Diaz-Gimenez, Prescott, Alvarez, and Fitzgerald (1992) - Banking in Computable General Equilibrium Economies

We replicate Díaz-Giménez, Prescott, Alvarez, and Fitzgerald (1992)

First we simply note that the parameter value for μ reported in Table 6 of original paper is incorrect due to a typo; given as 0.05, the correct value is 0.00625 (the codes implementing the model presumably use this correct value as we successfully replicate the Tables 7a and 7b of model outputs). The value given of 0.05 is the annual value associated with this parameter, but μ itself should be the value corresponding to the model period of one-eigth of a year.

The model is a partial equilibrium heterogenous agent model with idiosyncratic but no aggregate risk. The household problem has two endogenous states (bank deposits (loan if negative) and housing), one further decision variable (work or not), and one exogenous shock (the model is described as having two, but the second was not used in baseline calibration nor any part of the replication). The value function problem to be solved has a return function which depends on the state of the exogenous shock (which captures, working, retirement, and death) and on whether agent owns a house (K). In the first two states without a house it is

$$\frac{(C^{\alpha}(1-\alpha_k/\alpha)^{\alpha-\alpha_k}(\frac{\alpha_k}{\gamma\alpha})^{\alpha_k}(\tau-N)^{1-\alpha})^{1-\Psi}}{1-\Psi)} \tag{1}$$

In the first two states with a house it is

$$\frac{(C^{\alpha-\alpha_k}K^{\alpha_k}(\tau-N)^{1-\alpha})^{1-\Psi}}{1-\Psi} \tag{2}$$

in the third state (retirement) it is

$$\delta_r \frac{C^{\alpha*(1-\Psi)}}{1-\Psi} \tag{3}$$

in the fourth state (death) is it zero. Consumption is given by $C = A+(1-\theta)*(w(s,z)*N+i_d d-i_l l)+x_s-x_d+l-d+\omega(s,z)-\mu*K'$. l and d are (one plus inflation times) the absolute value of bank deposits when they are negative and positive respectively. If K'¡K then $x_s = \phi*(K-K')$ and $x_d = 0$, else $x_s = 0$ and $x_d = K'-K$. The exogenous states s and z evolve according to independent exogenous finite-valued markov processes. The model contains a substantial number of parameters so the reader is referred to either the original paper or the codes implementing the replication for their value. The value function problem is otherwise standard.

Simulation of the agents distribution is complicated by the presence of stochastic death together with no altruism towards future generations. A customized code therefore had to be written to compute the stationary distribution of agents as the standard commands of the VFI Toolkit would not have worked. Interestingly this combination of stochastic death and no altruism does not appear to have been used elsewhere in the literature suggesting that economic modelling choices do evolve based on ease of computation.

Paper does not provide explicit formulae for many of the model statistics reported in the Tables 7a and 7b (the 'model economy national accounts'); you can figure them out based on knowledge of national accounting, but this is not a trivial exercise and took some time.

Tables 7a and 7b reporting various statistics of the stationary distribution of agents replicates to high accuracy, although lack of explicit formula meant that doing this replication was very involved,

Table 1: Tables 7a and 7b of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)

Calibrated economys steady-state balance sheet data

	Stock/GNP
Household sector	
Tangible Capital	2.71
Deposits	1.00
Loans	0.46
Net Worth	3.25
Government Sector	
Reserves	0.01
Debt	0.55

Calibrated economys steady-state NIPA data

	Percent of GNP
Value added by Sectors	
Housing	
Banking	3.02
Goods producing	
Production	
Consumption	
Goods	50.26
Housing	
Maintainence	13.54
Banking Services	
Government Purchases	16.56
Investment	0.86

Replication of Tables 7a & 7b of Diaz-Gimenez, Prescott, Alvarez & Fitzgerald (1992) using grid sizes $n_a = 1000$, $n_s = 4$, $n_z = 1$ (Capital and Labour supply are discrete variables with two possible values each)

Missing values for Housing value added, Goods producing value added, Consumption, Housing, and Banking Services reflect numbers that could not be replicated. Since original paper does not report explicit formulae for their calculation it is unclear if this was simply an inability to find correct formula or actual error in original paper.

and some numbers have not been replicated. In contrast the welfare results reported in Tables 8 and 9 suggest substantial error in the original paper, as explicit formula was provided by original paper confidence in the replication numbers is high. It is suspected, but not known, that this reflects that while the linear-quadratic methods used to solve the model in the original paper did fine at solving for the policy functions they did a poor job of approximating the actual value function and so led to misleading welfare calculations as these depend on changes in the value function.

The paper performs two experiments, results of the first form Table 9. Results of the second experiment do not appear in any Table or Figure and so it was not done as part of this replication.

References

Javier Díaz-Giménez, Edward C. Prescott, Fernando Alvarez, and Terry Fitzgerald. Banking in computable general equilibrium economies. Journal of Economic Dynamics and Control, 16:

Table 2: Original Tables 7a and 7b of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)

Table 7a

Calibrated economy's steady-state balance sheet data.

	Stock/GNP
Household sector	
Tangible capital	2.71
Deposits	1.01
Loans	0.46
Net worth	3.26
Government sector	
Reserves	0.01
Debt	0.54

Table 7b

Calibrated economy's steady-state NIPA data.

	Percent of GNP
Value added by sectors	
Housing	15.74
Banking	3.01
Goods producing	81.25
Products	
Consumption	82.61
Goods	50.29
Housing	29.30
Maintenance	13.56
Banking services	3.10
Government purchases	16.55
Investment	0.84

Table 3: Table 8 of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)
Benefits of Switching to a policy of a zero after-tax real return on deposits

Current after-tax	Benefits as percent of wealth					
real return	Measured at Mean			Measured across Stationary Dist		
on deposits	S	S_1	S_2	M	M_1	M_2
-2.00	3.55	4.03	-0.48	3.31	3.78	-0.48
-4.00	5.37	5.92	-0.56	5.07	5.63	-0.55
-6.00	6.47	7.13	-0.66	6.16	6.82	-0.65

Replication of Table 8 of Diaz-Gimenez, Prescott, Alvarez & Fitzgerald (1992) using grid sizes $n_a = 1000$, $n_s = 2$ Original paper incorrectly describes the first measure as evaluated at the steady-state, it is in fact being evaluated at the mean of the stationary distribution. Note that Table 8 produces results relating not directly to the model of the paper itself, but to the model of Imrohoroglu and Prescott (1991), which is a subcase of the model, hence the different grid sizes used for this Table compared to others from this paper.

Table 4: Original Table 8 of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)
Benefits of switching to a policy of a zero after-tax real return on deposits.

Current after-tax real return on deposits	Benefits as percent of wealth					
	Steady-state measure			Our measure		
	S	S_1	S_2	M	M_1	M_2
−2.0%	0.20	2.62	−2.42	0.18	0.57	−0.39
−4.0	0.41	2.99	−2.58	0.36	1.08	−0.71
−6.0	0.63	3.42	−2.79	0.56	1.55	−0.99

Table 5: Table 9 of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)
Welfare benefits of switching to a policy of less-negative after-tax real return on deposits

Current policy		New policy		Benefits (percent of wealth)		
Inflation on deposits	After-tax real return	Inflation rate	After-tax real return	Total	Private	Public
4%	-0.80%	4%	-0.80%			
5	-1.80	4	-0.80	1.24	1.15	0.09
6	-2.80	4	-0.80	1.87	1.63	0.23

Replication of Table 9 of Diaz-Gimenez, Prescott, Alvarez & Fitzgerald (1992) using grid sizes $n_a = 1000$, $n_s = 4$.

Table 6: Original Table 9 of Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992)
Welfare benefits of switching to a policy of less-negative after-tax real return on deposits.

Current policy		New policy		Benefits (percent of wealth)		
Inflation rate	After-tax real return	Inflation rate	After-tax real return	Total	Private	Public
4%	−0.7%	4%	−0.7%	—	—	—
5	−1.6	4	−0.7	2.00	0.90	1.10
6	−2.5	4	−0.7	3.58	1.29	2.29

533–559, 1992.

Ayse Imrohoroglu and Edward C. Prescott. Evaluating the welfare effects of alternative monetary arrangements. Quarterly Review of the Federal Reserve Bank of Minneapolis, Summer:3–10, 1991.