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Computing general equilibrium models with occupational choice and financial frictions

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Abstract

This paper establishes the existence of a stationary equilibrium and a procedure to compute solutions to a class of dynamic general equilibrium models with two important features. First, occupational choice is determined endogenously as a function of heterogeneous agent type, which is defined by an agent's managerial ability and capital bequest. Heterogeneous ability is exogenous and independent across generations. In contrast, bequests link generations and the distribution of bequests evolves endogenously. Second, there is a financial market for capital loans with a deadweight intermediation cost and a repayment incentive constraint. The incentive constraint induces a non-convexity. The paper proves that the competitive equilibrium can be characterized by the bequest distribution and factor prices, and uses the monotone mixing condition to ensure that the stationary bequest distribution that arises from the agent's optimal behavior across generations exists and is unique. The paper next constructs a direct, non-parametric approach to compute the stationary solution. The method reduces the domain of the policy function, thus reducing the computational complexity of the problem.
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1. Introduction

This paper establishes the existence of a stationary equilibrium and a procedure to compute solutions to dynamic general equilibrium models with occupational choice and financial frictions. Occupational choice models are common in macroeconomics and there is a voluminous literature on financial market frictions.[1] These models often have non-convexities which give rise to discontinuous stochastic behavior (e.g., Antunes et al., 2006); standard fixed point

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[1] Examples of occupational choice models are Banerjee and Newman (1993); Erosa (2001); Lloyd-Ellis and Bernhardt (2000) and Antunes and Cavalcanti (2005). Examples of models with financial frictions are Antinolfi and Huybens (1998); Betts and Bhattacharya (1998) and Boyd and Smith (1998).

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existence arguments that require continuity are not applicable.[2] Hopenhayn and Prescott (1992) remedy this problem by proving existence of stationary equilibria for stochastically monotone processes. They use the Knaster-Tarski fixed point theorem to prove existence of fixed point mappings on compact sets of measures that are increasing with respect to a stochastic ordering (monotone). Our contribution is two-fold. First, we show how the Hopenhayn and Prescott result can be applied to this class of dynamic general equilibrium models to prove existence of a stationary equilibrium. Second, we construct a direct, non-parametric approach to compute the stationary solution. Our method reduces the domain of the policy function, thus reducing the computational complexity of the problem.

The class of models that we consider has two important features. First, occupational choice is determined endogenously as a function of heterogeneous agent type. Agents are endowed with different innate abilities to manage a firm (cf., Lucas, 1978) and different bequests (cf., Antunes et al., 2006). Heterogeneous ability is exogenous, in the sense that managerial ability is drawn from a fixed distribution, and is independent within and across generations. In contrast, agents choose consumption and bequests to maximize preferences subject to lifetime wealth. Bequests thus connect generations across time periods and the distribution of bequests evolves endogenously. Second, there is a financial market for capital with two frictions: a deadweight cost to intermediate loans and an incentive constraint to ensure loan repayment. The incentive constraint induces a non-convexity. We characterize the competitive equilibrium, and then use a condition derived by Hopenhayn and Prescott, monotone mixing, to ensure that the optimal stationary bequest distribution that arises from the stochastic optimization problem exists and is unique.

The paper proceeds as follows. Section 2 contains the model. Section 3 describes optimal consumption and production behavior. On the production side, agents choose an occupation (to manage a firm or work) and firm finance (if a manager). Consumers choose consumption and bequests, where bequests link agents across periods. Section 4 specifies the competitive equilibrium and proves existence of a stationary equilibrium. We show that there is a unique stationary equilibrium that is fully characterized by a time invariant bequest distribution and associated equilibrium factor prices. We use the monotone mixing condition from Hopenhayn and Prescott (1992) Theorem 2. In our context, this condition characterizes two types of mobility in the bequest distribution: given that ability is independent across generations, there is a positive probability that a future descendent of an agent changes occupation (i.e., from worker to entrepreneur or from entrepreneur to worker). Thus, the economy experiences occupation mobility, but from any initial bequest distribution and any interest rate, convergence to a unique invariant bequest distribution occurs. Finally, Section 5 contains the numerical solution method.

2. The Model

Consider an economy with a continuum of measure one agents who live for one period. Each agent reproduces another such that population is constant. There is one good each period that can be used for consumption or production, or left to the next generation as a bequest. Time is discrete and infinite, with $t = 0, 1, 2, \ldots$.

2.1. Preferences, endowments, technology and frictions

2.1.1. Preferences

In period t, agent i's utility is defined over personal consumption and a bequest to offspring, denoted by c_t^i and b_{t+1}^i, respectively. Assume the utility function has the form

$$U^i = u(c_t^i, b_{t+1}^i). \tag{1}$$

$u(\cdot, \cdot)$ is twice continuously differentiable, strictly concave and increasing in both arguments. We also assume that the utility function satisfies the Inada conditions.[3] Preferences are for the bequest and not the offspring's utility (cf., Banerjee and Newman, 1993).

[2] Standard Brouwer-Kakutani type fixed point theorems cannot be used because the fixed point mapping is not necessarily continuous or upper or lower semi-continuous (cf., Krasa and Yannelis (1994)). We use the Knaster-Tarski fixed point theorem, which is non-topological.

[3] Both Cobb-Douglas and CES utility functions satisfy these restrictions.

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