Problem Set #5

Innovation and Growth

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Due Friday 3/31 by 2PM

1. (Are ideas getting harder to find?) This question asks you to consider the scale effects present in the endogenous growth model featuring input varieties developed in class. Initially, assume the set-up is identical to the in-class version: perpetual patents for intermediate input innovators, a fixed cost of R&D equal to $\eta > 0$, and final good production of each firm i given by

$$Y_i = L_i^{1-\alpha} \sum_{j=1}^{N(t)} X_{ij}^{\alpha} \tag{1}$$

(a) Explain in words what scale effects are, and the intuition for why they are present in this model. Show directly that they are present in the model (you may refer to an equation we derived in class without deriving it yourself).

(b) Now suppose that the cost of R&D is not constant, but instead depends on $N(t)$ in the following way

$$\eta(N) = \phi N(t)^{\sigma}, \qquad \phi > 0, \ \sigma > 0 \tag{2}$$

Interpret this formulation. Do you think it is realistic?

(c) Assume that a balanced growth equilibrium exists in this version of the model (it does), derive an expression for the equilibrium interest rate $r(t)$. *Hint: it is useful to consider the no-arbitrage argument for the risk free asset (bond) paying r and owning an intermediate input supplier. What is $\dot{v}$ in this version?*

(d) How does the interest rate depend upon $N(t)$ and the rate of growth of N? Interpret this.

(e) Using your answer from part (d), explain how the model can be consistent with positive population growth and a balanced growth equilibrium. (You don't need

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to show this directly mathematically, just provide a sentence or two of intuition.)

2. (Policy in the IV model)

   (a) Explain the concepts of static and dynamic inefficiency in the context of the input variety model (general description). How do we determine if the model is statically and/or dynamically inefficient?

   (b) Use our depiction of patent protected monopoly in the input market to illustrate/describe the model's two types of inefficiency.

   (c) Consider the following policy (A simplified version of the Bayh-Doyle Act passed in 1980) - the government subsidizes R&D through a grant system, decreasing the private cost of innovation to $\beta\eta$, where $0 < \beta < 1$. The government allows firms (or universities) that receive a grant to obtain a patent on the resulting innovation. However, the government retains "march-in rights," which allows the government to assume control of licensing the innovation (essentially voiding the patent) if the government can show that it serves the public interest.

      i. Describe how this policy attempts to strike a balance between promoting static and dynamic efficiency.
      ii. What do you think of the policy? Do you think it will be successful in practice? Do you expect any problems to come up?