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Optimal Ramsey taxation with endogenous risk aversion☆

Orhan Erem Ateşağaoğlu [a], Orhan Torul [b,*]

[a] Department of Finance, Istanbul Bilgi University, Santral Istanbul, 34060, Eyüp, Istanbul, Turkey
[b] Department of Economics, Boğaziçi University, 34342 Bebek, Istanbul, Turkey

HIGHLIGHTS

- We study optimal Ramsey taxation when risk aversion co-moves counter-cyclically.
- We solve for the Ramsey problem both via the primal and the dual approach.
- Both intertemporal and intratemporal household optimality conditions change.
- Optimal taxation requires positive capital income tax rates in the long run.

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ABSTRACT

In this paper, we study optimal Ramsey taxation under endogenous risk aversion formulation in an otherwise standard real business cycle economy. We show that when the risk aversion coefficient co-moves counter-cyclically, the canonical Chamley–Judd (Chamley, 1986; Judd, 1985) result does not hold true, and the Ramsey planner chooses a positive capital income tax rate in the long run. We report that result is due to additional wedges both in the intratemporal and the intertemporal optimality condition of the representative household.

1. Introduction

A key feature of modern macroeconomic models has been the choice of formulating some of their core elements in the form of *deep structural parameters*.[1] This approach has not been immune to criticism, as a growing body of literature attributes shortcomings of these models to the state and time invariance assumption of their underlying deep structural parameters.[2] Of the criticisms over deep structural parameters, the state and time invariance assumption of preferences over risk has been particularly raising eyebrows, as an increasing number of studies argue otherwise based on empirical grounds.[3] Despite these developments, neither alternative formulations of alternative risk aversion formulations, nor their implications have been investigated in detail under general equilibrium settings.[4]

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* Corresponding author.
E-mail addresses: erem.atesagaoglu@bilgi.edu.tr (O.E. Ateşağaoğlu), orhan.torul@boun.edu.tr (O. Torul).

1 Examples of such parameters include the subjective discount rate, a constant returns to scale production technology, a linear capital depreciation rate, the functional form of utility functions, and their associated risk-aversion/intertemporal elasticity of substitution parameters. See Kydland and Prescott (1982) for an elaborate discussion on this methodology.

2 Among others, see Fernández-Villaverde et al. (2007) for a general critique on modeling structural parameters as "structural".

3 See Eeckhoudt et al. (1996), Malmendier and Nagel (2011), Giuliano and Spilimbergo (2014), Bucciol and Zarri (2013), Guiso et al. (2018) and Mengel et al. (2016) for different critiques on the invariance assumption of risk aversion.

4 A main exception is by Epstein and Zin (1989), which intends to break the link between intertemporal elasticity of substitution and preferences over risk, but does not address the time or state-dependent nature of risk aversion.

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In this paper, we address this issue by studying optimal Ramsey taxation when household risk aversion is endogenously formulated in an otherwise standard real business cycle (RBC) economy. Specifically, motivated by the advances in the empirical literature on preferences over risk, we formulate risk aversion coefficient as an inverse function of output deviations from the natural level of output, thereby co-moving *counter-cyclically* over time.[5] Under representative-agent settings, Chamley (1986) and Judd (1985) show that optimal capital income tax rate is zero in the long run, which is coined as the canonical Chamley-Judd result.[6] We report that when the risk aversion coefficient is endogenous and counter-cyclical as described, in an otherwise standard RBC model the Chamley-Judd result does *not* hold true, and the Ramsey planner chooses a positive capital tax rate for the calibrated United States economy in the long run. We show that this result is due to additional wedges both in the intratemporal and the intertemporal optimality condition of the representative household, which is factored in by the Ramsey planner in her search for optimal allocations.

In order to quantify this result, we compare optimal Ramsey taxation in a plain-vanilla RBC economy to that of an identical model environment except for its formulation of the risk aversion coefficient, and we coin this specification as the "endogenous σ" specification. Throughout our analysis, we employ two parameter sets for each specification: the first parameter set featuring convex disutility over supplied labor and the second with linear disutility, as in the idea of "indivisible labor" *à-la* Hansen (1985) and Rogerson (1988). We solve for the Ramsey planner's problem both via the primal and the dual approach, and we report that under both parameter sets, the Ramsey planner finds taxing capital income positively optimal in the long run.

The rest of the paper is organized as follows: in Section 2, we describe the two model environments and the Ramsey problem, in Section 3, we discuss the computational methodology and present our results, in Section 4, we conclude.

2. Model environment

The model is a standard real business cycle environment with households, firms and government. For brevity, we describe the two model environments, (i) the plain-vanilla RBC (baseline) model, and (ii) the endogenous σ model, jointly.

Households

The representative household maximizes her present-discounted life-time utility subject to her dynamic budget constraint:

$$\max_{\{c_t,n_t,k_{t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t) - v(n_t) \tag{1}$$

subject to

$$c_t + k_{t+1} = (1-\tau_t^n)w_t n_t + [1+(1-\tau_t^k)(r_t-\delta)]k_t \tag{2}$$

where $c_t \geq 0$ denotes consumption, $n_t \geq 0$ denotes hours worked as a fraction of the period, $k_t > 0$ denotes physical capital, δ denotes the depreciation rate, β denotes the subjective discount factor, and w_t and r_t denote factor prices: real wage, and real interest rate, respectively.

Let the functional form of the representative household's preferences over consumption and labor in the **baseline model** take an additively-separable utility function with constant relative risk aversion (CRRA) over consumption and convex (or linear) disutility over hours worked, as it is common in the macroeconomics literature:

$$u(c) - v(n) = \frac{c^{1-\sigma}-1}{1-\sigma} - \frac{\psi}{1+\upsilon} n^{1+\upsilon} \tag{3}$$

where σ refers to the risk aversion parameter, and $\frac{1}{\upsilon}$ refers to the constant Frisch elasticity of labor supply. Optimal decision rules by the household imply the following optimal intratemporal and intertemporal margins:

$$\psi n_t^{\upsilon} = (1-\tau_t^n) w_t c_t^{-\sigma} \tag{4}$$

$$c_t^{-\sigma} = \beta \mathbb{E}_t[(1-\tau_{t+1}^k)(r_{t+1}-\delta)+1]c_{t+1}^{-\sigma} \tag{5}$$

In accordance with our above description of the endogeneity of risk aversion, let the utility function under the **endogenous σ model** take the following form:

$$u(c,n) = \frac{c^{1-\sigma_t}-1}{1-\sigma_t} - \frac{\psi}{1+\upsilon} n^{1+\upsilon} \tag{6}$$

where the endogenous σ_t follows:

$$\sigma_t = \overline{\sigma} - \gamma(y_t - \overline{y}) \tag{7}$$

with $\overline{y}$ denoting the endogenously-determined steady-state level of output, and γ denoting the responsiveness parameter of the risk aversion coefficient to income fluctuations. This formulation implies that when output exceeds the natural level of output, the representative household's risk aversion decreases, and when the economy experiences recession, risk aversion increases, as in accordance with Malmendier and Nagel (2011) and Giuliano and Spilimbergo (2014).[7]

The solution to the above problem yields the following consumption-leisure and consumption–investment optimality conditions:

$$\psi {n_t}^{\upsilon} - {c_t}^{-\sigma_t} w_t \left(1-\tau_t^n\right) = \underbrace{-\gamma\,(1-\alpha)\,\frac{y_t}{n_t}\left(\frac{{c_t}^{1-\sigma_t}\log(c_t)}{\sigma_t-1} + \frac{{c_t}^{1-\sigma_t}-1}{(\sigma_t-1)^2}\right)}_{\text{Intratemporal Wedge due to the Endogeneity of } \sigma_t} \tag{8}$$

$$c_t^{-\sigma_t} - \beta\,\mathbb{E}_t {c_{t+1}}^{-\sigma_{t+1}}\left[1+\left(1-\tau_{t+1}^k\right)(r_{t+1}-\delta)\right] = \underbrace{-\gamma\alpha\beta\,\mathbb{E}_t\left(\frac{{c_{t+1}}^{1-\sigma_{t+1}}\log(c_{t+1})}{\sigma_{t+1}-1} + \frac{{c_{t+1}}^{1-\sigma_{t+1}}-1}{(\sigma_{t+1}-1)^2}\right)\frac{y_{t+1}}{k_{t+1}}}_{\text{Intertemporal Wedge due to the Endogeneity of } \sigma_t} \tag{9}$$

where the underbraced terms in (8) and (9) show up additionally due to the endogeneity of the risk aversion coefficient. Note that for both optimality conditions, when γ is set to zero (so that the risk aversion coefficient becomes a time-invariant parameter as in the plain-vanilla RBC case), Eqs. (8) and (9) would be identical to Eqs. (6) and (7), respectively.

5 Our motivation behind formulating risk aversion counter-cyclically is by Malmendier and Nagel (2011) and Giuliano and Spilimbergo (2014) among others, who claim that in bad times risk aversion increases and in good times it decreases. This argument is motivated by authors' claim that during times of substantial negative shocks, as in the case of world wars or the great depression, households tend to get more risk-averse and favor social insurance more.

6 Luca Jr. (1990) also shows that in a representative-agent set-up, zero capital taxation provides the socially-optimal allocation. In heterogeneous-agent economic models with incomplete markets, optimal capital taxation can be strictly positive. Among others, see Aiyagari (1995), Conesa et al. (2009) and Domeij and Heathcote (2004). The literature on tax policy without government commitment also documents positive tax results. See Klein et al. (2008), Martin (2010), Ortigueira (2006), Phelan and Stacchetti (2001) and Feng (2015) for further discussion.

7 Note that (7) implies $\sigma_t(\cdot)$ can be considered as a first-order Taylor approximation of a non-linear counter-cyclical risk aversion function formulation, hence preserves generality despite its simplicity.