Computer Algorithm:

November 30, 2017

High-level overview and logic

A "good" computer algorithm does two things. (1) It decompose the larger problem into a nested (i.e. recursive) sequence of smaller problems (e.g. in this case, fixed point problem for an operator on a lower-dimensional vector space); and (2) each of these subproblems is guaranteed to have a solution. The purpose of (1) is that it makes it more clear how to update a guess. With a scalar problem this is often as simple as checking one inequality. The purpose of (2) is to make this procedure coherent. In general (1) is easy – even trivial – to accomplish: simply split up a large dimensional guess/verify/update into a series of guesses and verifications and updates. But to accomplish (1) while accomplishing (2) as well requires some economic logic, i.e. the inner problem is a partial equilibrium model given a guess in an outer problem.

1. Find L^F that satisfies the resource constraint on labor. To do this, need to guess L^F, then...
   (a) Compute growth rate given L^f. To do this, need to guess growth rate g, then...
      i. Compute (partial)-equilibrium given L^f, g. To do this, need to guess $w(q, m, n)$, then...
         A. Compute Nash equilibrium given L^f, g and $w(q, m, n)$.[1]
      ii. Then can check consistency: $w(q, m, n) + \nu W^{NC}(q, m, n) = \overline{w}$
   (b) Then check consistency: $g = g^*$ where g^* is computed by simulating the model over time
2. Then check consistency: $L^F + L^I + L^{RD} = 1$.

Details

The details that are missing are the following:

1. Initial guesses for (indicated by subscript 0)
   (a) L_0^F
   (b) $g_0(L^F)$
   (c) $w_0(q, m, n | g, L^F)$
2. Update rules (indicated by subscript 1):
   (a)
   (b) $w_1(q, m, n)$
   (c) g_1
3. Guess L^f
   (a) Guess g
      i. Guess $w(q, m, n)$

[1] Conjecture: pure strategy NE exists and is unique. Reasoning:

A. Compute Nash Equilibrium of innovation race game between incumbent firms and entrant firms, assuming they can hire exactly what workers they want at exogenous wage $w(q, m, n)$.

B. Involves initial guesses of $z_E(q, m, n)$, $F^*(q, n)$ and/or $z_I(q, m, n)$.

C. Outputs policy functions $z_E(q, m, n) = \xi \min(m, F^*(q, n)$ and $z_I(q, m, n)$, as well as value functions $A(q, m, n), W^{NC}(q, m, n), W^F(q, m, n)$.