1 Benchmark Simulations with the EURACE Model

2 Simulation results

2.1 Transient period

Before we show the benchmark results, we show a transient run for the default parameter settings. Figure 1 shows a simulation of the model for 20 batch runs of 5000 iterations. After approximately 1000 iterations the transient phase settles down to quasi-stable stochastic behavior.

We summarize the data using a box-and-whisker plot in which the dark grey area shows the data between Q1 and Q3 (50% of the data) and the light grey area indicates the outer hinges of the distribution, i.e. 1.5 times the interquartile range (IQR). In Figure 2 the box plots show the distribution for each single run. The outlyers are shown individualy.

[These points need to be written in a paragraph of text:]

- GDP converges to
- The unemployment rate approaches a stable level of 30%.
- Inflation rates are between -5% and $+5\%$ for most periods, but in some periods inflation rates of -20% and $+20\%$ can occur.
- The investment/GDP ratio cycles around 15%.

2.2 Benchmark scenario

In this section we show a more detailed overview of the economy that will serve as our benchmark scenario. We show cross sectional data across the various sectors of the economy (Consumption goods, Investment goods, Credit market), and for the different agent types (Firms, Banks, Households). See Table **??** for a listing of all parameter settings.

Of course there is always a danger of showing too many plots and too much data, but it appears to us essential to do this exercise one time and to show the reader how all the elements of the EURACE system fit together.

In this and all following sections we ommit the transient phase of 1000 periods and show only results for iterations $1001-5000$. All plots show distributional data for 20 batch runs. The results reported here are for an income tax rate of 10%.

Macrodata

We have already shown the general trends pertaining to the macroeconomic data in 1 above. In Figure 3 we show the growth rates of GDP, monthly output, the unemployment rate, and the average wage.

[These points need to be written in a paragraph of text:]

- The GDP growth rate is about $3 - 4\%$ annually.
- Output growth rate is approx. 4%.
- The average wage grows about 3% per year.

Government

For the Government financing we show in Figure 4 the monthly tax revenues, total benefit payments, the monthly budget balance, and the total amount of bond financing.

The growth rate of tax revenues and of benefit payments are approximately equal, but since the level of tax revenues is lower than the unemployment benefit payout there is a monthly budget deficit. This deficit needs to be financed by government bonds, as showns in Fig. 4d.

Firms

For the firms we show in Figure 5 the monthly output, cumulative revenues, number of employees, the actual capital price paid for machinery, and the firm's payment account. The number of employees is 25 on average.

The earnings data and the cumulative revenues show a wide distribution. To show that this is not due to one or two runs in the 20 batch runs, but a general feature of all the runs, we show in 6 the complete set of batch run box plots. This plot makes clear that in each run the distribution across firms of earnings and cumulative revenues is a wide distribution. Whether or not the earnings distribution has power law tails we have not yet investigated.

The firms' financial data are shown in Figure 7. We show total assets, debt and equity, as well as the average debt earnings ratio and the average debt equity ratio (first averaged across firms, then averaged across runs).

Total assets increase, while total debt decreases, so equity is increased. Total earnings stabilize to a level of 50. The debt earnings ratios and the debt equity ratios decrease asymptotically to 0 since debt decreases.

Labour market

From the labour market data we show the average unemployment rate, the unemployment rate for skill level 1 and 5, the average wage and average wage for skill level 1 and 5. Then we show the total number of vacancies, the labour/profit share ratio and the average specific skill level in the economy.

Figure 8 shows that the unemployment rate stabilizes to 32%, but due to the heteregeneity in workers' skill level there are stark differences: the unemployment for skill level 1 is 56% while for skill level 5 it is 14%.

Figure 9 shows that the average labour share ratio converges to 3, which means that the total wage bill is 3 times the profits.

Consumption Goods Market

Figure 10. From the consumption goods market we show data pertaining to: monthly outpu, monthly planned output, quantity sold, totall monthly revenues, the firms' average productivity, and the firms' average productivity progress. This should give a good idea of the production sector. All data are steadily increasing with the average productivity progress of 0.25%.

Credit Market

There are 2 banks in the system. We show the banks' cash, total deposits, the total credit given to firms, its equity, ECB debt, and its total dividend payout. On the credit market we see in Figure 11 that banks deposits are incresing, total credits to firms are converging to a constant levele, and banks' equity is increasing. Furthermore, banks have 0 ECB debt, and are able to pay out positive dividends to the households.

3 Tax rate scenarios

In a first sensitivity analysis we consider four income tax rate scenarios using respectively 5%, 10%, 20% and 25%.

In Figure 12 we show the results for GDP and the unemployment rate across the four tax rate scenarios. If we increase the tax rate the GDP decreases and unemployment increases.

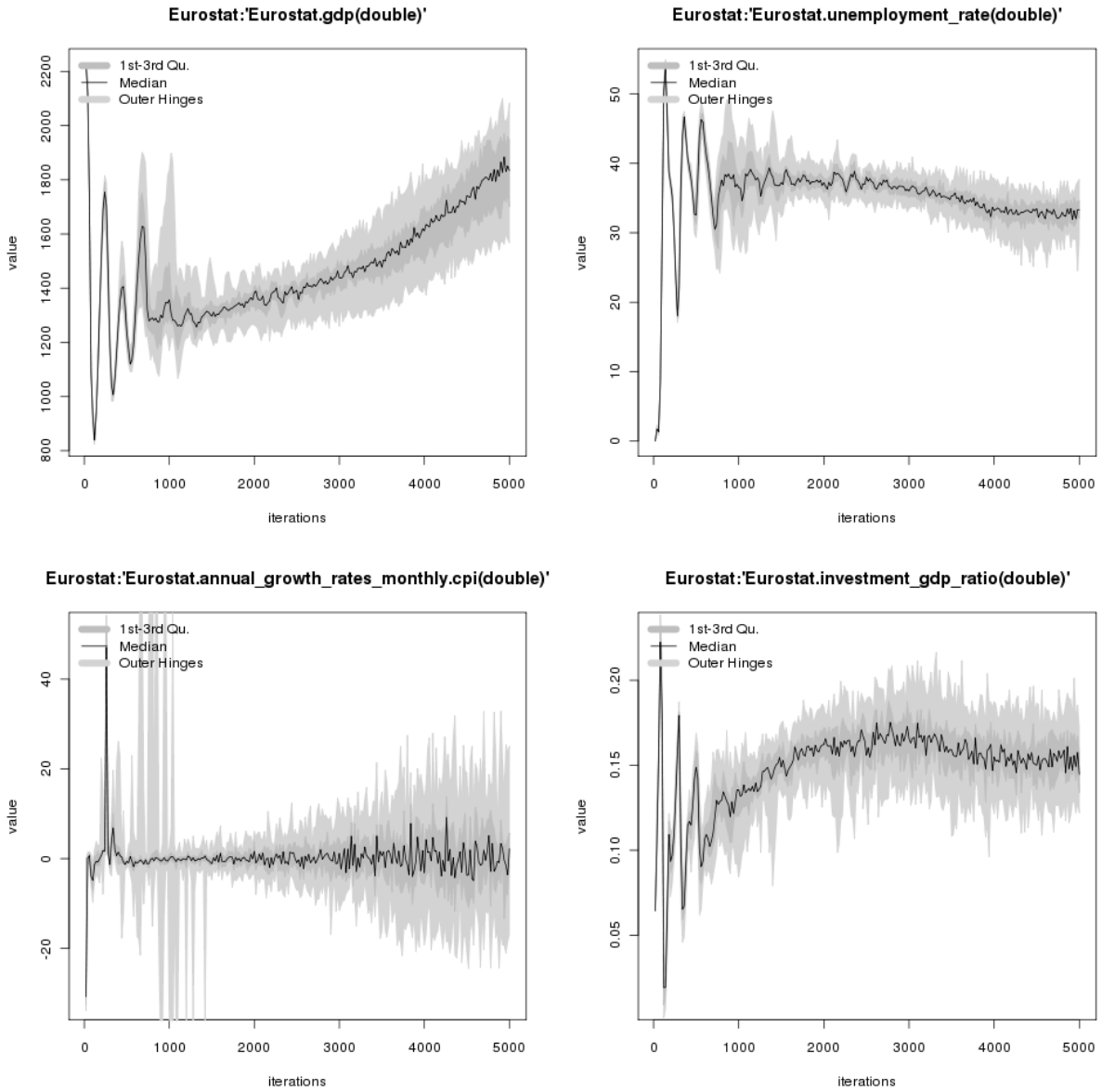

Figure 1: Time series plots for 20 batch runs. (a) GDP, (b) unemployment rate, (c) inflation rate and (d) investment/GDP ratio. Tax rate: 10%.

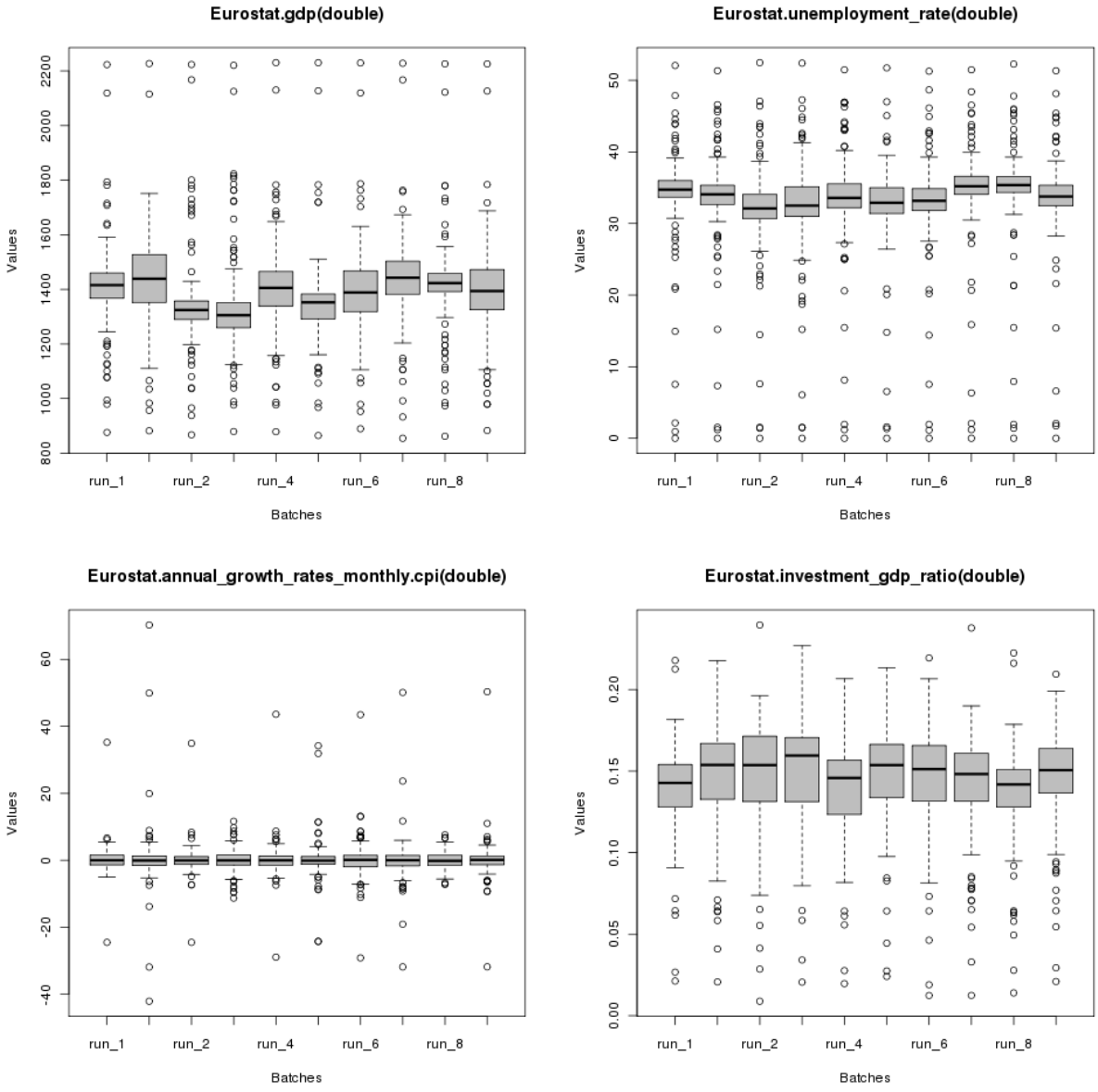

Figure 2: Box plots for separate run of GDP, unemployment rate, inflation rate and investment/GDP ratio. Scenario: tax rate 5%.

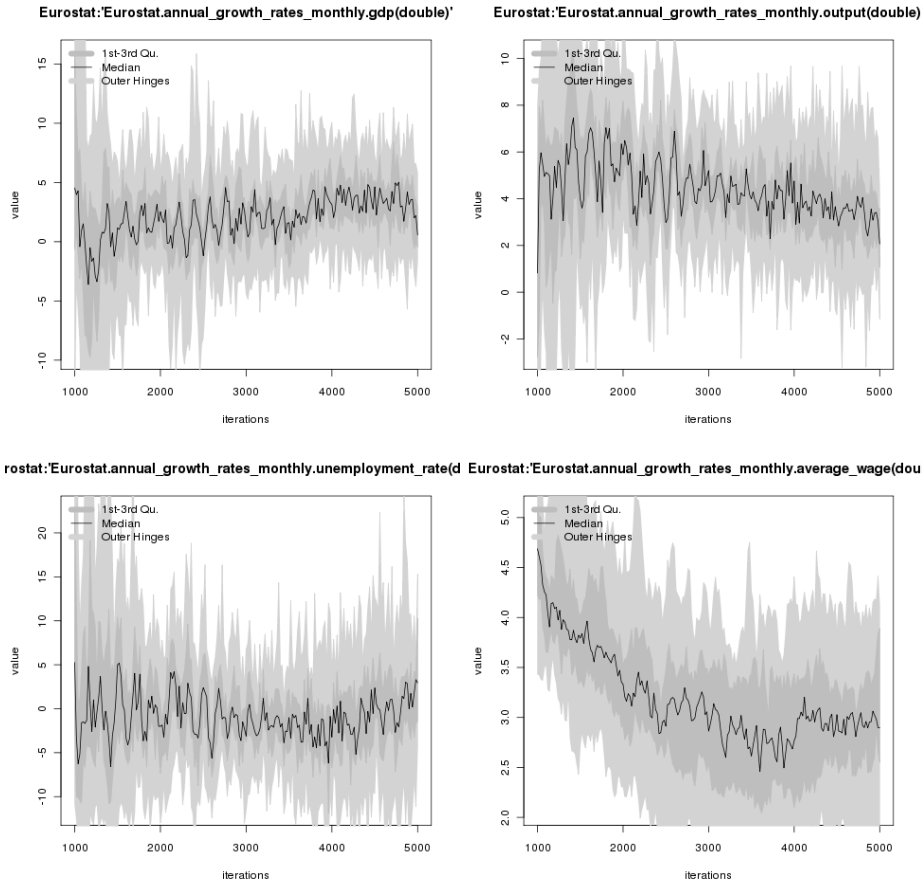

Figure 3: Annual growth rates (with respect to same month in the previous year): GDP, output, unemployment rate and avgerage wage. Tax: 10%.

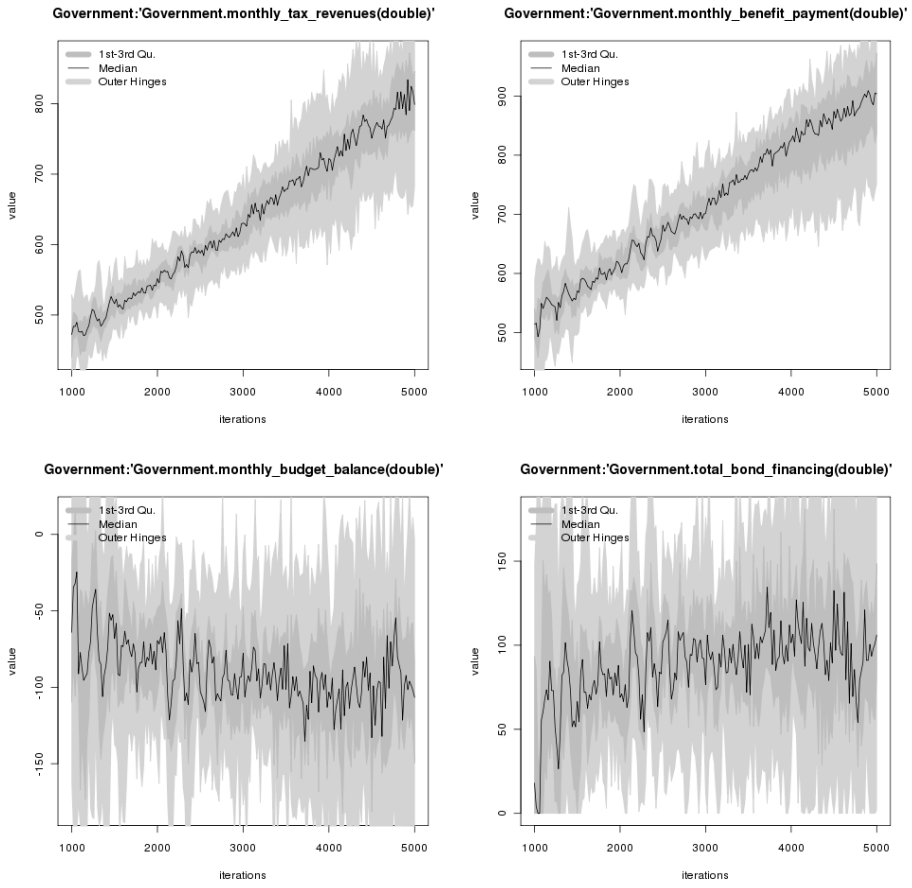

Figure 4: Government finances.

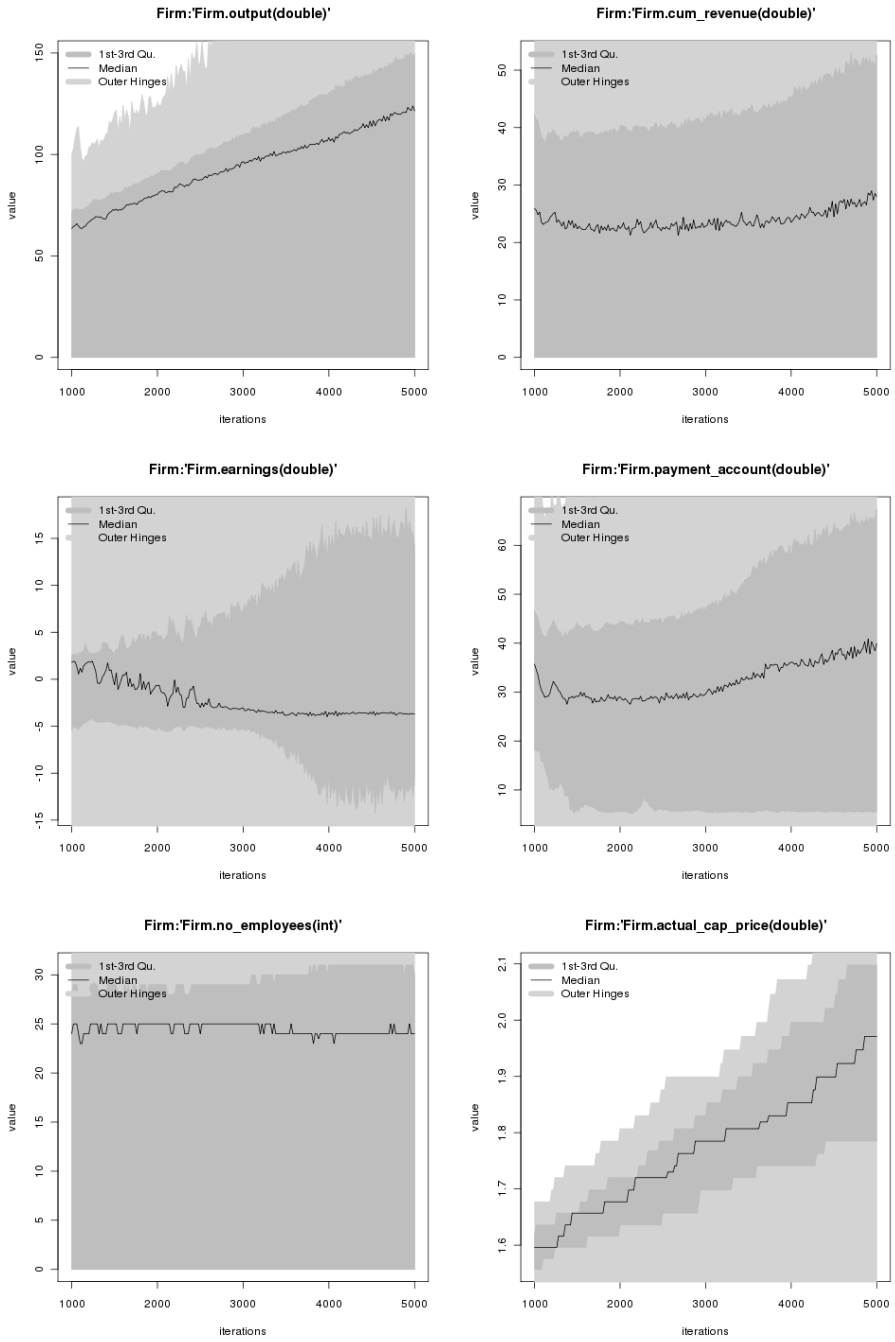

Figure 5: Firm production data.

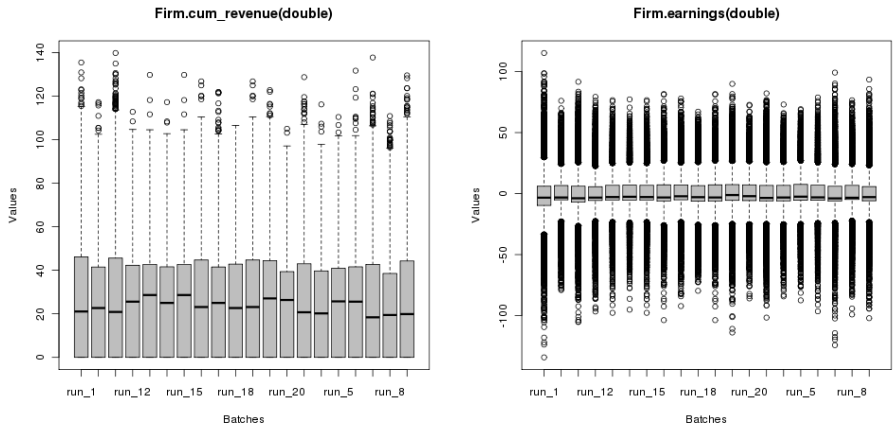

Figure 6: Firm production data, all batch runs.

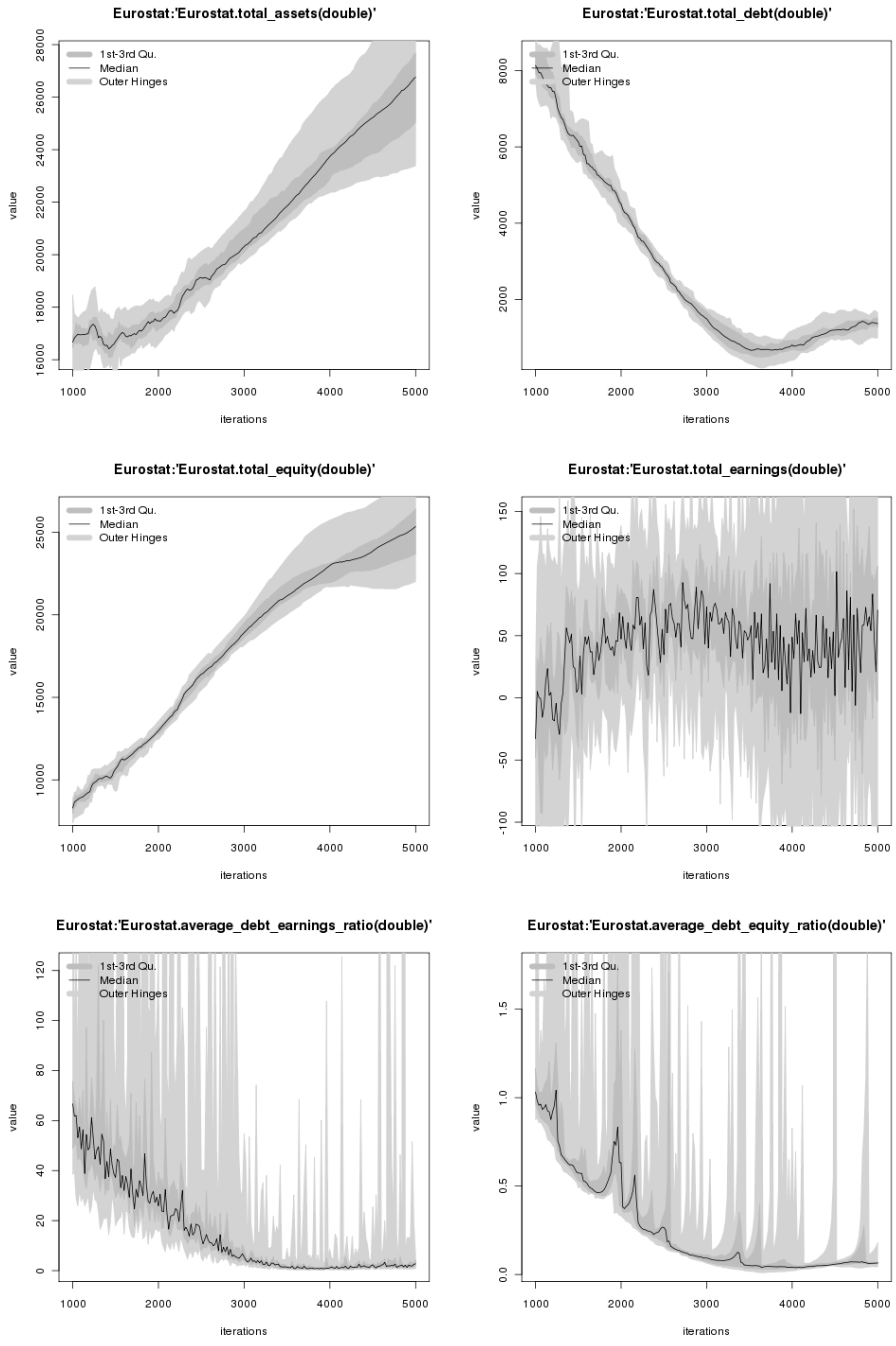

Figure 7: Firm financial data.

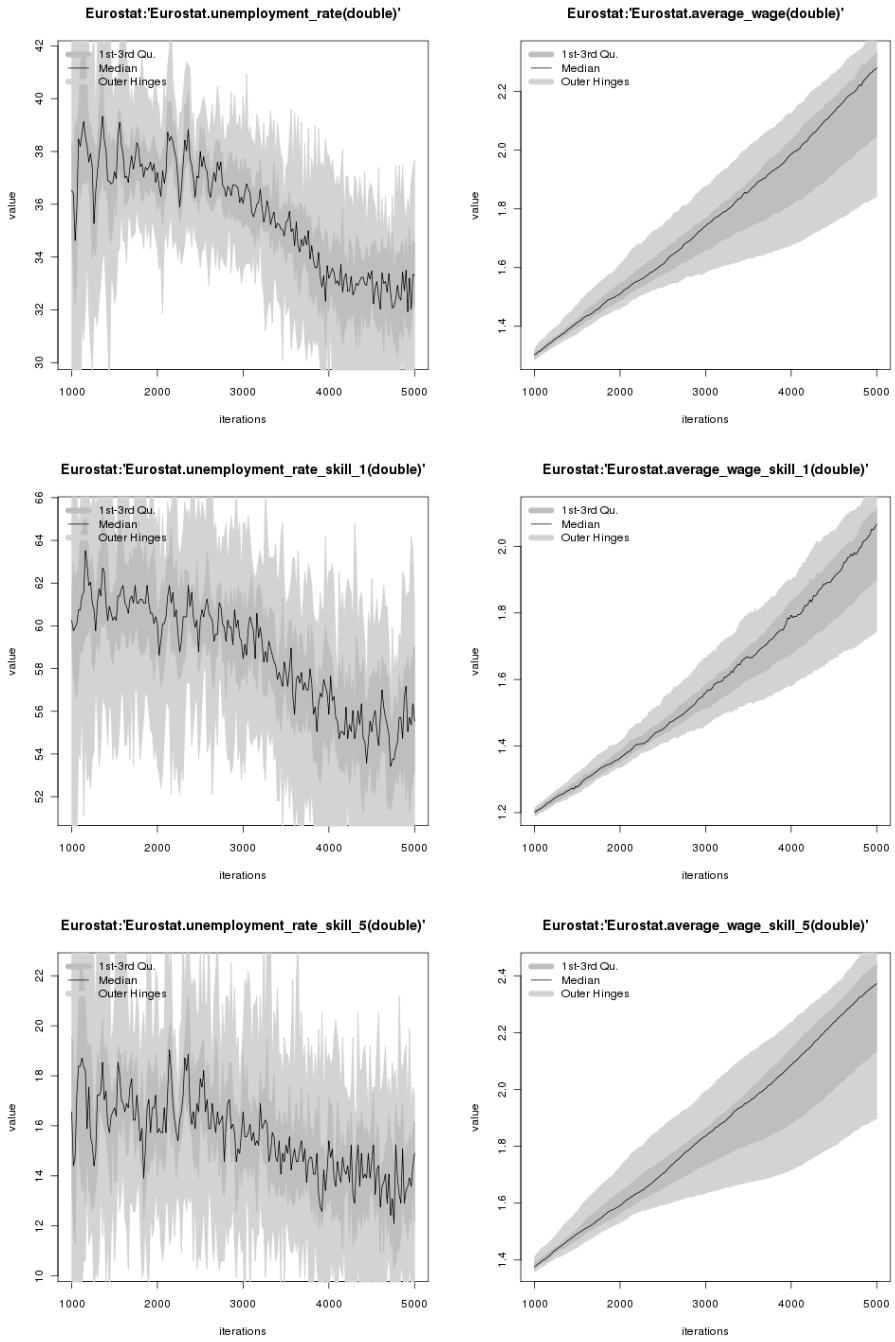

Figure 8: Labour market data.

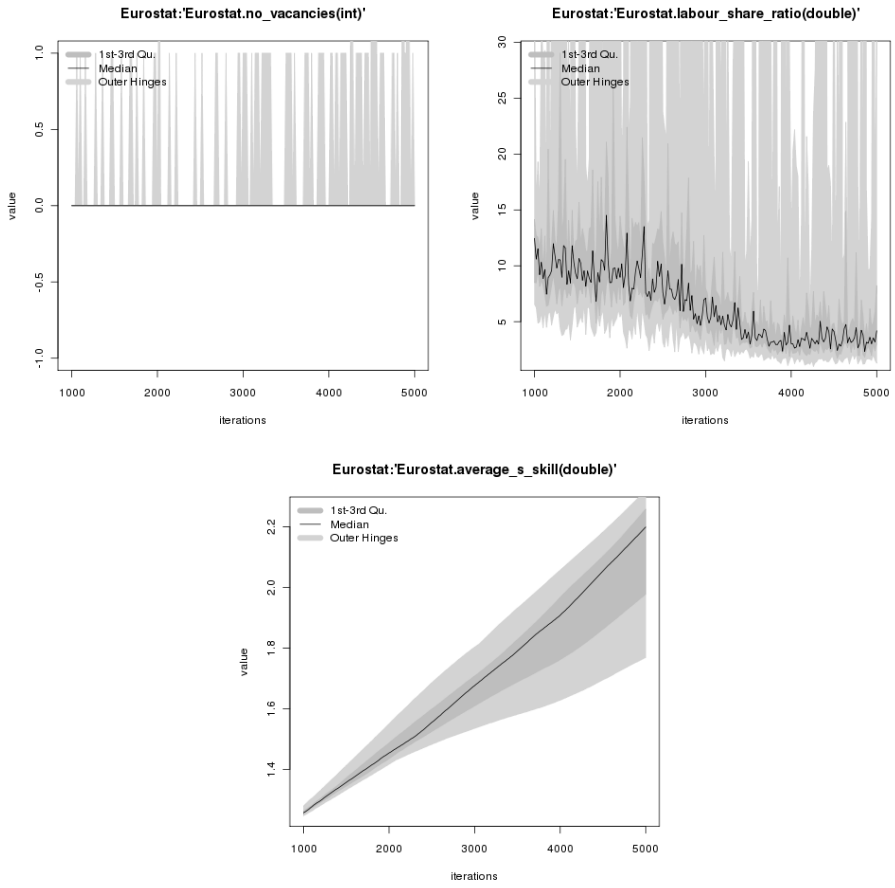

Figure 9: Labour market data (cont).

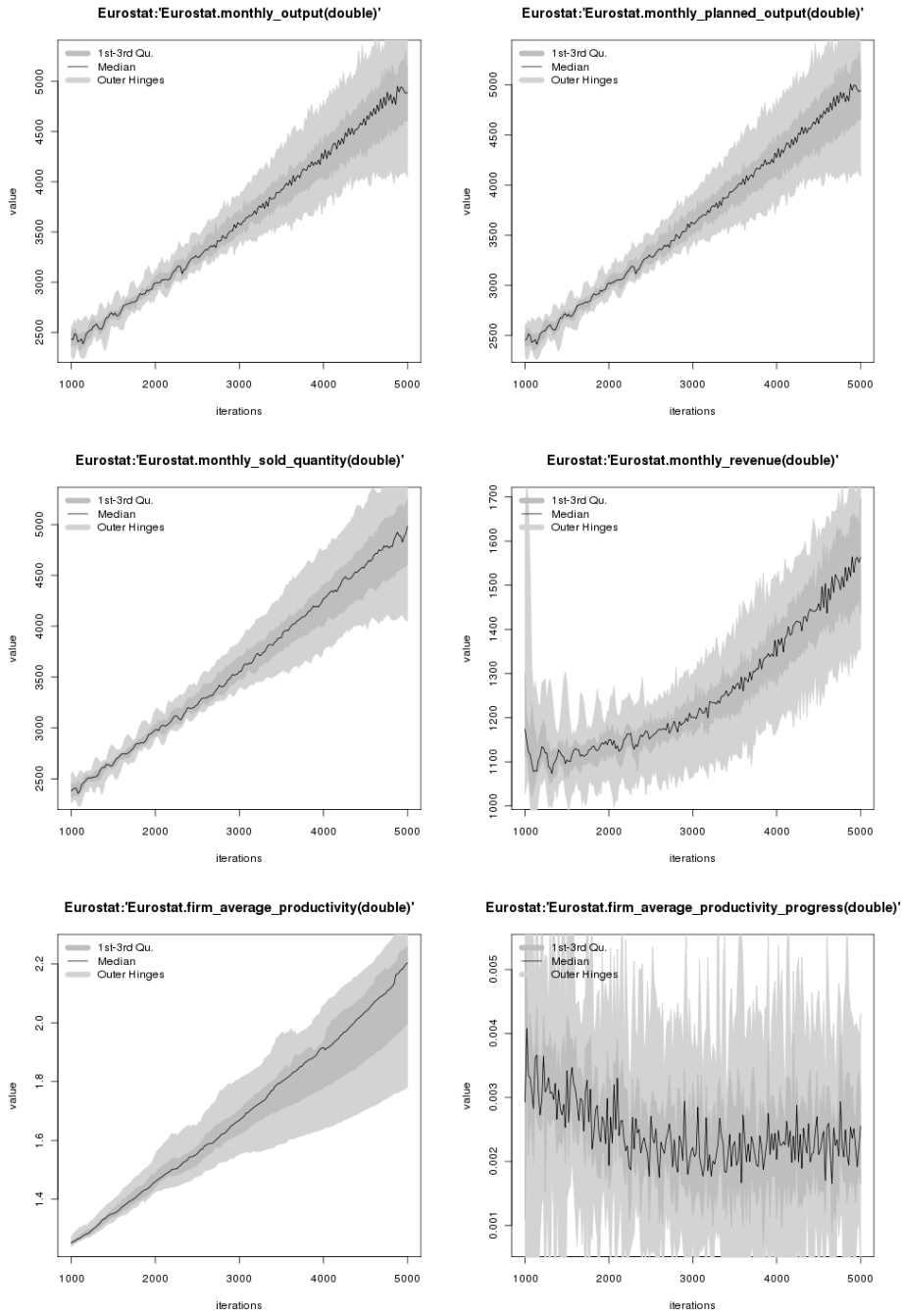

Figure 10: Consumption goods market.

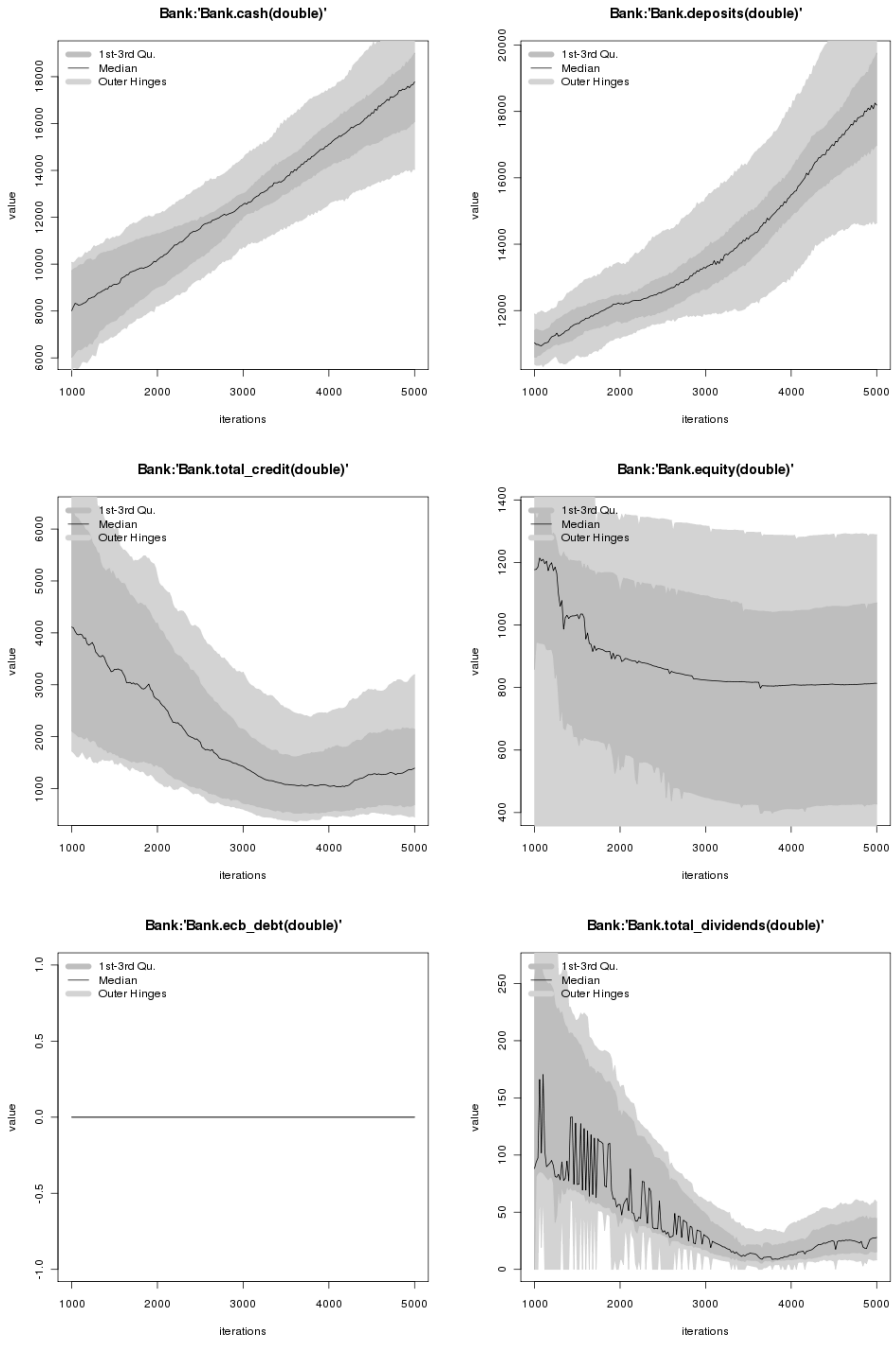

Figure 11: Credit market data.

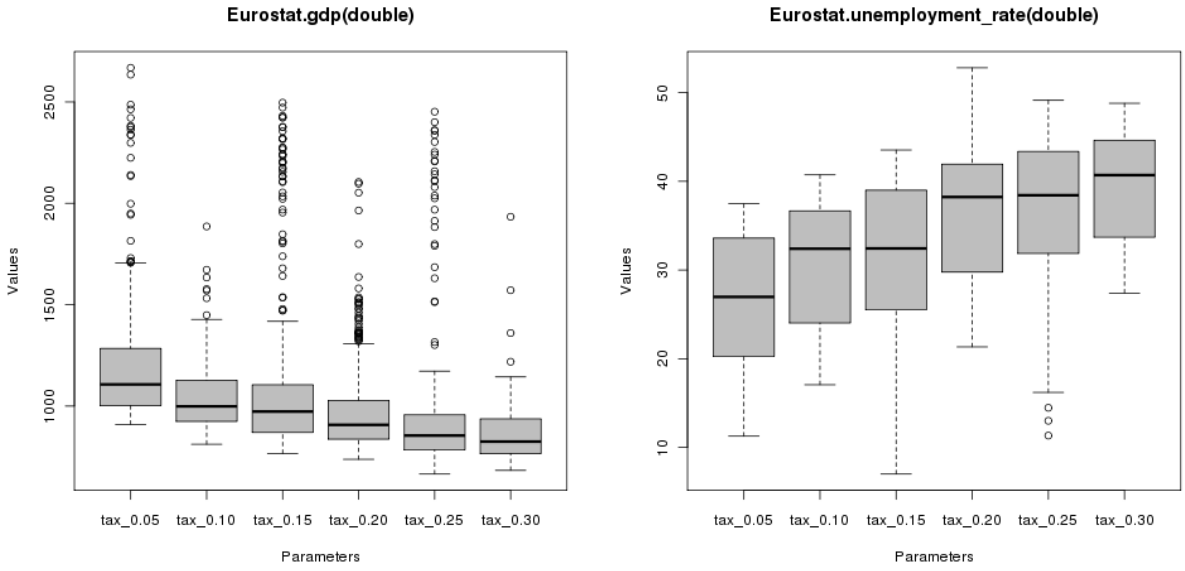

Figure 12: Batch runs for the different tax scenarios. Left panel: GDP; right panel: unemployment rate.