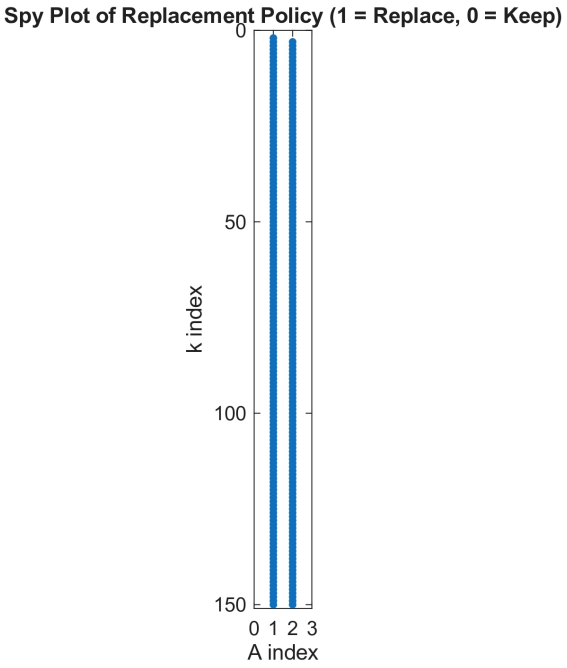
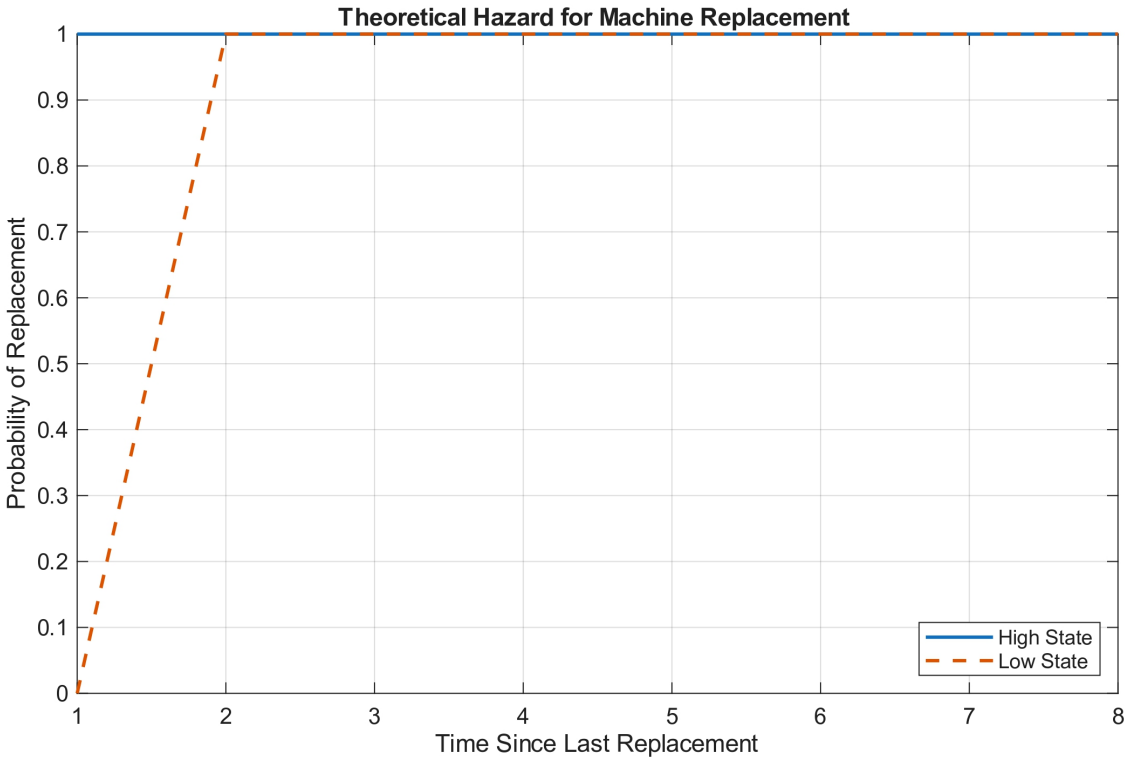
Problem 4. Comment on the important features of the policy function.



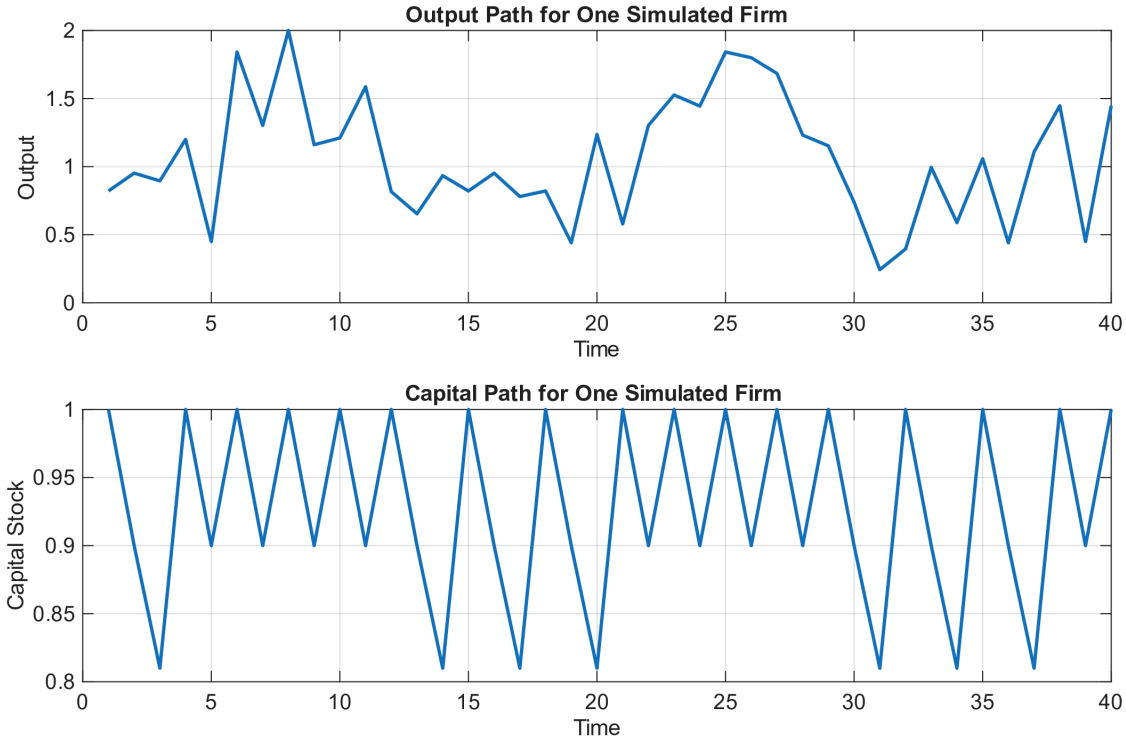
The spy plot shows that for capital levels below the cutoff $k = 0.0164$, the firm always chooses replacement (solid line of ones). Above this level, replacement becomes dependent on state, productivity and investment opportunity. This confirms the theoretical prediction of a replacement threshold in (k, A, ε)-space.

Problem 5. Plot the hazard function of capital replacement for the two values of A. Comment on the important features of the hazard function.

The theoretical hazard is increasing in the time since last replacement. It is uniformly higher in the high aggregate state than in the low state. This is consistent with Figure 1 in Cooper, Haltiwanger, and Power (1999). In the discretized model the hazard rises quickly to 1 for both states. This means that replacement becomes optimal for all idiosyncratic shock realizations when capital has depreciated for a couple of periods.

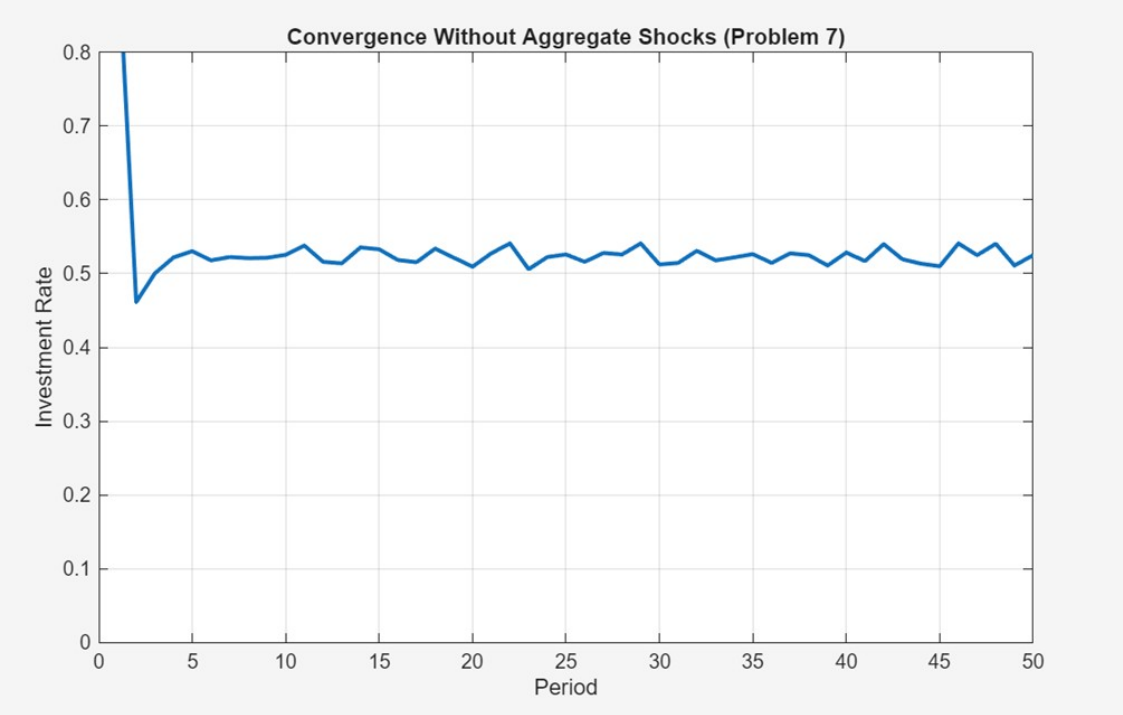


Problem 6. Comment on the behavior of firms in the model.



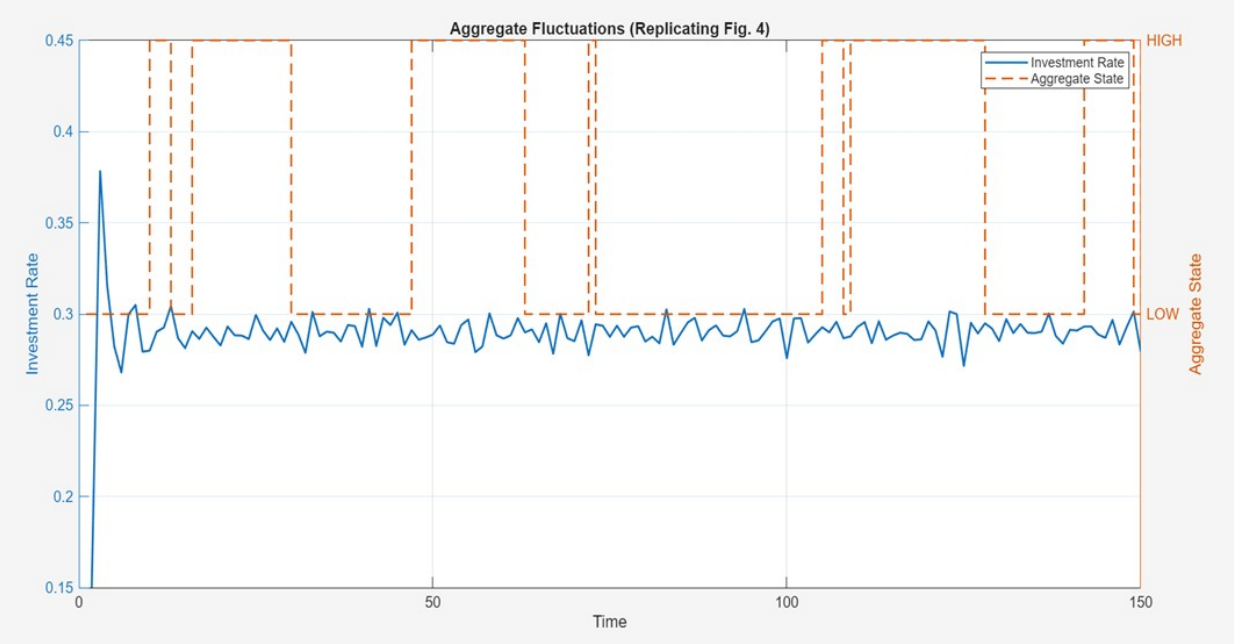
The firm shows lumpy investment behavior. Capital slowly decreases as the machine ages, then jumps sharply back to the maximum when replacement occurs. This creates a saw-tooth pattern. Output follows the same logic. It is high after replacement and falls as the machine depreciates. It also fluctuates with productivity shocks. This captures the key insight of the model which is, "rare but large replacement events combined with continuous depreciation lead to volatile output and infrequent investment spikes". This insight is consistent with Cooper, Haltiwanger & Power (1999).

Problem 7: Assume that A is fixed. Replicate Figure 3 in the paper.



The simulated economy shows a sharp decline initially in investment. After that it starts oscillating and eventually settle to a stable replacement rate. Early periods have high investment because many firms begin with new capital. This quickly reaches to the age where replacement becomes optimal. Eventually, the cross-section of capital ages spreads out. It creates short-run fluctuations before stabilizing. After roughly 10–15 periods, the investment rate converges around approximately 0.52 and shows steady-state frequency at which firms choose to replace their machines. This behavior is consistent with lumpy, infrequent investment in vintage capital models without aggregate shocks.

Problem 8: Now let A follow the Markov process specified earlier. Replicate Figure 4 in the paper.



After adding aggregate shocks, the investment rate becomes volatile over time. When productivity switches into the HIGH aggregate state, firms replace machines slightly more often, raising the investment rate. During LOW states, replacement activity slows down. Although the fluctuations are not extremely large, the pattern replicates the qualitative behavior in Figure 4 of the paper. Investment co-moves positively with aggregate productivity, and the process shows clusters of high and low replacement frequencies corresponding to persistent aggregate states.

Problem 9: Comment on the implications for firm investment behavior that you see as important from your replications of Figures 3 and 4

From Figure 3 (no aggregate shocks), the main learning is that investment quickly settles down to a stable rate. Firms keep replacing machines because of depreciation and their own idiosyncratic shocks, but in the aggregate, there is no systematic variation or cyclical pattern. So, without aggregate shocks, investment looks almost like a flat line with small noise. In Figure 4 (with aggregate shocks), the picture changes. When the aggregate state is high, replacement suddenly becomes more profitable, so many firms choose to invest at the same time. When the state is low, they delay replacement. This creates visible swings in the aggregate investment rate that line up with movements in the aggregate state.
So, the main idea is:

- Idiosyncratic risk alone doesn't generate large movements in aggregate investment.
- Once aggregate shocks are added, firms' decisions become synchronized, and investment "waves" look a lot more like business cycle fluctuations.