage-point					
Consumption ratio	*bcp*	0.07	0.02	-0.12	-0.07	-0.02	0.07	0.07	0.04	0.01	-0.01
Wage ratio	*byw*	0.30	0.27	0.21	0.16	0.13	0.05	0.00	-0.03	-0.04	-0.04

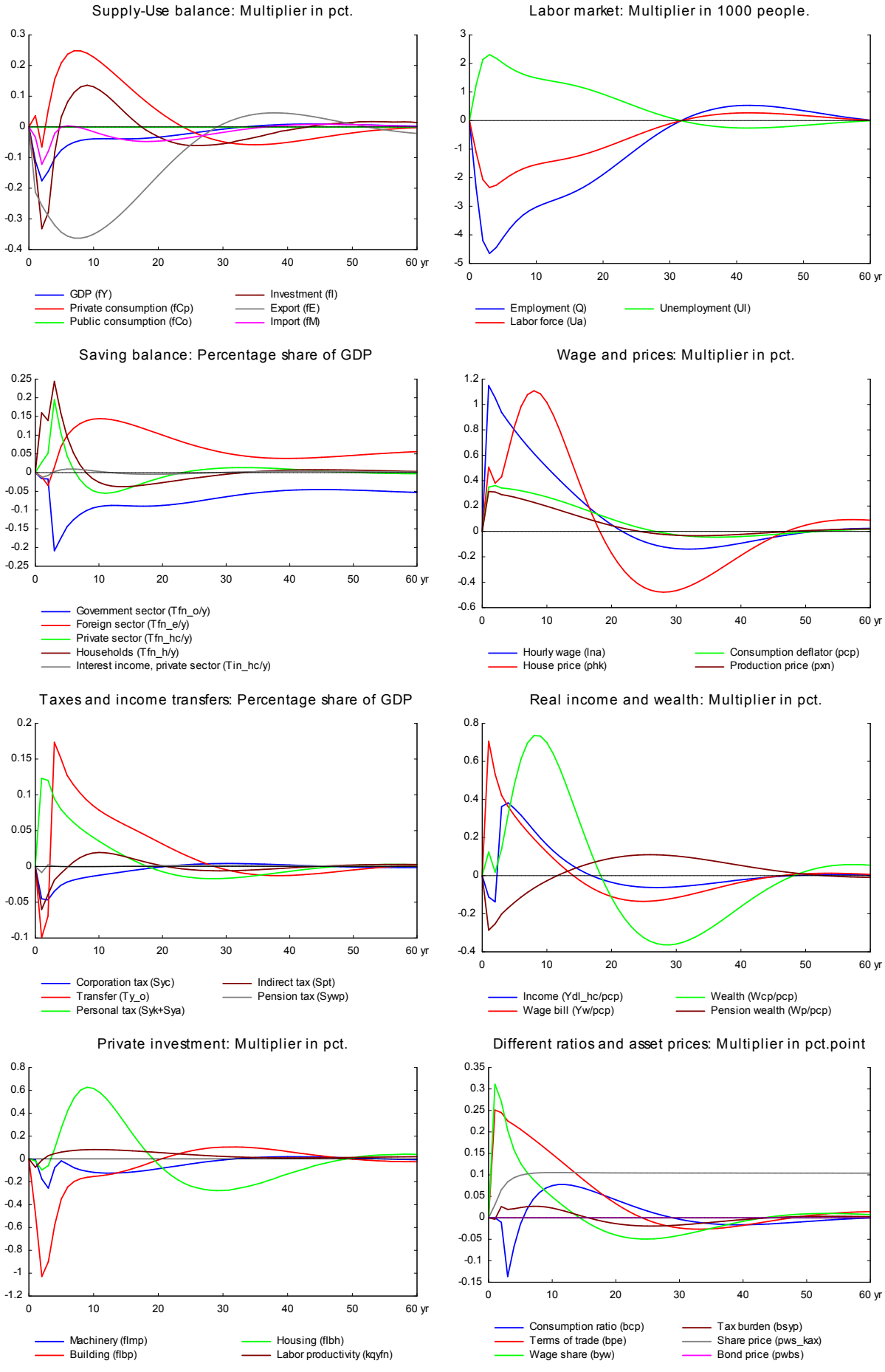
The higher wage has both a positive and negative effect on the economy. The former is due to the positive effect on real wages which raises private consumption. Two years after the wage increase, income transfers from the government increase, because the equation for the rate of income transfers depends on wages with a lag of two years. This further increases disposable income and consumption and worsens public finance.

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 ***wage-driven crowding out*** returns unemployment and wage 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



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 1.25 percent and the capital tax is temporarily raised by a lump sum of 0.2 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*	-387	-697	-865	-1052	-1192	-1472	-1550	-1600	-1633	-1662
Pub. consumption	*fCo*	895	908	925	940	955	1026	1103	1188	1280	1381
Investment	*fI*	115	78	-248	-422	-506	-520	-347	-232	-192	-177
Export	*fE*	-27	-33	-36	-34	-28	98	279	370	337	221
Import	*fM*	236	117	-85	-201	-250	-193	-39	58	92	92
GDP	*fY*	394	175	-94	-318	-466	-615	-419	-275	-240	-262
						1000 Persons					
Employment	*Q*	0.41	0.39	0.17	-0.07	-0.28	-0.50	-0.10	0.20	0.27	0.21
Unemployment	*Ul*	-0.24	-0.21	-0.09	0.05	0.16	0.28	0.05	-0.11	-0.15	-0.12
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	0.16	0.02	0.01	-0.01	-0.01	-0.02	-0.01	0.00	0.00	0.00
Priv. saving surplus	*Tfn_hc/Y*	-0.18	-0.02	0.00	0.02	0.03	0.04	0.02	0.01	0.01	0.01
Balance of payments	*Enl/Y*	-0.02	-0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Foreign receivables	*Wnnb_e/Y*	-0.04	-0.04	-0.02	0.00	0.02	0.11	0.15	0.17	0.19	0.21
Bond debt	*Wbd_os_z/Y*	-0.15	-0.16	-0.15	-0.14	-0.12	0.00	0.06	0.05	0.02	-0.01
						Percent					
Capital intensity	*fKn/fX*	-0.05	-0.04	-0.03	-0.02	-0.02	-0.06	-0.09	-0.11	-0.11	-0.10
Labour intensity	*hq/fX*	-0.04	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
User cost	*uim*	0.00	0.00	0.01	0.00	0.00	-0.01	-0.02	-0.02	-0.01	-0.01
Wage	*Ina*	0.00	0.01	0.02	0.02	0.01	-0.03	-0.06	-0.05	-0.03	-0.01
Consumption price	*pcp*	0.00	0.00	0.01	0.00	0.00	-0.01	-0.03	-0.03	-0.02	-0.02
Terms of trade	*bpe*	0.00	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.01	0.00
						Percentage-point					
Consumption ratio	*bcp*	0.02	0.00	0.00	-0.02	-0.03	-0.04	-0.03	-0.03	-0.03	-0.03
Wage ratio	*byw*	-0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01

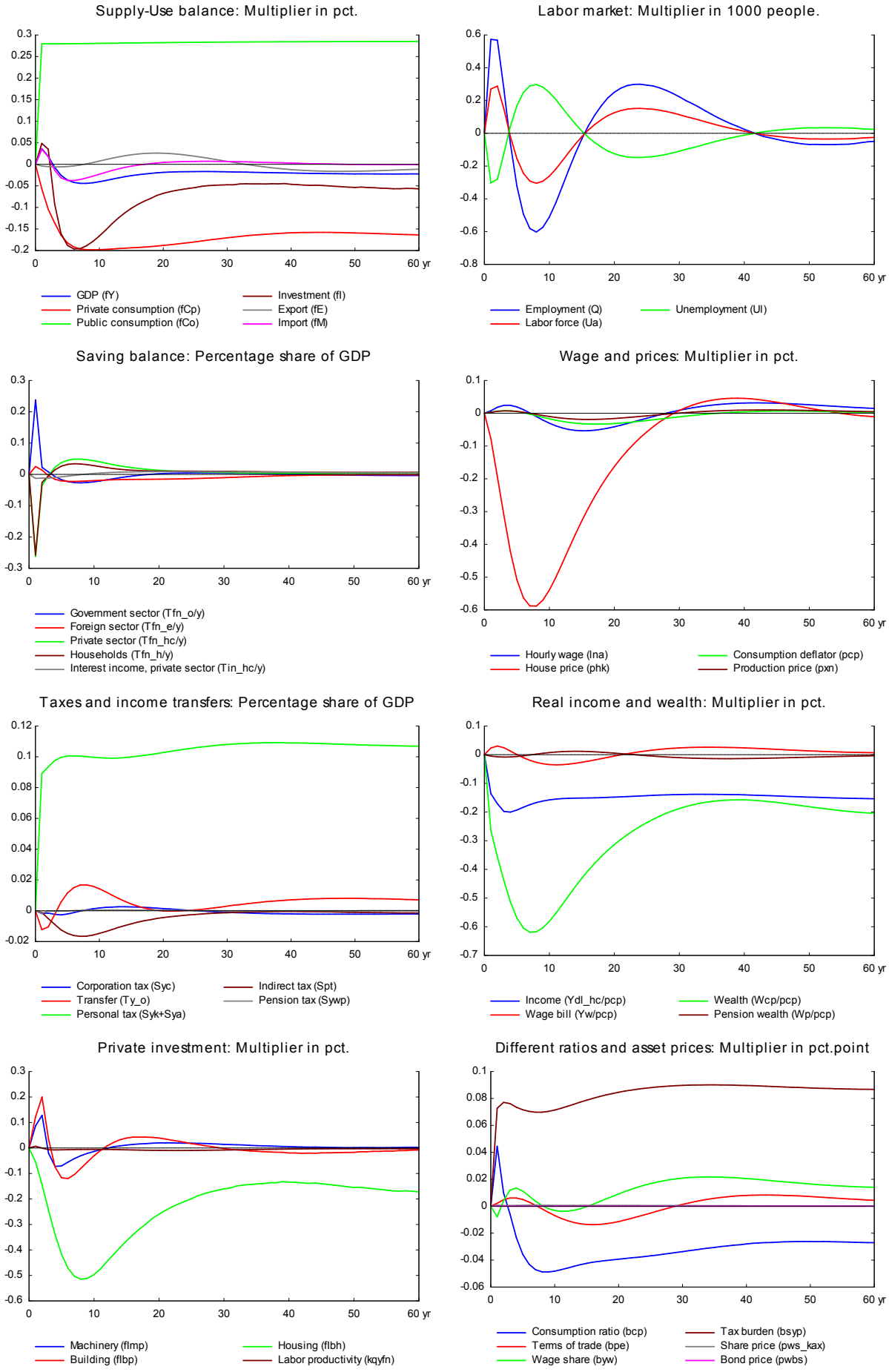
In contrast to the unfinanced experiment in section 1, the long-term effect on government debt is now zero. There are two opposing effects - expansionary and contractionary effects. The former is due to the increase in public expenditures that increases domestic demand, production and employment. The 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 further 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 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. For example, the outcome of the unfinanced shock in section 1 is equivalent to the outcome of an increase in public purchase 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*	1259	2442	3224	3671	3883	3556	2919	2569	2488	2632
Pub. consumption	*fCo*	-12	-27	-38	-45	-49	-55	-57	-64	-75	-86
Investment	*fI*	533	1453	2105	2411	2554	2179	1459	1189	1247	1449
Export	*fE*	192	442	703	975	1251	2478	3542	4643	5720	6621
Import	*fM*	786	1659	2193	2431	2528	2346	2167	2339	2707	3130
GDP	*fY*	1177	2611	3726	4480	4989	5653	5535	5826	6479	7268
						1000 Persons					
Employment	*Q*	1.05	2.75	4.43	5.83	6.90	8.66	8.32	8.38	8.87	9.38
Unemployment	*Ul*	5.34	3.95	3.01	2.26	1.68	0.74	0.93	0.89	0.62	0.34
						Percent of GDP					
Pub. budget balance	*Tfn_o/Y*	-0.17	-0.14	-0.09	-0.04	-0.01	0.02	-0.01	-0.03	-0.02	-0.01
Priv. saving surplus	*Tfn_hc/Y*	0.13	0.04	-0.04	-0.10	-0.13	-0.12	-0.05	-0.01	0.00	0.00
Balance of payments	*Enl/Y*	-0.05	-0.10	-0.13	-0.15	-0.15	-0.10	-0.06	-0.04	-0.02	-0.01
Foreign receivables	*Wnnb_e/Y*	-0.05	-0.16	-0.30	-0.44	-0.57	-1.02	-1.16	-1.16	-1.09	-0.98
Bond debt	*Wbd_os_z/Y*	0.16	0.27	0.34	0.36	0.36	0.21	0.17	0.21	0.23	0.19
						Percent					
Capital intensity	*fKn/fX*	-0.06	-0.12	-0.15	-0.16	-0.16	-0.05	0.00	-0.01	-0.04	-0.07
Labour intensity	*hq/fX*	-0.03	-0.05	-0.06	-0.05	-0.05	-0.02	-0.02	-0.02	-0.02	-0.02
User cost	*uim*	-0.04	-0.07	-0.10	-0.11	-0.13	-0.17	-0.20	-0.23	-0.26	-0.27
Wage	*lna*	-0.08	-0.22	-0.32	-0.39	-0.43	-0.54	-0.61	-0.70	-0.77	-0.78
Consumption price	*pcp*	-0.04	-0.08	-0.11	-0.14	-0.16	-0.22	-0.26	-0.32	-0.36	-0.38
Terms of trade	*bpe*	-0.03	-0.06	-0.08	-0.09	-0.10	-0.13	-0.16	-0.18	-0.20	-0.21
						Percentage-point					
Consumption ratio	*bcp*	-0.11	-0.06	0.00	0.05	0.08	0.08	0.03	0.00	-0.01	-0.02
Wage ratio	*byw*	-0.04	-0.09	-0.11	-0.11	-0.11	-0.10	-0.11	-0.12	-0.12	-0.12

Compared to section 10, where labor supply increases without changes 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