

# 1 Rectifying the solution to this model with Bover's solution

Bover (1991) did not take the same solution approach as this paper. In the original, Bover solves the intertemporal problem with a Lagrangian and a clever transformation of the budget constraint. Yet, my approach using a Bellman equation produces a slightly different looking solution. Yet, the two are indeed the same. Bover's solution regarding consumption takes the following form:

$$c_t = \gamma_c + B_2 \lambda_t^{-1}$$

To see that my solution is the same, we first look at the consumption Euler equation I derived earlier. This provides a very clear relationship between  $c_t - \gamma_c$  and  $c_{t+1} - \gamma_c$ .

$$\frac{c_t - \gamma_c}{c_{t+1} - \gamma_c} = \frac{1 + \rho}{1 + r}$$

According to the solution in Bover (1991), we can use Equation 7 in her paper to obtain a similar ratio.

$$\frac{c_t - \gamma_c}{c_{t+1} - \gamma_c} = \frac{\lambda_t^{-1}}{\lambda_{t+1}^{-1}}$$

Therefore, a simple test will be to see if the ratio of the inverse lagrange multipliers is equal to  $(1 + \rho)/(1 + r)$ . The code is created using the Bover notation, which allows us to see if there are any bugs in the code.

Figure 1 demonstrates that we do indeed observe a constant relationship between  $c_t - \gamma_c$  and  $c_{t+1} - \gamma_c$ . Thus, we conclude that the ratio of subsequent Lagrange multipliers is  $(1 + \rho)/(1 + r)$ .

Bover solves this problem in terms of labor hours, but this does not prove any difficulty since our time constraint will tell us that  $l_t = T - h_t$ . Thus, Bover's equation 6 suggests that the ratio of leisure hours will be:

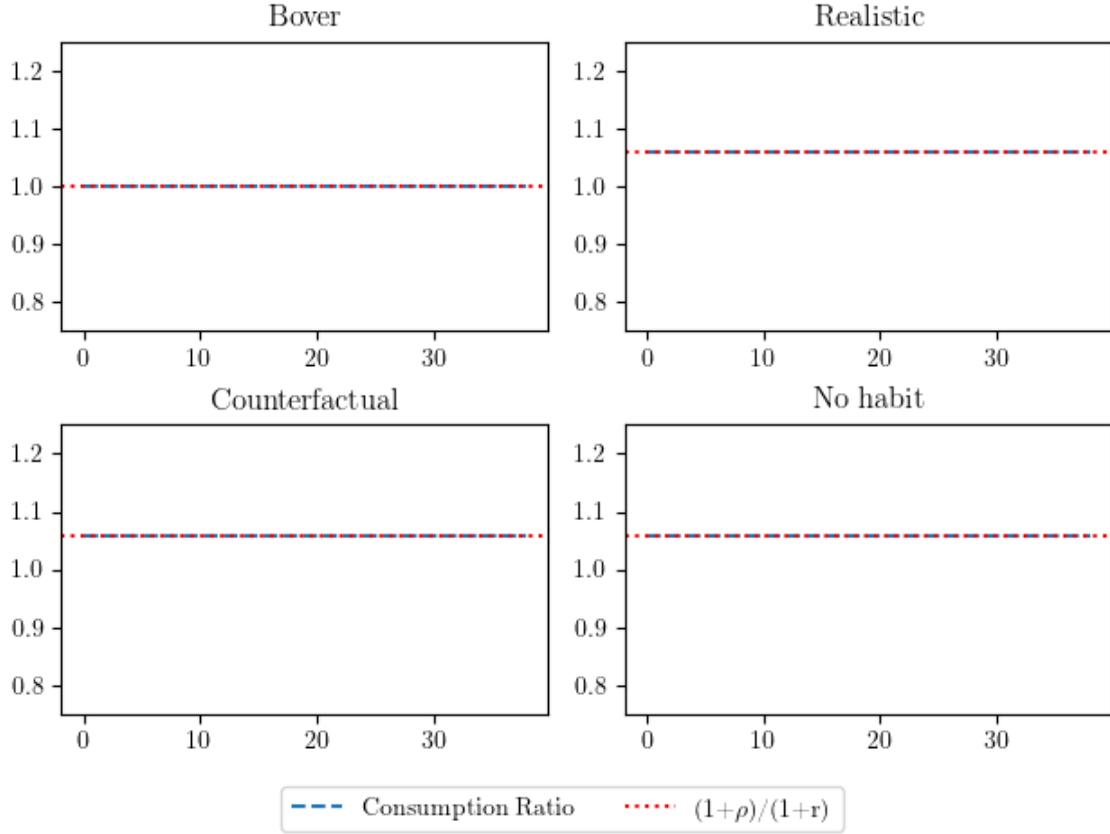
$$\frac{l_t - \varphi l_{t-1} - \gamma_l}{l_{t+1} - \varphi l_t - \gamma_l} = \frac{\lambda_t^{-1}}{\lambda_{t+1}^{-1}} \frac{w_{t+1}^+}{w_t^+} \quad (1)$$

where

$$w_k^+ = W \sum_{j=0}^{T-k} \left( \frac{\varphi}{1 + r} \right)^j$$

The hope is that starting from our FOC for leisure and using the Bover's FOC for hours (leisure), we hope to arrive at some tautology. For notational simplicity, let  $\hat{l}_i = l_i - \varphi l_{i-1} - \gamma_l$ . Starting from our FOC for leisure:

$$\frac{B_1}{\hat{l}_t} = \frac{B_2 W}{c_t - \gamma_c} + \frac{B_1 \frac{\varphi}{1 + \rho}}{\hat{l}_{t+1}}$$



**Figure 1** Consumption between time  $t$  and  $t + 1$

$$\begin{aligned} \frac{w_t^+}{\lambda_t^{-1}} &= \frac{W}{\lambda_t^{-1}} + \frac{w_{t+1}^+ \frac{\varphi}{1+\rho}}{\lambda_{t+1}^{-1}} \\ \frac{1 - \left(\frac{\varphi}{1+r}\right)^{T-t+1}}{1 - \frac{\varphi}{1+r}} &= 1 + \frac{\varphi}{1+\rho} \cdot \frac{1+\rho}{1+r} \frac{1 - \left(\frac{\varphi}{1+r}\right)^{T-t}}{1 - \frac{\varphi}{1+r}} \\ 1 - \left(\frac{\varphi}{1+r}\right)^{T-t+1} &= \left(1 - \frac{\varphi}{1+r}\right) + \frac{\varphi}{1+r} \left(1 - \left(\frac{\varphi}{1+r}\right)^{T-t}\right) \\ 1 - \left(\frac{\varphi}{1+r}\right)^{T-t+1} &= 1 - \left(\frac{\varphi}{1+r}\right)^{T-t+1} \end{aligned}$$

This tautology suggests that both approaches yield the same solution.

## References

BOVER, OLYMPIA (1991): “Relaxing Intertemporal Separability: A Rational Habits Model of Labor Supply Estimated from Panel Data,” *Journal of Labor Economics*, 9(1), 85–100.