Macroeconomics-Pset1

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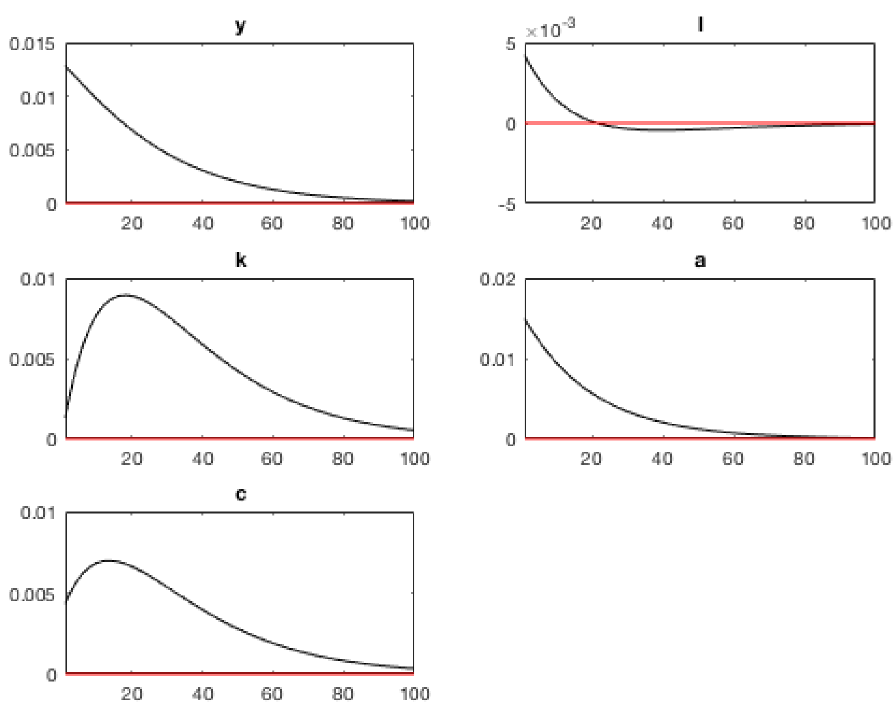
Exercise 2 - Computational Part

Part (i)

Figure 1 plots the IRFs of the variables (note: as the equations make clear, the variables used are scaled by $\bar{A}$) to a one percentage point increase in productivity (rescaled-indeed productivity jumps mode than 1% as the picture makes clear). As productivity jumps up, all the other variables increase despite in a different fashion from each other. Labor jumps up at the beginning as the substitution effect is higher, but then this effect is attenuated by the wealth effect (it even becomes negative) and after 100 periods it returns to the steady state as the two effects equally compensate each other again. Output jumps at the beginning and then declines to the steady state. Consumption and investment have a more smooth pattern: they increase slowly, reach a peak and then decline towards the steady state. Consumption smoothing is the reason of this smoothness. Note that capital peaks a little bit later because of this same reason:

Figure 1: Baseline



Part (ii)

Figure 2 reports the IRFs when φ^{-1} is raised to 10. Recall that φ^{-1} is Fisher labor supply elasticity to a change in salary: when it increases the household is more willing to increase the amount of labor. This implies a higher substitution effect on the supply of labor after a productivity positive shock. This is clear from Figure 2: labor increases more (the scale of the y-axis is different than from Figure 1) as the substitution effect prevails at the beginning and then it follows the same behavior as the baseline. The other variables (y, c, k) follows the same pattern as above although with different values: output jumps up more at the beginning as labor supply is higher, capital and consumption peak at, respectively a slightly lower and higher value than baseline. This is because at the beginning wealth increases more than before as labor supply increases more, so that in order to smooth consumption, the household has to raise consumption (and savings) "faster" than before.

Figure 2: $\varphi^{-1} = 10$

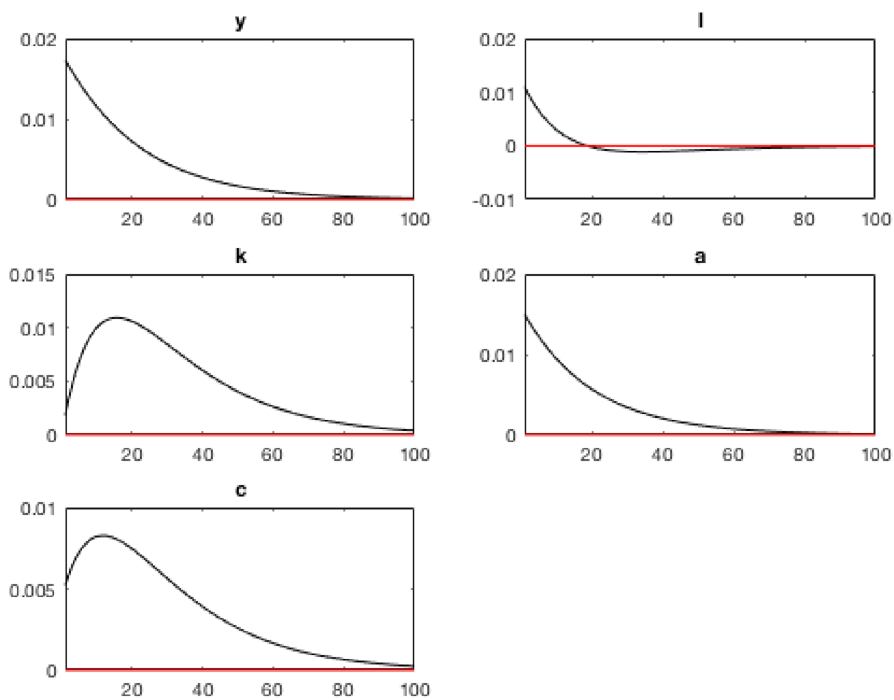
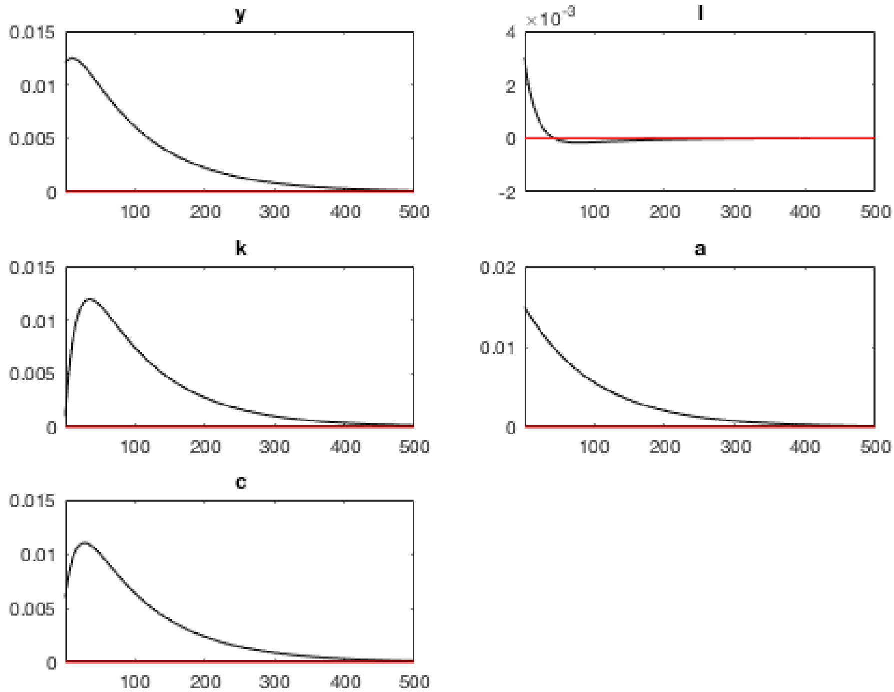


Figure 3 reports the IRFs with $\rho = 0.99$. This change implies more persistence in the AR(1) process for log productivity, which implies that more time is needed before returning to the steady state. Indeed, while in (i) and (ii) it took around 100 periods to return to the steady state, here it takes around 500, as the picture makes clear. The consequences of this more prolonged shock are evident in the behaviour of the variables: the effects on the variables are the same as in baseline but they last longer. It takes around 40 periods rather than 20 for the substitution effect on labor to be compensated bt the wealth effect and consumption smoothing lasts longer, as the pictures for capital and consumption make clear. This holds also for output, even though it does not peak anymore right at the beginning but after some periods : the reason is that in the first ten periods capital increases a little bit more than the decline in productivity growth because of the increased motive for consumption smoothing.

Figure 3: $\rho = 0.99$



Part (iii)

Figure 4 reports the artificial data generated under the baseline calibration for 1000 periods, while Table 1 reports the MATLAB output for moments, correlations and autocorrelations of these simulated variables. Standard deviations for output, consumption, capital, investment and labor are respectively, 2.34%, 1.82%, 2.33%, 5.26%, 0.46%. As we saw in class this reflects the fact that labor does not fluctuate much during the business cycle in the model. Moreover, investment is the more volatile as we saw in the slides. Correlations with output of consumption, capital, investment and labor are respectively 0.9333, 0.8458, 0.8887, 0.6965. Consumption and investment seems more correlated with output than labor. Finally, from the autocorrelation table we get that consumption and investment are highly persistent while labor has a much lower persistence. Output is persistent though not as much as consumption and investment as its persistence is dampened by the low autocorrelation of labor. The reason why we don't get the same values (in particular the lower correlations of labor and output and of capital and output) as King and Rebelo in the slides (a part from the fact that our parametrization is slightly different), is due to the preferences' specification: first, we have to keep $\gamma = 1$ to get balanced growth, so the results hold only for a specific value of relative risk aversion. Moreover, separability between labor and consumption implies that marginal utilities of labor and consumption do not depend on both labor and consumption, which generates "less variation" in the marginal utilities and, therefore in the model (specifically labor next period enters into the Euler equation with non separable preferences).

Table 1: Simulated Variables Moments, Correlations and Autocorrelations

MOMENTS OF SIMULATED VARIABLES

VARIABLE	MEAN	STD. DEV.	VARIANCE	SKEWNESS	KURTOSIS
y	0.905204	0.023356	0.000545	0.237348	0.353857
l	-0.083002	0.004560	0.000021	-0.381310	0.425522
k	2.897785	0.023321	0.000544	0.223316	0.423168
a	-0.008067	0.022669	0.000514	0.170511	0.259799
c	0.665743	0.018220	0.000332	0.254688	0.439317
i	-0.641505	0.052644	0.002771	-0.079751	0.150672

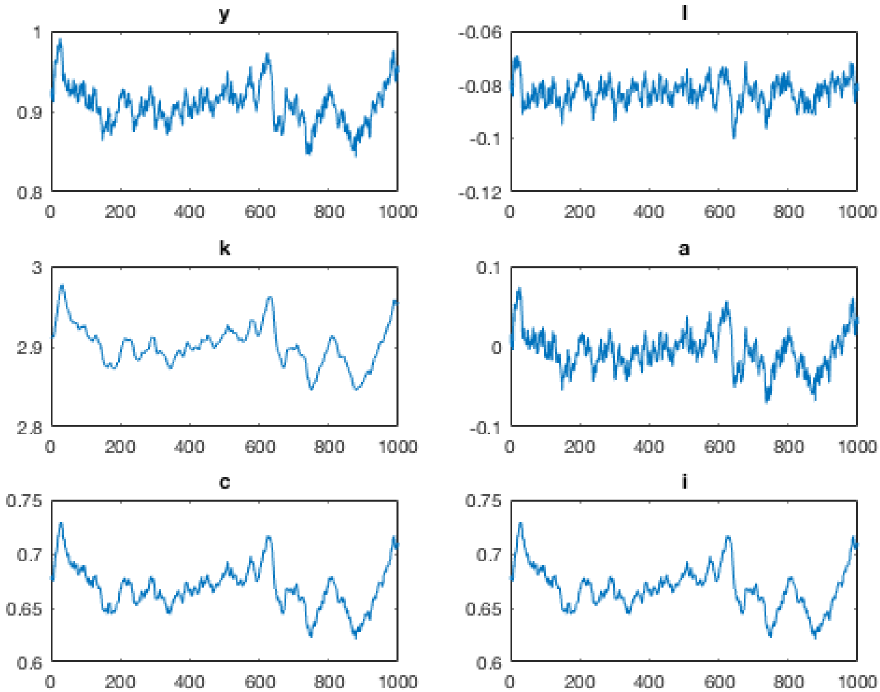
CORRELATION OF SIMULATED VARIABLES

VARIABLE	y	l	k	a	c	i
y	1.0000	0.6965	0.8458	0.9881	0.9333	0.8887
l	0.6965	1.0000	0.2062	0.7987	0.3923	0.9480
k	0.8458	0.2062	1.0000	0.7534	0.9810	0.5070
a	0.9881	0.7987	0.7534	1.0000	0.8668	0.9487
c	0.9333	0.3923	0.9810	0.8668	1.0000	0.6647
i	0.8887	0.9480	0.5070	0.9487	0.6647	1.0000

AUTOCORRELATION OF SIMULATED VARIABLES

VARIABLE	1	2	3	4	5
y	0.9651	0.9294	0.8919	0.8577	0.8263
l	0.8966	0.7948	0.6929	0.6067	0.5339
k	0.9972	0.9926	0.9852	0.9754	0.9635
a	0.9496	0.8989	0.8467	0.8006	0.7597
c	0.9922	0.9827	0.9707	0.9572	0.9424
i	0.9177	0.8362	0.7541	0.6838	0.6235

Figure 4: Artificial Data



Remarks on the code

Below I report the MATLAB codes I used. I report only the Dynare code for the baseline specification. Of course, when I change φ^{-1} I compute the new steady state values with the program steady_state.m attached: in this case, the steady state values for capital, output, consumption and labor are, respectively, $log(17.1566)$, $log(2.3329)$, $log(1.8353)$, $log(0.8602)$. When ρ changes, instead, steady state conditions are the same as baseline. Finally, when I generated the artificial data I substituted the variance of the shock with the calibrated value σ_a^2. To get summary statistics for investment I also added the equation for investment (i.e. $I = Y - C$) in the Dynare code in the baseline specification.