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Factor substitution and taxation in a finance constrained economy

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ABSTRACT

In this paper, we examine the effects of constant-rate factor taxation on macroeconomic stability in the Woodford (1986) model. Our focus is on how the degree of factor substitution, as measured by the elasticity of factor substitution (EOS) in production, affects different balanced-budget tax rules. Analytically, we show that indeterminacy can occur under capital income taxation only when the EOS is very low, whereas indeterminacy under labor income taxation is not subject to the EOS restriction. This finding is robust when we tax all of the factor incomes with equal rates. Thus, in terms of macroeconomic stability, taxing capital income is preferred to taxing labor income.

1. Introduction

In response to the recent economic downturn in the Western developed economies, increasing research attention is being paid to the importance of balanced budget rules for fiscal discipline. However there is a growing concern among macroeconomists about the destabilizing nature of fiscal rules. In a neoclassical growth model in which the government finances its spending with distortionary taxes, Schmitt-Grohé and Uribe (1997, henceforth SGU) show that the rational expectation equilibrium can be indeterminate under a balanced budget rule. More importantly, calibration of the model shows that the SGU indeterminacy finding holds "within the range of capital and labor income tax rates observed for the United States and other industrialized countries" (p. 977). A number of papers have examined the robustness of the SGU indeterminacy result. Guo and Harrison (2004) focus on the endogeneity of fiscal instruments and show that if endogenous spending is combined with the given income tax rates, the indeterminacy finding of SGU (1997) is no longer valid. Moreover, Guo and Harrison (2008) extend the SGU analysis by introducing productive government spending and conclude that the indeterminacy result remains unchanged. Finally, Xue and Yip (forthcoming) apply the normalized constant elasticity of substitution (CES) production function to study how factor substitution affects the indeterminacy result of SGU (1997). They show that the SGU indeterminacy finding is sensitive to the alternation of the elasticity of substitution. Using the two-step normalization procedure of Klump and Saam (2008), they decompose the effects of factor substitution on the balanced budget rules into an efficiency effect and a distribution effect. For the economically relevant case of relatively more abundant per capita capital, in which these opposing effects are at work, a larger elasticity of factor substitution makes the balanced budget rules less destabilizing and enhances the equilibrium determinacy.

All of the above analyses are based on the Ramsey–Cass–Koopmans model of neoclassical growth. However, another strand of the literature has studied the destabilizing nature of fiscal balanced-budget rules in the segmented asset market economy of Woodford (1986). Using the analytical procedure introduced in the seminal paper by Grandmont et al. (1998), Gokan (2006) examines the effect of a given increase in government spending financed by labor income taxation and shows that multiple equilibria emerge. When the elasticity of factor substitution is sufficiently low, the high steady state becomes indeterminate. Gokan (2008) allows for capital tax financing and finds that indeterminacy is very unlikely with capital taxation. However, when variability of income tax rates is allowed, Gokan (2013) shows that increasing the progressiveness of labor income taxation is stabilizing but the results are ambiguous for capital income taxation. While Gokan (2008, 2013) uses the Cobb–Douglas production technology (with factor-generated externalities), Dromel and Pintus (2008) obtain the same conclusion that progressiveness in the labor income tax rate is stabilizing under general production technology.[1] Finally,

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[1] In their conclusion, Dromel and Pintus (2008) mention that "adding progressive taxes on *capital* income in the Woodford model results in a negligible reduction of

by introducing consumption externalities in preferences, Lloyd-Braga et al. (2008) and Lloyd-Braga and Modesto (2012) investigate the effectsof the variability of tax rates on indeterminacy under Cobb–Douglas production technology. With public consumption externalities, Lloyd-Braga et al. (2008) find that both labor and consumption taxes yield indeterminacy when private and public consumption are Edgeworth complements in preferences. Under a "keep up with the Joneses" setup where the marginal utility of an individual's (worker's) own consumption increases with the aggregate consumption, Lloyd-Braga and Modesto (2012) conclude that sufficiently procyclical labor and/or capital income taxes can ensure saddle path stability. Their finding that capital taxation is stabilizing is crucial as the conventional conclusion is that only progressive labor income tax helps stabilization.[2] In summary, indeterminacy can occur in the Woodford economy when the elasticity of factor substitution (EOS) is low. When tax rate variability is allowed, progressive labor tax is stabilizing under balanced-budget rules.

In this paper, we investigate the effects of constant-rate factor taxation on stabilization in the Woodford model. Because the factor income tax rates are non-progressive (or flat) in our analysis, the balanced-budget rules are likely to be destabilizing. Our focus is on how the degree of factor substitution, as measured by the EOS in production, affects different balanced-budget tax rules on macroeconomic stability. We consider different kinds of balanced-budget rules according to the sources of financing, namely, government spending that is financed by labor income tax, capital income tax, or both.[3] Analytically, with capital income taxation, we show that indeterminacy can occur only when the EOS is very low. Specifically, we need the EOS to be below the steady-state level of capital income share for indeterminate outcomes.[4] However, indeterminacy under labor income taxation is not subject to the above EOS restriction. As a result, labor income taxation is always more destabilizing compared to capital income taxation. The intuition comes from the fact that with labor income taxation, a rise in the tax rate always leads to a reduction in the tax base via intratemporal substitution between consumption and leisure. However, for capital income taxation where intertemporal substitution is involved, the effects on the tax base are ambiguous. When the EOS is low, the tax base increases so that the initial increase in the tax rate cannot be self-fulfilling. Thus, with low EOS, to have indeterminacy the tax base and the tax rate must move in the same direction, implying that we are along the upward-sloping portion of the Laffer curve. Finally, when the incomes from workers and capitalists are taxed at an equal rate in the Woodford model, it is shown that indeterminacy diminishes for sufficiently low EOS. Thus, in terms of macroeconomic stability, capital income taxation can be considered a preferable second-best option.[5]

The remainder of the paper is organized as follows. In the next section, we develop the basic model. Section 3 provides the equilibrium analysis. Sections 4 and 5 characterize the local bifurcations and stability under labor and capital income taxation, respectively. In Section 6, we present our main findings on the comparison of the two types of factor income taxation in relation to macroeconomic stability, i.e., the likelihood of local indeterminacy. We also explore the indeterminacy relation between balanced-budget factor tax rules and the Laffer curve. Section 7 extends the analysis to allow for income taxation on both capitalists and workers. Finally, Section 8 concludes the paper.

2. The model

Consider the one-sector monetary model of Woodford (1986) and Grandmont et al. (1998) in which balanced-budget rules are introduced. There are two types of infinitely long-lived agents: workers and capitalists. Only workers supply labor and are subject to a liquidity constraint. It is well documented in the literature on the Woodford model that workers are more impatient than capitalists. As a result, in the neighborhood of a monetary steady state, the workers do not hold any capital and the liquidity constraint is always binding. Alternatively, the capitalists hold capital but no money. Three types of taxation are studied in this paper: labor income tax on workers, capital income tax on capitalists, and a general equal-rate tax on the incomes of all agents. Finally, the government follows the balanced-budget rule as in Schmitt-Grohé and Uribe (1997).

In the following analysis, we focus on an overlapping generation structure in which the corresponding equations reflect the actual dynamics near the monetary steady states. The workers choose their optimal labor supply for today (l_t), save their after-tax income in the form of money holdings (M_t), and consequently decide their consumption for the next period (c^w_{t+1}). Formally speaking, the optimal problem for the representative worker is

$$\begin{aligned} &\max \frac{\left(c^w_{t+1}/B\right)^{1-\phi}}{1-\phi} - \rho\frac{l_t^{1+\chi}}{1+\chi}, \\ &\text{s.t.} \quad M_t = p_t\left(1-\tau^w_{lt}\right)w_t l_t = p_{t+1}c^w_{t+1}, \end{aligned} \tag{1}$$

where $B > 0$ is a scaling parameter, $\rho \in (0, 1)$ is the common discount factor of workers, and $0 < \phi < 1$ and $\chi > 0$ are the reciprocal of the intertemporal elasticity of substitution and the inverse of the labor supply elasticity, respectively. Moreover, w_t is the real wage, p_t is the price of output today, and τ^w_{lt} denotes the tax rate on the wage income. To keep things simple, the price of output in the next period (p_{t+1}) is known by workers today with perfect foresight. Solving the optimal problem gives the intertemporal relation between the future consumption of workers and the labor supply as

$$c^w_{t+1}/B = l_t^{\gamma}, \tag{2}$$

where $\gamma \equiv (1+\chi)/(1-\phi) > 1$, implying that the elasticity of the labor supply with respect to the real wage is positive.

Capitalists are assumed not to supply labor and their utility function is defined over their consumption (c^c_t) only in logarithmic form. Because the real return on capital is higher than that of the money balances at and nearby the monetary steady state, capitalists choose to hold capital (k_t) only. Their lifetime optimization problem is

$$\max \sum_{t=1}^{\infty} \beta^{t-1} \ln c^c_t,$$

subject to the budget constraint in each period t,

$$k_t + c^c_t = \left[(1-\delta) + \left(1-\tau^c_{kt}\right)r_t\right]k_{t-1}, \tag{3}$$

the set of parameter values that is associated with local indeterminacy" (p. 344). Nevertheless, our paper does not deal with the progressiveness of income taxation.

[2] Other extensions of the Woodford (1986) model include Cazzavillan et al. (1998) and Barinci and Chéron (2001) with productive externalities, and Lloyd-Braga and Modesto (2007) and Dufourt et al. (2008) on the effect of labor market institutions.

[3] In the limiting case where capitalists do not consume, as in Grandmont et al. (1998), labor income taxation is equivalent to consumption taxation, see Gokan (2006).

[4] Because the empirical plausible range of the EOS is between 0.4 and 0.6 according to Chirinko (2008), capital income taxation is likely to be stabilizing as the capital income share is usually below 1/3, which is smaller than the EOS.

[5] This finding on the comparison between labor and capital income taxation corroborates the recent results of Conesa et al. (2009) and Chen et al. (2013).