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Optimal government policies in models with heterogeneous agents ☆

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Abstract

In this paper we develop a new approach for finding optimal government policies in economies with heterogeneous agents. Using the calculus of variations, we present three classes of equilibrium conditions from government's and individual agent's optimization problems: 1) the first order conditions: the government's Lagrange–Euler equation and the individual agent's Euler equation; 2) the stationarity condition on the distribution function; and, 3) the aggregate market clearing conditions. These conditions form a system of functional equations which we solve numerically. The solution takes into account simultaneously the effect of the government policy on individual allocations, the resulting optimal distribution of agents in the steady state and, therefore, equilibrium prices. We illustrate the methodology on a Ramsey problem with heterogeneous agents, finding the optimal limiting tax on total income.

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1. Introduction

This paper provides a new approach for computing equilibria in which the stationary distribution of agents is a part of an optimal nonlinear, second-best government problem in a general equilibrium, Bewley type economy with heterogeneous agents. We formulate the optimal government policy problem as a calculus of variations problem where the government maximizes an objective functional subject to a system of operator constraints: 1) the first order condition for the individual agent's problem; 2) the stationarity condition on the distribution function; and, 3) the aggregate market clearing conditions. The first order necessary conditions of the government functional problem given by an Euler–Lagrange equation (with transversality conditions) form a system of functional equations in individual agents' and government's policies and in the distribution function over agents' individual state variables. We solve this system numerically by the projection method.

Our main contribution is the derived Euler–Lagrange equation for the government problem and the operator formulation of the individual agent's Euler equation and of the endogenous stationary distribution. In this way, we are able to solve *simultaneously* for the *government optimal policy*, for the *optimal individual allocations*, and for the (from a government's point of view) *optimal distribution* of agents in the steady state. The first and second order conditions, in the form of the Euler–Lagrange equation and a modified Legendre condition, respectively, represent the necessary and sufficient conditions for concavity and a unique maximum attained by the government policy function. There are two restrictions we impose on the solution: the government cannot use taxes that are state-contingent (to preserve incomplete markets and heterogeneity in the economy) and, because of the variational approach, the tax function must belong to the class of continuously differentiable functions. We do not impose additional assumptions on the shape of the government policy function. The optimal policy is derived from the first order and envelope conditions and from the stationarity of the endogenous distribution in the steady state. To our knowledge, this paper is the first one that provides a solution method for this kind of optimal government problem in an economy with heterogeneous agents.

We formulate the government problem as a modified Golden Rule. That is, we solve for an optimal limiting government policy under an assumption that the economy converges to a steady state. The optimal limiting government policy is a long-run optimal outcome that takes into account intertemporal discounting and the convergence to the steady state. In a related paper, Davila et al. (2012) consider a social planner that attains a constrained optimum by directly manipulating the savings decision of each agent. They derive a functional first-order necessary condition with an added pecuniary externality arising from general equilibrium effects and use the variational approach for its characterization. Compared with Davila et al. (2012), the contribution of our paper is in the formulation of the Euler–Lagrange equations and the joint consideration of general equilibrium and distributional effects of the optimal limiting tax policy function.

We illustrate this methodology on a Ramsey problem, solving for the optimal limiting tax schedule on total income that maximizes average welfare in a steady state of a standard neoclassical, dynamic general equilibrium model with heterogeneous agents and incomplete markets calibrated as in Davila et al. (2012). For this calibration with a realistic wage and wealth in-