Tax Havens, Growth, and Welfare

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Abstract

This paper develops an endogenous growth model featuring tax havens, and uses it to examine how the existence of tax havens affects the economic growth rate and social welfare in high-tax countries. We show that the presence of tax havens generates two conflicting channels in determining the growth effect. First, the *public investment effect* states that tax havens may erode tax revenues and in turn decrease the government's infrastructure expenditure, thereby reducing growth. Second, the *tax planning effect* of tax havens reduces marginal cost of capital and hence encourages capital accumulation so as to spur economic growth. The overall growth effect is ambiguous and is determined by the extent of these two effects. The welfare analysis shows that tax havens are more likely to be welfare-enhancing if the government expenditure share in production is low, or the initial income tax rate is high. Moreover, the welfare-maximizing income tax rate is lower than the growth-maximizing income tax rate if tax havens are present.

Keywords: tax havens, endogenous growth, optimal income tax
JEL classification: H21, O11, O41

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1. Introduction

Tax havens have attracted increasing attention from policy-makers in recent years. By definition, the term "tax haven" refers to a jurisdiction that imposes little or no taxes and offers itself as a place to be used by non-resident firms or individuals to escape the tax burden in their home country (OECD, 1998). The empirical evidence reveals that in 2006, US foreign direct investment in tax havens amounted to around 4% of GDP.[1] With the presence of tax havens, multinational firms can engage in *interest stripping* paperwork; more specifically, they can generate interest deductions in a high-tax host country by directing interest payments to low-tax haven countries. In practice, however, tax havens are usually regarded as "harmful" and need to be eliminated by the high-tax countries. As stressed in the 1998 OECD report, "governments cannot stand back while their tax bases are eroded through the actions of countries which offer taxpayers ways to exploit havens to reduce the tax that would otherwise be payable to them."

This traditional "negative" viewpoint of tax havens is theoretically modeled by Slemrod and Wilson (2009), in which tax havens are viewed as "parasites" on the tax bases of high-tax countries and thus decrease public good provision. Therefore, the elimination of tax haven activities can certainly increase tax revenues and improve social welfare. This negative view is also supported by Krautheim and Schmidt-Eisenlohr (2011), who consider tax competition between a tax haven and a large country with heterogeneous firms. As for campaigning against tax havens, Elsayyad and Konrad (2012) argue that the current OECD process against tax havens, which is to reduce the number of tax havens instead of eliminating them altogether, can be

[1] In 2006, US direct foreign investment amounted to US$2,477 billion and US GDP amounted to US$13,399 billion (US Bureau of Economic Analysis; http://www.bea.gov). Moreover, according to Dharmapala (2008), a fraction of about 25% of US direct foreign investment is located in tax havens, which would have been US$619 billion in 2006. Therefore, it can be roughly inferred that US foreign direct investment in tax havens account for around 4.6% of GDP.

harmful to welfare in OECD countries.

However, whether the existence of tax havens is unfavorable to high-tax countries becomes more controversial due to the fact that a growing number of studies propose some new "beneficial" viewpoints of tax havens. For example, in their empirical study, Desai et al. (2006a) find that the multinational firms benefit from tax haven operations by paying significantly lower taxes compared to non-multinational firms. Hong and Smart (2010) show that tax havens can provide firms with opportunities for *international tax planning*, which makes the firms more willing to invest and thus benefits the workers in the home country. As a result, Hong and Smart (2010) find that an increase in tax planning stemming from tax havens is associated with a higher level of social welfare. Johannesen (2010) proposes that tax havens make it less attractive for countries to set a low tax rate and thus have the effect of mitigating the problem of tax competition. He further shows that this positive effect could possibly dominate other negative effects, thereby enabling high-tax countries to benefit from the existence of tax havens.[2]

This paper develops a general equilibrium model featuring endogenous growth and tax havens. We ask the following question: Does the existence of tax havens lead to a deterioration in the growth of high-tax host countries? Our analysis points out that the answer to the question is uncertain and is determined by two conflicting effects. First, tax avoidance activities resulting from tax havens erode the tax bases and thus reduce government spending on core infrastructure, which tends to depress the economic growth rate (namely, the *public investment effect*). Second, tax havens provide firms with opportunities for international tax planning, such as interest stripping activities. For example, firms can set up an affiliate in a tax haven, and

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[2] Other studies on the positive view of tax havens include Desai et al. (2006b) and Hines (2005, 2006). See Dharmapala (2008) for a detailed survey.

then finance investment through a loan from that overseas affiliate. In doing so, the interest income is taxed at a lower (zero) rate in the tax haven and the interest payment is deducted at a higher rate in the home country. Hence the firms' tax burden is reduced; in other words, such tax planning lowers the marginal cost of capital, and in turn increases the incentives for capital accumulation. As a result, the firms are more willing to invest, thereby stimulating the economic growth rate (namely, the *tax planning effect*). The overall growth effect therefore crucially depends on the two opposing forces.

By taking the growth effect into account, we demonstrate that the level of social welfare in the second-best equilibrium may be higher or lower in the presence of tax havens. This result could be treated as a vehicle to synthesize the previous mixed results (the traditional "negative" view and the new "beneficial" view) of the welfare effect of tax havens. It should be noted that although our conclusion that tax havens may increase the welfare in high-tax countries is similar to Hong and Smart (2010), the main intuition behind our result and theirs is quite different. In the present paper, the social welfare reflects the representative household's consumption path. On the one hand, the tax planning effect reduces welfare since it encourages capital accumulation and thus reduces consumption. On the other hand, if tax havens boost growth, they can raise the slope of the consumption path and enhance welfare (i.e., the growth-stimulating effect). If the latter effect outweighs the former, tax havens can improve the social welfare. This growth-stimulating effect is not considered in previous studies supporting the new beneficial view of tax havens.

Our simulation results further point out that the welfare effect of tax havens crucially depends on two parameters: the initial income tax rate and the government expenditure share in production. The basic idea is that if the economy is initially at its efficient state, then introducing tax havens is a distortion and thus depresses social welfare. However, if the economy is inefficient in the sense that the initial income tax rate is too high or the government expenditure share in production is too small, tax havens could act as a correcting device to remedy the unjustifiably high tax rates.

The structure of this paper is arranged as follows. In Section 2 we explain the motivation of our endogenous growth approach, and discuss what new implications we can add to the existing literature. In Section 3 we establish an endogenous growth model that incorporates tax havens. Within this framework, we examine the growth effect of tax havens in Section 4, and study the welfare implications in Section 5. The optimal (welfare-maximizing) and growth-maximizing income tax rates are investigated in Section 6. The last section concludes.

2. Motivation: Why the Growth Approach?

In order to strengthen the motivation of our approach, in this section we first abstract from the context of growth and present a simple tax competition model with tax havens. We use this conventional model to discuss previous results of tax havens, and then provide an idea of the possible implications if the context of endogenous growth is brought into the picture, both in the literature on tax havens and that on endogenous growth.

2.1. A simple tax competition model with tax havens

The model presented in this subsection is generally based on Hong and Smart (2010) and Haufler and Runkel (2012). Let us consider a large number of identical (non-haven) countries, each of which contains many competitive and identical firms (we normalize the number of firms to unity), a^k capitalists, and a^l workers. Each capitalist possesses κ units of immobile capital k^n and one unit of mobile capital k^m. Each worker is immobile between countries and is endowed with one unit of labor that is inelastically supplied to firms. A representative firm hires the immobile capital, mobile capital, and labor to produce a single final good. The two types of capital are perfect substitutes in the production process.

In addition to the non-haven countries, there also exist some countries levying no taxation on capital income, to which we refer as tax havens. As discussed earlier, tax havens enable the firms to engage in international tax planning. A firm can set up a financial subsidiary in a tax haven, which makes an intra-company loan (by paperwork) to its parent company. The home country of the parent company allows the deduction of an interest payment for this loan, while the tax haven levies no tax on the interest income of the subsidiary. We follow Hong and Smart (2010) to assume that a firm's internal debt to its subsidiary is bounded by an exogenous proportion, denoted by $\phi \in [0,1)$, and that this bound is always binding. Accordingly, the profit function of the representative firm is written as:

$$\Psi = f(k) - k^n(r^n + t) - k^m[r^m + (1-\phi)t] - a^l w,$$

where $k = k^n + k^m$ is the total capital employed, w denotes the wage rate, and r^n and r^m are the net returns on immobile capital and mobile capital, respectively. The government imposes a source-based tax at the rate t on each unit of capital. The production function has the standard properties $f' > 0$ and $f'' < 0$.[3]

Let u^k and u^l denote the utility of a capitalist and a worker, respectively, so that we have $u^k = \kappa r^n + r^m$ and $u^l = w = \left[f(k) - k f'(k) \right] / a^l$.[4] Thus, the social welfare W can be defined as a weighted utilitarian function:

$$W = a^k u^k + a^l u^l + (1+\varepsilon)T,$$

where T denotes the total tax revenues. The parameter $\varepsilon > 0$ represents the higher weight that the government attaches to the tax revenues. The possible justification for $\varepsilon > 0$ is that the tax revenues can be used for income redistribution,

[3] The fixed input labor is omitted from the production function to simplify the notation.
[4] For analytical simplicity, we assume that the individual's utility is linear in income.

or to reduce the excess burden of other more distortionary taxes (see, e.g., Lai, 2009; Hong and Smart, 2010; Haufler and Runkel, 2012).

To investigate the welfare effect of tax havens, we differentiate W with respect to the parameter that captures the degree of international tax planning, ϕ, which gives:[5]

$$\frac{dW}{d\phi}=\frac{-a^{k2}\kappa(1-\phi+\kappa)\varepsilon^2 f''}{(1+\varepsilon)(1-\phi)^3}>0.$$

The above equation is parallel to the interesting result in Hong and Smart (2010) that tax havens increase the welfare of high-tax countries. The insight for this result is that governments in a small open economy would ideally like to impose a positive tax rate on immobile capital and a zero tax rate on perfectly mobile capital (multinationals), whereas for some practical reasons the governments are unable to discriminate against them. Therefore, the existence of tax havens potentially improves welfare by giving rise to the desirable differential tax treatment of the two kinds of capital.

2.2. What new can be learned from our growth model?

In this subsection we discuss which elements may be missing in the conventional model mentioned above. Broadly speaking, our adoption of the endogenous growth model proposed by Barro (1990) could generate new implications for conventional models at least in the following four significant respects.

First, in the tax competition model, a tax haven is beneficial to welfare mainly because it attracts capital inflow ($\partial k/\partial\phi=-t/f''>0$). As discussed in Chu (2012), it is relevant to examine the relationship between tax havens and economic growth because capital accumulation is one of the main driving forces of growth. In other words, tax havens affect the incentive to invest, and in turn affect growth that is

5 A detailed derivation of this equation is available from the authors upon request.

relevant to welfare. Therefore, it is fair to say that the welfare analysis of tax havens should not lack an appropriate discussion on the linkage between tax havens and economic growth. Although conventional models can provide insightful viewpoints, these models are static in nature, and thus are not very suitable for studying the issue of economic growth. For the purpose of examining the relationship between the behavior of tax haven activities and long-term growth in high-tax countries, it would be better to resort to a (dynamic) growth model. On these grounds, our approach contributes to the existing literature by being capable of studying the growth effect of tax havens.[6]

Second, in the tax competition model the tax revenues are often used to provide public goods to increase the individual's utility, to reduce other distortionary tax, or to redistribute income (captured by the parameter ε). None of these purposes are related to the production side. In the present Barro-type endogenous growth model, however, tax revenues are assumed to be used to establish public infrastructure, which generates a positive external effect on the private production. As will be seen later, this setup creates an additional *public investment effect* of tax havens. In particular, we will demonstrate that this effect, which is not considered in conventional models, plays an important role in determining the growth and welfare effects of tax havens.

Third, conventional models often consider a small open economy (in the sense that the return on mobile capital r^m is exogenously given); our analysis instead deals with a relatively large economy in which the return on capital can be endogenously adjusted. Furthermore, these tax competition models typically assume that the

[6] Bucovetsky (2011) studies the issue of tax havens in a dynamic partial equilibrium model. The dynamics in his paper is related to the reputation of tax havens when the interactions between firms and havens are repeated infinitely, and is not directly related to the present growth model. Koethenbuerger and Lockwood (2010) study the effect of tax competition within an endogenous growth model but does not deal with the issue of tax havens. The most related paper is Chu (2012), who develops an Ak-type endogenous growth model to study the optimal thin capitalization rules. His paper does not, however, consider imperfect competition and public infrastructure.

multinational firms are in the competitive price-taking position and earn zero profit. By contrast, our analysis introduces imperfect competition so that firms are able to earn a positive profit. Adopting such a framework not only justifies the firms' active choices in international tax planning but also, more importantly, enables us to analyze how distinct market structures influence the welfare effect of tax havens.

Fourth, as for practicality, in 2013 the G8 Lough Eene Declaration declared that countries should change the rules that let companies shift their profits across borders to avoid taxes because fair taxes and promoting transparency are critical for growth and economic development across the world. Our results, which explore the conditions under which tax havens may harm the economic growth rate, are particularly valuable for policy-makers in high-tax developing as well as developed countries who are concerned that tax havens may impede their country's development.

2.3. The Barro Proposition

In addition to the contributions to the literature on tax havens, our results are also related to the issue of the optimal income tax rate in the literature on endogenous growth. In his frequently-cited paper, Barro (1990) shows that the optimal income tax rate (i.e., the welfare-maximizing tax rate) is equal to the growth-maximizing tax rate. This result is widely discussed in the literature on endogenous growth models featuring government expenditure (see, e.g., Futagami et al., 1993; Turnovsky, 2000; Ott and Turnovsky, 2006; Agénor, 2008; Fullerton and Kim, 2008; Gong and Zou, 2011), and is dubbed the Barro proposition by Ott and Turnovsky (2006). In this paper we reexamine the Barro proposition by introducing international tax planning resulting from the emergence of tax havens. We find that tax planning provides a new effect for the optimal tax rate. In the presence of tax havens, the income tax rate generates an additional channel that distorts the decision between consumption and savings, thereby reducing social welfare. As a consequence, the optimal income tax rate is lower than the growth-maximizing income tax rate.

3. An Endogenous Growth Model with Tax Havens

3.1. The model

The model we set up incorporates imperfect competition and tax havens into an otherwise standard endogenous growth model proposed by Barro (1990), in which the tax financed government services have a positive externality on the production sector. The economy is comprised of a continuum of identical infinitely-lived households, imperfectly competitive multinational firms, and the government.

For simplicity, population is normalized to unity. The representative household derives utility from a consumption bundle C and seeks to maximize its lifetime utility, which is given by:

$$U = \int_0^\infty \frac{C^{1-\sigma}-1}{1-\sigma} e^{-\rho t} dt , \tag{1}$$

where $\rho > 0$ is the constant rate of time preference, $\sigma > 0$ is the inverse of the intertemporal substitution elasticity in consumption, and C is a CES index aggregated across the differentiated varieties of the consumption good. As in Dixit and Stiglitz (1977), we specify that the CES form of aggregate consumption is given by:

$$C = \left(\int_0^1 c_i^{\,1-\theta} di \right)^{\frac{1}{1-\theta}}; \quad 1 > \theta \geq 0 , \tag{2}$$

where c_i is the consumption of the *i*th good, and the parameter θ is the reciprocal of the elasticity of substitution between any two varieties. The parameter θ also represents the degree of monopoly of the multinational firms. The lower that θ is, the better substitutes the varieties are for each other. In the case where $\theta = 0$, the varieties are perfect substitutes, meaning that the goods market is perfectly competitive.[7]

The household inelastically supplies one unit of labor to the firms, implying that labor supply N^s can be expressed by $N^s = 1$. As the owner of the firms, the representative household receives the profits of the firms in the form of dividends. In addition, the household holds physical capital as its asset, and thus receives capital income from lending capital to the firms. To simplify the analysis, the depreciation rate is assumed to be zero. Therefore, the household's budget constraint is given by:

$$\dot{K} = rK + w + \Pi - \frac{\int_0^1 p_i c_i di}{P}, \tag{3}$$

where K is the capital stock, r is the real rental rate of capital, w is the real wage rate, Π denotes the real distributed profits from the firms, and all r, w, and Π are in terms of the price index of (composite) consumption goods P. In addition, p_i is the nominal price of the ith consumption good.

The price index of composite consumption P is postulated to satisfy $\int_0^1 p_i c_i di = PC$. It can be shown that the price index of composite consumption P is given by:

$$P = \left(\int_0^1 p_i^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}}. \tag{4}$$

It should be noted in this paper that the bundle of composite final goods is treated as the *numeraire*, and hence in what follows the price index of composite consumption P is normalized to unity (i.e., $P = 1$).

The household's optimization problem can be solved by applying a two-stage budgeting decision. In the first stage, the household maximizes the discounted sum

[7] When θ=0, the model is equivalent to a model with only one single good. However, the present model with many goods is essential because we wish to examine the tax haven effects under different market structures. In fact, as will be shown in Section 5, θ is crucial in determining the welfare effect of tax havens.

of future instantaneous utilities reported in Eq. (1) subject to the budget constraint reported in Eq. (3) with $\int_0^1 p_i c_i di = PC$ and the initial capital stock K_0. Then, we can formulate the current-value Hamiltonian as follows:

$$H = \frac{C^{1-\sigma} - 1}{1-\sigma} + \lambda [rK + w + \Pi - C], \tag{5}$$

where λ is the shadow value of the physical capital stock K.

By means of some simple manipulations, it is easy to obtain the standard Keynes-Ramsey rule:

$$\frac{\dot{C}}{C} = \frac{1}{\sigma}(r - \rho) \tag{6}$$

In the second stage, the solution to the household's optimization problem yields the demand function for each good:

$$c_i = \left(\frac{p_i}{P} \right)^{-\frac{1}{\theta}} C = (p_i)^{-\frac{1}{\theta}} C. \tag{7}$$

Eq. (7) indicates that (the absolute value of) the price elasticity of demand for the *i*th consumption good is $1/\theta$.

Following Heijdra (2009, pp. 362-363), assume that the household's investment and the government's spending are also composed of differentiated varieties of the consumption good. Let $V(=\dot{K})$ denote the household's composite investment and G denote the government's composite spending. As in the case of the household's consumption, both the household's composite investment and the government's composite spending can respectively be expressed as:

$$V = \left(\int_0^1 v_i^{1-\theta} di \right)^{\frac{1}{1-\theta}}; \quad 1 > \theta \geq 0, \tag{8a}$$

$$G = \left(\int_0^1 g_i^{1-\theta} di \right)^{\frac{1}{1-\theta}}; \quad 1 > \theta \geq 0, \tag{8b}$$

where v_i denotes the household's investment for the *i*th good and g_i denotes the government's spending on the *i*th good. It should be noted from Eq. (8b) that the government purchases a variety of goods g_i, $i \in [0,1]$, to establish core infrastructure, and hence the government's composite spending G can also be treated as an index to reflect core infrastructure.

By a similar derivation to that of the household's consumption of the *i*th good, the household's investment for the *i*th good v_i and the government's spending on the *i*th good g_i, $i \in [0,1]$, can respectively be expressed as:

$$v_i = \left(\frac{p_i}{P} \right)^{-\frac{1}{\theta}} V = (p_i)^{-\frac{1}{\theta}} V . \tag{9a}$$

$$g_i = \left(\frac{p_i}{P} \right)^{-\frac{1}{\theta}} G = (p_i)^{-\frac{1}{\theta}} G . \tag{9b}$$

Based on Eqs. (7), (9a) and (9b) and $P = 1$, we can define the total demand for each good $y_i (= c_i + v_i + g_i)$ as follows:[8]

$$y_i = (p_i)^{-\frac{1}{\theta}} (C + \dot{K} + G) . \tag{10}$$

We then define the aggregate demand for composite goods $Y^d = C + \dot{K} + G$, and hence Eq. (10) can be rewritten as:

$$y_i = (p_i)^{-\frac{1}{\theta}} Y^d . \tag{11}$$

3.2. International tax planning

We now turn to formulate how the multinational firms avoid their tax burden via the existence of tax havens. We borrow the theoretical ideas from Slemrod and Wilson (2009) and Hong and Smart (2010). Assume that each multinational firm has an affiliate located in a tax haven jurisdiction, and that the firm can finance investment through a loan from an overseas affiliate. The government of the host country, as in Barro (1990), levies a flat-rate income tax but allows for the interest

[8] Heijdra (2009, Ch.12) and Coto-Martínez (2006) make a similar assumption and hence derive a similar function for the total demand for each good.

payments to the haven affiliate to be deductible from host taxable income. Accordingly, the multinational firms that maximize profits are capable of choosing the proportion of interest payments to the haven affiliate (interest stripping activities). The avoidance services provided by the tax havens are not a free lunch and require some (operating) costs, which are correlated with the proportion of interest stripping (to be discussed later).

We then deal with the behavior of the monopolistically competitive firms. In line with the viewpoint proposed by Aschauer (1989), Barro (1990), Turnovsky and Fisher (1995), the production technology of the *i*th firm for product y_i is expressed as:

$$y_i = Ak_i^{1-\alpha} n_i^{\mu} G^{\alpha}, \quad 0 \le \alpha < 1, \quad 0 < \mu < 1, \tag{12}$$

where $A > 0$ is a productivity parameter, n_i is the labor input, and G is the government's infrastructure expenditure. In relation to Eq. (12), three points should be mentioned here. First of all, the government's infrastructure expenditure G has a positive external effect on the private production with the degree of production externalities α. The production function reduces to the typical *AK* production function in the absence of production externalities (i.e., $\alpha = 0$). Second, as in the literature, the production function exhibits constant returns to scale in the two growing variables, k and G.[9] This setting, that enables the economy to grow continuously, is the nature of endogenous growth models. Third, private capital and public expenditure are Edgeworth complements in the production process;[10] hence we do not consider the crowding out effect of public investment on private

[9] More generally, the production function should read as $y_i = Ak_i^{1-\alpha} n_i^{\mu} G^{\eta}$ where η denotes the degree of production externalities. However, to sustain a continual growth rate, in line with the standard literature (e.g., Barro, 1990; Barro and Sala-i-Martin, 2004; Barman and Gupta, 2010) we impose the restriction $\eta = \alpha$.

[10] By definition, private capital and public expenditure are Edgeworth complements (substitutes) if $\partial(\partial y_i / \partial k_i) / \partial G$ is positive (negative). See, for example, Lindbeck and Snower (1994).

investment.

Based on Eqs. (11) and (12), the maximization problem of the *i*th firm can be expressed as follows:

$$\underset{k_i, n_i, s_i}{Max}\, \pi_i = (1-\tau) p_i y_i - rk_i - wn_i + \tau s_i rk_i - h_i(s_i, r, k_i), \tag{13a}$$

$$s.t.\ \ y_i = (p_i)^{-\frac{1}{\theta}} Y^d\ , \tag{13b}$$

$$y_i = Ak_i^{1-\alpha} n_i^{\mu} G^{\alpha}. \tag{13c}$$

where τ is the income tax rate, and s_i is the proportion of interest stripping, and thus the amount of $s_i rk_i$ is deductible from the taxable income. The term $h_i(s_i, r, k_i)$ represents the total cost required to engage in tax avoidance. In order to obtain tractable results, we assume that $h_i(s_i, r, k_i)$ is a linear function of k_i.[11] Moreover, according to Stöwhase (2005), Haufler and Runkel (2012), and Johannesen (2010), it is reasonable to assume an increasing marginal cost of tax avoidance. Therefore, we follow their settings to consider a convex cost function, which is of the form:

$$h_i(s_i, r, k_i) = \frac{\beta}{2} s_i^2 rk_i. \tag{14}$$

The parameter $\beta\,(>0)$ describes the size of the operating cost for engaging in tax haven activities. Conceptually, the parameter β can be interpreted as the relative size of the accounting fees, or the cost needed to search for the available tax havens. To be more specific, a higher value of β reflects a situation in which it is more difficult for the multinational firms to engage in tax avoidance via the existence of tax havens. As β is extremely large ($\beta \to \infty$), the operating cost is too high for the firm to locate any affiliate in tax havens (or there are no available tax havens for the

[11] In an endogenous growth model, it is necessary to assume that the cost grows jointly with another growing factor, e.g., capital. This is admittedly a simplified assumption since there is empirical evidence in support of scale economies in tax planning involving tax havens.

firms in the home countries). Under such a situation, no tax haven activities will be undertaken, and the economy will reduce to Barro's (1990) model with imperfect competition.

Thus the first-order conditions for the firm's problem are:

$$(1-\tau)(1-\theta)\frac{\partial y_i}{\partial k_i}\frac{y_i}{Y^d} = r(1-\tau s_i + \frac{\beta}{2}s_i^{\,2}), \tag{15a}$$

$$(1-\tau)(1-\theta)\frac{\partial y_i}{\partial n_i}\frac{y_i}{Y^d} = w, \tag{15b}$$

$$s_i = \frac{\tau}{\beta}. \tag{15c}$$

Eq. (15a) points out that the marginal revenue product of capital is equal to the marginal cost of capital MFC_k. Eq. (15c) indicates that the optimal avoidance s_i is positively related to the income tax rate and negatively related to the parameter that reflects the extent of the operating cost. When $\beta \to \infty$, the firm's optimal avoidance approaches zero, meaning that tax avoidance activities are unavailable in the economy. In addition, to exclude the possibility that the amount of the firms' deductible interest payments exceeds the actual total interest payments, in what follows we impose the restriction $\beta \geq \tau$ to ensure that s_i cannot be greater than unity.

The government is subject to a balanced-budget requirement, and levies an income tax on the firms to finance government expenditure. Hence, the government's budget constraint is given by:

$$\int_0^1 p_i g_i di = \int_0^1 (\tau\, p_i y_i - \tau s_i r k_i) di. \tag{16}$$

3.3. Symmetric macroeconomic equilibrium

We focus our analysis on a symmetric equilibrium in which all firms make the same decisions so that $p_i = p$, $y_i = y$, $n_i = n$, $k_i = k$, $s_i = s$, $h_i = h$, and $\pi_i = \pi$. Since Π stands for the real distributed profits of the firms, we can define

$\Pi = \int_0^1 \pi_i di$ $(= \pi)$. Moreover, let N denote the aggregate labor demand, K denote the aggregate capital demand, and Y denote the aggregate output. Then, we have $N = \int_0^1 n_i di$, $K = \int_0^1 k_i di$, and $Y = \int_0^1 y_i di$. Given that the symmetric conditions require that $y_i = y$ and $p_i = p$ and that the price index of composite consumption P is normalized to unity (i.e., $P = 1$), we can further infer from the definitions $Y = \int_0^1 y_i di$ and $P = \left(\int_0^1 p_i^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}}$ that $Y = y$ and $P = p = 1$. Accordingly, the government's budget constraint reported in Eq. (16) can be rewritten as $G = \tau(Y - srK)$. Lastly, by inserting $\Pi (= \pi)$ and Eqs. (15a)-(15c) into the household's budget constraint, Eq. (3), and using the above symmetric relationships, we can obtain the resource constraint of this economy $Y = C + \dot{K} + G + h$.

Based on the above discussion, the main equations of the symmetric equilibrium of the economy can then be described by the following equations:

$$\frac{\dot{C}}{C} = \frac{1}{\sigma}(r - \rho), \tag{17a}$$

$$(1-\tau)(1-\theta)(1-\alpha)\frac{Y}{K} = r(1 - \tau s + \frac{\beta}{2}s^2), \tag{17b}$$

$$(1-\tau)(1-\theta)\mu\frac{Y}{N} = w, \tag{17c}$$

$$s = \frac{\tau}{\beta}, \tag{17d}$$

$$\dot{K} = Y - C - G - \frac{\beta}{2}s^2 rK, \tag{17e}$$

$$Y = AK^{1-\alpha}N^{\alpha}G^{\alpha}, \tag{17f}$$

$$G = \tau(Y - srK), \tag{17g}$$

$$\Pi = (1-\tau)Y - rK - wN + \tau srK - \frac{\beta}{2}s^2 rK, \tag{17h}$$

$$N = N^s = 1. \tag{17i}$$

As mentioned before, the right-hand side of Eq. (17b) is the marginal cost of capital MFC_k. Given $s=\tau/\beta$ reported in Eq. (17d), the marginal cost of capital can be alternatively expressed as $MFC_k = r[(2\beta-\tau^2)/2\beta]$. To facilitate our subsequent discussion, it is convenient to define $\Delta(\tau,\beta)=(2\beta-\tau^2)/2\beta$, and hence we have the following result: $MFC_k = r\Delta(\tau,\beta)$.

In line with the literature on endogenous growth, we define the balanced-growth path as a competitive equilibrium where all growing variables (C,Y,K,G) grow at a common endogenous growth rate denoted by $\tilde{\gamma}$:

$$\tilde{\gamma}=\frac{\dot{C}}{C}=\frac{\dot{K}}{K}=\frac{\dot{Y}}{Y}=\frac{\dot{G}}{G}. \tag{18}$$

Moreover, for future use we define a transformed variable: $g=G/K$, which represents the ratio of government investment to the capital stock.

Let us focus the analysis on the steady-state solution. By using Eqs. (17a)-(17i), (18), and the transformed variable $g=G/K$, we can obtain the following steady-state relationships:

$$\tilde{\gamma}=\frac{1}{\sigma}(\tilde{r}-\rho), \tag{19a}$$

$$(1-\tau)(1-\theta)(1-\alpha)A\tilde{g}^{\alpha}=\tilde{r}\Delta(\tau,\beta), \tag{19b}$$

$$\tilde{g}=\tau A\tilde{g}^{\alpha}-\frac{\tau^2}{\beta}\tilde{r}, \tag{19c}$$

where a tilde represents the steady-state values. It is easy to obtain that the function $\Delta(\tau,\beta)=(2\beta-\tau^2)/2\beta$ has the following properties: $\Delta(\tau,\infty)=\Delta(0,\beta)=1$, $\Delta_\beta=\partial\Delta/\partial\beta>0$, and $\Delta_\tau=\partial\Delta/\partial\tau<0$. Based on Eqs. (19a)-(19c), the closed-form solutions of the balanced growth rate and the government investment ratio are calculated as:

$$\tilde{\gamma}=\frac{1}{\sigma}\left(\frac{A}{\Delta}(1-\tau)(1-\theta)(1-\alpha)\left[\tau A-\frac{\tau^2}{\beta\Delta}(1-\tau)(1-\theta)(1-\alpha)A\right]^{\frac{\alpha}{1-\alpha}}-\rho\right), \tag{20}$$

$$\tilde{g} = \left[\tau A - \frac{\tau^2}{\beta\Delta}(1-\tau)(1-\theta)(1-\alpha)A \right]^{\frac{1}{1-\alpha}}. \tag{21}$$

In the next sections, we utilize Eqs. (20) and (21) to analyze how the economic growth rate is related to the behavior of tax havens.

4. The Growth Effect of Tax Havens

We are now in a position to examine the growth effects in the presence of tax havens. We first infer the relationship between the government investment ratio and tax havens. From Eq. (21) the following result can be derived:

$$\frac{d\tilde{g}}{d\beta} = \frac{1}{1-\alpha}\tilde{g}^{\alpha}\left[(1-\tau)(1-\theta)(1-\alpha)A\frac{4\tau^2}{(2\beta-\tau^2)^2} \right] > 0. \tag{22}$$

Note that an increase in β is associated with less utilization of tax havens. Therefore, Eq. (22) indicates that tax havens are harmful to tax revenues so that the elimination of tax havens will increase government expenditure. This finding is consistent with the result of Slemrod and Wilson (2009), who claim that the existence of tax havens ambiguously erodes tax revenues, and hence reduces the provision of public goods.

From Eq. (20) we can infer the relationship between the balanced growth rate and the utilization of tax havens:

$$\frac{d\tilde{\gamma}}{d\beta} = (1-\tau)(1-\theta)(1-\alpha)A\frac{1}{\Delta\sigma}\left[\underbrace{-\frac{\Delta_\beta}{\Delta}\tilde{g}^{\alpha}}_{\text{Tax planning effect}} + \underbrace{\alpha\tilde{g}^{\alpha-1}\frac{d\tilde{g}}{d\beta}}_{\text{Public investment effect}} \right] \gtrless 0. \tag{23}$$

Eq. (23) reveals that the growth effect of tax havens is ambiguous. As emphasized in Eq. (23), the existence of tax havens affects economic growth through two channels. On the one hand, the services provided by tax havens can offer opportunities for international tax planning, which contributes to a lower marginal cost of capital. As a consequence, growth is boosted as a result of more incentives to accumulate capital. We refer to this effect as the *tax planning effect*, which supports the viewpoint of a beneficial tax haven. On the other hand, tax havens also allow for legal tax avoidance that erodes the tax revenues. Given that the government's infrastructure expenditure is beneficial to private production, the growth rate is depressed following a reduction in government infrastructure expenditure. We refer to this effect as the *public investment effect*. To sum up, whether the existence of tax havens enhances or worsens growth depends mainly on the magnitude of these two opposite forces. Obviously, under the situation in association with $\alpha = 0$, the public investment effect is absent since government expenditure does not play any role in private production. That is to say, under such a situation only the tax planning effect is present so that the elimination of tax havens always causes the balanced growth rate to fall ($d\tilde{\gamma} / d\beta < 0$).

Summing up the above discussion, the following proposition can be established:

Proposition 1. *When government expenditure exerts a positive externality on the private production sector, the elimination of tax havens raises the public investment ratio, and has an uncertain effect on the balanced growth rate. By contrast, if the positive externalities of government expenditure are absent, eliminating tax havens always reduces economic growth.*

5. Welfare Implications

This section deals with how the existence of tax havens affects welfare. We present the results via both analytical and numerical analyses.

5.1. Analytical results

Along the balanced growth equilibrium, the time path of private consumption is given by $C_t = C_0 e^{\tilde{\gamma} t}$, where C_0 is the initial level of consumption. Substituting

$C_t = C_0 e^{\tilde{\gamma} t}$ into Eq. (1), the welfare function (i.e., the indirect life-time utility function of the representative household) can be expressed by:

$$\tilde{U} = \frac{1}{1-\sigma}\left[\frac{C_0^{\;1-\sigma}}{\rho-(1-\sigma)\tilde{\gamma}} - \frac{1}{\rho}\right], \tag{24}$$

where $C_0 = [(1-\tau)A\tilde{g}^{\alpha} + \tau^2 \tilde{r}/2\beta - \tilde{\gamma}]K_0$, and K_0 is the given initial level of the capital stock. Next, by substituting $C_0 = [(1-\tau)A\tilde{g}^{\alpha} + \tau^2 \tilde{r}/2\beta - \tilde{\gamma}]K_0$, Eqs. (19a) and (19c) into Eq. (24), we obtain:

$$\tilde{U} = \frac{1}{1-\sigma}\left\{\frac{\left[\left(\frac{\Delta}{(1-\theta)(1-\alpha)} + \frac{\tau^2}{2\beta} - \frac{1}{\sigma}\right)\tilde{r} + \frac{\rho}{\sigma}\right]^{1-\sigma} K_0^{\;1-\sigma}}{\rho - \frac{(1-\sigma)}{\sigma}(\tilde{r}-\rho)} - \frac{1}{\rho}\right\}. \tag{25}$$

Without loss of generality we assume $K_0 = 1$ in the following analysis.

To examine the welfare effect of tax havens, one can differentiate $\tilde{U}$ with respect to β to obtain the following relationship:

$$\frac{d\tilde{U}}{d\beta} = \frac{C_0^{\;-\sigma}}{\Omega}\left[\underbrace{\left(\frac{1-(1-\theta)(1-\alpha)}{(1-\theta)(1-\alpha)}\right)\Delta_{\beta}\tilde{r}}_{\text{Substitution effect}} + \underbrace{\sigma\left(\frac{\Delta}{(1-\theta)(1-\alpha)} + \frac{\tau^2}{2\beta} - \frac{1}{\sigma} + \frac{C_0}{\sigma\Omega}\right)\frac{d\tilde{\gamma}}{d\beta}}_{\text{Income (growth) effect}}\right], \tag{26}$$

where $\Omega \equiv \rho - (1-\sigma)\tilde{\gamma}$. In line with Barro (1990), we impose the condition $\rho > (1-\sigma)\tilde{\gamma}$ to ensure that the welfare level is bounded, thereby enabling us to ascertain $\Omega > 0$.

We can see from Eq. (26) that the sign of $d\tilde{U}/d\beta$ is either positive or negative due to the undetermined sign of $d\tilde{\gamma}/d\beta$. That is to say, the welfare effect of tax havens is uncertain. To explain this result more intuitively, we divide the impact of tax havens on welfare into two parts, namely, the substitution effect and the income effect (or growth effect). The first term in the brackets in Eq. (26) is the substitution effect, which is positive, indicating that the existence of tax havens is harmful to welfare. The intuition for this effect can be interpreted as follows. First, since the services provided by havens lower the marginal cost of capital, the firms are inclined to use more capital. Second, more use of tax havens results in more resources devoted to tax havens that cannot be used for investment or consumption. In both cases, the effect leads to a lower level of consumption, and thereby causes welfare to decrease. On the other side, the second term in the brackets captures the ambiguous income effect, which states that the existence of tax havens in Eq. (26) will enhance (worsen) welfare by boosting (reducing) the economic growth.[12] Specifically, when $d\tilde{\gamma}/d\beta > 0$, both effects are positive, and thus the elimination of tax havens certainly improves the welfare level. However, when $d\tilde{\gamma}/d\beta < 0$, two conflicting effects work together so that the overall welfare effect is determined by the relative magnitude between these two effects.

The above discussions can be summarized by the following proposition:

Proposition 2. *A tax haven always reduces welfare if it causes economic growth to deteriorate. However, if a tax haven boosts growth, the welfare effect is ambiguous, implying that a tax haven may enhance the welfare of high-tax countries.*[13]

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[12] Let Φ denote the term $\Delta(1-\theta)^{-1}(1-\alpha)^{-1} + \tau^2(2\beta)^{-1} - \sigma^{-1} + c_0(\sigma\Omega)^{-1}$ in Eq. (26). Mathematically, if σ is extremely small, Φ may possibly become negative. The case of $\Phi < 0$ corresponds to the situation in which, other things being equal, the welfare suffers a loss from higher economic growth. We do not intend to deal with this unrealistic case and thus simply assume that $\Phi > 0$. In fact, this condition is met under almost all possible parameter values within a reasonable range.

[13] It should be noted that the utility function does not take into account the endogenous choice of leisure in the analysis. In his growth model with endogenous labor supply, Turnovsky (2000) finds that a rise in the capital tax rate decreases the fraction of time devoted to work and thus reduces growth. On the other hand, he also finds that a rise in government expenditure reduces leisure. Based on these results, it can be inferred that, if we introduce leisure in our model, tax havens (which reduce the effective tax rate as well as the tax revenues) have an additional ambiguous effect on labor time and growth. Both different working time and the growth rate affect the level of welfare. As a result, the welfare effect of tax havens may adjust quantitatively if leisure is introduced into the analysis. We are grateful to an anonymous referee for bringing this point to our attention.

To examine the role of market structure and production externalities in relation to the welfare effect of tax havens, we first deal with the situation where production externalities are absent ($\alpha = 0$). By substituting $\alpha = 0$ into Eq. (26), we can infer that the substitution effect is positive ($\theta \Delta_{\beta} \tilde{r} / (1-\theta) > 0$) and the growth effect is negative (see Proposition 1). Therefore, unlike the growth effect, the welfare effect of tax havens is still uncertain in the absence of production externalities. However, under the situation where production externalities are absent and the product market is perfectly competitive $\alpha = \theta = 0$, the substitution effect is zero and the growth effect is negative, implying that $d\tilde{U} / d\beta < 0$ is true. This means that, with perfect competition in the product market and the absence of production externalities, making greater use of tax havens is associated with a higher level of welfare.

Thus, the following proposition is obtained:

Proposition 3. *With perfect competition and the absence of production externalities, tax havens certainly improve welfare. By contrast, in the presence of imperfect competition, the welfare effect of tax havens is ambiguous even if the government spending has no enhancing effect on private production.*

Proposition 3 sheds light on the role of market structure in determining the welfare effect of tax havens. Intuitively, in the non-distortion case where perfect competition is present and the government spending has no production externality to private-sector production, tax havens that allow the firms to avoid the tax are always welfare-enhancing. However, if the product market is imperfectly competitive, the consumption level will be lower since the firms produce too few goods compared to the case of perfect competition. Introducing tax havens will aggravate this distortion by reducing the marginal cost of capital and thus giving the firms more monopoly power. As a consequence, tax havens lead to an additional negative welfare effect if the firms can exert monopoly power. Therefore, even if the government spending is purely wasteful and tax havens certainly boost economic growth, the effect of tax havens on the welfare level is determined by the relative strength of the positive growth effect and the additional negative effect.

5.2. Numerical results

Due to the mathematical complexity in Eq. (26), we then provide some numerical examples to illustrate the welfare effect of tax havens, and report our numerical results in Table 1. In order to highlight the role of various structural parameters, it is convenient to establish a benchmark scenario. The benchmark scenario involves the following parameter values. First, as frequently documented in the existing literature including Jones et al. (1993) and Zeng and Zhang (2007), the inverse of the intertemporal substitution elasticity in consumption and the time preference rate are set as $\rho = 0.05$ and $\sigma = 1.5$, respectively. Second, in line with Barro (1990), the degree of government expenditure externalities in the production function is set as $\alpha = 0.25$, and the income tax rate is set to be equal to the government expenditure share $\tau = 0.25$. This in turn implies that the government's spending as a proportion of GDP is 24.5%, which is close to the ratio in many developed countries (see, e.g., Gali, 1994, Table 5).

Third, the parameter that describes the monopoly power is specified as $\theta = 0.028$, such that the resulting profit ratio in our economy is 4%, and nearly tallies with the profit ratio of the typical US industry (see, e.g., Basu and Fernald, 1997).[14] Fourth, to test the role regarding the extent to which the tax havens have been utilized, the benchmark value of β is set to 7, indicating that the corresponding tax revenue loss to GDP ratio is 0.5%.[15] We also assume that the firms face a constant

[14] Basu and Fernald (1997) find that the profit ratio of the typical US industry is about 3%. The ratio is expected to be higher for multinationals since they can engage in international tax planning.

[15] For example, Clausing (2009) estimates that the tax revenue loss from international tax planning

returns-to-scale technology so that $\mu = 0.25$. Finally, the productivity parameter $A = 0.383$ is calibrated such that the balanced growth rate is 3%.

Table 1. Welfare effect of tax havens

Baseline parameters: $\alpha = 0.25$, $\rho = 0.05$, $\sigma = 1.5$, $\theta = 0.028$, $\tau = 0.25$, $\mu = 0.25$, $A = 0.383$									
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Baseline	$\alpha = 0.1$	$\alpha = 0.4$	$\sigma = 0.8$	$\sigma = 2.2$	$\theta = 0.01$	$\theta = 0.1$	$\tau = 0.1$	$\tau = 0.4$
$\beta = 1$	-97.1285	-55.8820	-171.663	76.4872	-157.891	-96.8165	-98.3649	-107.842	-98.5244
4	-96.5947	-57.1992	-168.693	76.9455	-156.358	-96.2621	-97.9090	-106.839	-100.874
7	-96.5548	-57.4025	-168.321	76.9893	-156.257	-96.2208	-97.8749	-106.702	-101.288
10	-96.5411	-57.4848	-168.176	77.0055	-156.225	-96.2067	-97.8631	-106.648	-101.458
13	-96.5343	-57.5294	-168.099	77.0139	-156.209	-96.1996	-97.8573	-106.619	-101.551

Table 1 shows the effect of changing the parameter regarding the use of tax havens (β). The numerical results in Table 1 reveal some welfare implications. First, the column labeled (a) in Table 1 shows that, under the benchmark scenario, greater utilization of tax havens (a smaller value of β) reduces the level of welfare. Second, a change in the degree of monopoly power parameter θ and the time preference rate σ only affect the results quantitatively. Third, the benchmark result would be qualitatively reversed following a change in the parameter value of either the government expenditure share or the initial income tax rate. To be more specific, we can find that greater utilization of the tax havens becomes beneficial to welfare in the following two cases: where there is a lower government expenditure share ($\alpha = 0.1$) and/or a higher initial income tax ($\tau = 0.4$). To understand the economic intuition behind this result, one must realize that in the basic Barro (1990) model without any tax havens, the only distortion in the economy consists of the production externalities of government expenditure, which is corrected by the income

may be as high as US$90 billion in 2008, which is 0.5% of the US GDP for that year.

tax. Once we take the existence of tax havens into consideration, one of the major consequences is that it will reduce the "effective" tax rate owing to the participation in tax avoidance activities.[16] If the economy without tax havens is originally at its optimal steady state, then allowing for tax havens constitutes an additional distortion and thus will certainly make the economy worse. On the contrary, if the production externality of government expenditure is very small or the initial income tax rate is too high, the tax havens can serve as a correcting device to remedy the unjustifiably high tax rate. Under such a situation, tax havens improve social welfare. This is what we see in the columns labeled (b) and (i) in Table 1.

6. Optimal Income Tax

In his famous paper, Barro (1990) shows that, in the presence of production externalities, the welfare-maximizing income tax rate is exactly equal to the growth-maximizing tax rate. This section makes an effort to reexamine the validity of the Barro proposition in the presence of tax havens. To this end, by differentiating Eq. (25) with respect to τ we have:

$$\frac{d\tilde{U}}{d\tau} = \frac{C_0^{-\sigma}}{\Omega}\left[\left(\frac{1-(1-\theta)(1-\alpha)}{(1-\theta)(1-\alpha)}\right)\Delta_\tau \tilde{r} + \sigma\left(\frac{\Delta}{(1-\theta)(1-\alpha)} + \frac{\tau^2}{2\beta} - \frac{1}{\sigma} + \frac{C_0}{\sigma\Omega}\right)\frac{d\tilde{\gamma}}{d\tau}\right]. \tag{27}$$

Let τ_γ denote the income tax rate that maximizes the growth rate and τ_U denote the income tax that maximizes welfare. We see from Eq. (27) that, with no tax havens ($\beta \to \infty$), $\Delta_\tau = -\tau/\beta = 0$ is true, and hence the first term in the brackets on the right-hand side is zero. Under such a situation, $d\tilde{U}/d\tau = 0$ if and only if

[16] Let $G = \tau(Y - srK) = \tau_E(\tau,\beta)Y$, where $\tau_E(\tau,\beta)$ denotes the effective income tax rate. We can infer that $\partial\tau_E/\partial\tau > 0$ and $\partial\tau_E/\partial\beta > 0$. The latter indicates that introducing tax havens (decreasing β) reduces the effective income tax rate.

$d\tilde{\gamma}/d\tau = 0$, implying that $\lim_{\beta \to \infty} \tau_\gamma = \lim_{\beta \to \infty} \tau_U$. This is the well-known Barro's proposition. However, if tax havens are present (when β is positive and relatively small), we have $\Delta_\tau < 0$, thereby rendering the first term in the brackets in Eq. (27) negative. Then, we can infer from Eq. (27) that $d\tilde{U}/d\tau$ is negative as $d\tilde{\gamma}/d\tau = 0$. As a consequence, we can conclude that $\tau_\gamma > \tau_U$ in the presence of tax havens. We depict the above discussions in Figure 1.

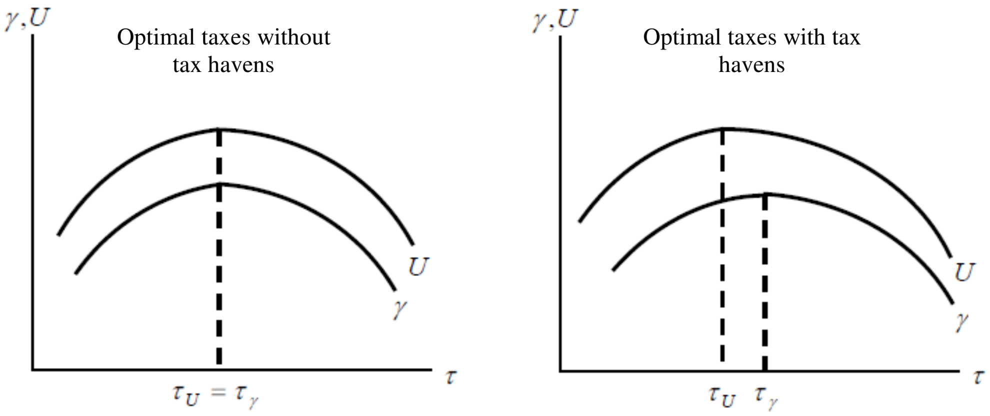

Figure 1. The optimal income tax rate

The intuition of Figure 1 can be understood as follows. As mentioned above, it is clear from Eq. (27) that the main reason for $\tau_\gamma > \tau_U$ lies in Δ_τ, which reflects the effect of income tax on the marginal cost of capital. To be more specific, once the tax avoidance services provided by tax havens are available, raising the income tax rate has an additional effect of increasing the benefit of tax avoidance behaviors and thus further decreases the marginal cost of capital ($\Delta_\tau < 0$). This in turn leads the firm to boost investment (use more capital) and crowds out private consumption. As a result, the level of welfare is reduced in association with a lower level of consumption. In other words, the existence of tax havens leads the income tax to generate an additional distortionary effect on the allocation of resources between saving (investment) and consumption. This additional effect does not emerge in the Barro economy, in which the welfare-maximizing income tax rate is equal to the growth-maximizing tax rate.

Proposition 4. *With the existence of tax havens, the welfare-maximizing income tax rate is lower than the growth-maximizing income tax rate.*

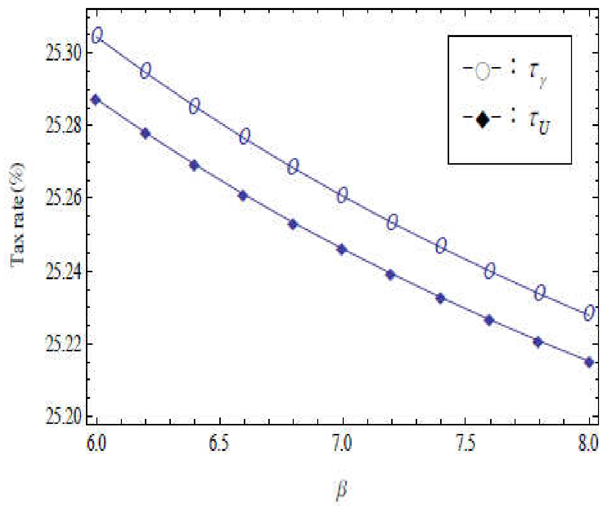

Figure 2. The welfare-maximizing and growth-maximizing income tax rates

A numerical illustration of Proposition 4 is exhibited in Figure 2. We utilize the same parameter values under the benchmark scenario. Several findings revealed in Figure 2 deserve some comments. First, both τ_γ and τ_U decrease with β, meaning that the growth-maximizing tax rate and the welfare-maximizing tax rate need to be higher with more tax haven activities. This is obviously because tax havens reduce the effective tax rates in high-tax countries. Second, given that our baseline parameter regarding the government expenditure share is $\alpha = 0.25$, the Barro proposition is valid if $\tau_\gamma = \tau_U = \alpha = 0.25$. As is clearly displayed in Figure 2, $\tau_\gamma > \tau_U > \alpha = 0.25$ is true. This result indicates that the growth-maximizing income tax rate is greater than the welfare-maximizing income tax rate, and hence the Barro proposition becomes invalid by introducing tax havens. Third, in association with a lower extent of tax haven activities (a higher β), the gaps between tax rates (τ_γ and τ_U) and α decline. Not surprisingly, when we increase β to approach infinity, both τ_γ and τ_U coincide with the $\alpha = 0.25$ in the simulation model, indicating that the Barro proposition holds in the absence of tax havens.

7. Concluding Remarks

This paper makes an attempt to study the consequences of the recent rise of tax havens on economic growth and social welfare in high-tax countries. Our analysis shows that the growth rate of high-tax countries may either increase or decrease with the presence of tax havens. To be specific, the rise of tax havens affects economic growth through two conflicting channels, namely, the positive tax planning effect and the negative public investment effect. The overall growth effect is determined by the relative strength between these two forces. As for welfare analysis, we show that tax havens could improve the social welfare in high-tax countries due to the possible growth-stimulating effect. A beneficial tax haven is more likely to be the case if the government expenditure share in production is low; or the initial income tax rate is high. Moreover, we show that the welfare-maximizing income tax rate should be lower than the growth-maximizing income tax rate. Therefore, the Barro proposition is not valid in the presence of tax havens.

Two extensions can be considered in future research. First, this paper focuses on the effects in high-tax host countries. However, since the empirical studies find that tax haven countries often experience a higher rate of economic growth (see, e.g., Hines, 2006; Butkiewicz and Gordon, 2013) it would also be interesting to study the growth performance in tax haven jurisdictions. For this purpose, a two-country growth model may be a plausible framework. Second, Desai et al. (2006a) find that the firms using tax havens often have high R&D intensities. Based on this finding, an interesting extension would be to study the relationships among innovation, growth, and tax havens using an R&D-based endogenous growth model proposed by Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992). These issues, we believe, merit further research on tax havens and economic growth.

References

Agénor P. R. (2008), Fiscal policy and endogenous growth with public infrastructure, *Oxford Economic Papers* 60, 57-87.

Aghion, P. and P. Howitt (1992), A model of growth through creative destruction, *Econometrica* 60, 323-351.

Aschauer, D. A. (1989), Is public expenditure productive? *Journal of Monetary Economics* 23, 177-200.

Barman, T. R. and M. R. Gupta (2010), Public expenditure, environment, and economic growth, *Journal of Public Economic Theory* 12, 1109-1034.

Barro, R. J. (1990), Government spending in a simple model of endogenous growth, *Journal of Political Economy* 98, S103-S125.

Barro, R. J. and X. Sala-i-Martin (2004), *Economic Growth*, 2nd edition, MIT Press, Cambridge, MA.

Basu, S. and J. G. Fernald (1997), Returns to scale in U.S. production: Estimates and implications, *Journal of Political Economy* 105, 249-283.

Bucovetsky, S. (2011), Honor among tax havens, Unpublished manuscript, York University.

Butkiewicz, J. L. and L. C. Gordon (2013), The economic growth effect of offshore banking in host territories: Evidence from the Caribbean, *World Development* 44, 165-179.

Chu, H. (2012), Optimal thin capitalisation rule in a simple endogenous growth model with tax havens, *Australian Economic Papers* 51, 123-133.

Clausing, K. A. (2009), Multinational firm tax avoidance and tax policy, *National Tax Journal* 62, 703-725.

Coto-Martinez, J. (2006), Public capital and imperfect competition, *Journal of Public Economics* 90, 349-378.

Desai, M. A., C. F. Foley and J. R. Hines Jr. (2006a), The demand for tax haven operations, *Journal of Public Economics* 90, 513-531.

Desai, M. A., C. F. Foley and J. R. Hines Jr. (2006b), Do tax havens divert economic activities? *Economics Letters* 90, 219-224.

Dharmapala, D. (2008), What problems and opportunities are created by tax havens? *Oxford Review of Economic Policy* 24, 661-679.

Dixit, A. K. and J. E. Stiglitz (1977), Monopolistic competition and optimum product diversity, *American Economic Review* 67, 297-308.

Elsayyad M. and K. A. Konrad (2012), Fighting multiple tax havens, *Journal of International Economics* 86, 295-305.

Fullerton, D. and S. R. Kim (2008), Environmental investment and policy with distortionary taxes, and endogenous growth, *Journal of Environmental Economics and Management* 56, 141-154.

Futagami, K., Y. Morita and A. Shibata (1993), Dynamic analysis of an endogenous growth model with public capital, *Scandinavian Journal of Economics* 95, 607-625.

Gali, J. (1994), Government size and macroeconomic stability, *European Economic Review* 38, 117-132.

Gong, L. and H. Zou (2011), Public expenditures, taxes, federal transfers, and endogenous growth, *Journal of Public Economic Theory* 13, 973-991.

Grossman, G. M. and E. Helpman, (1991), Quality ladders in the theory of growth, *Review of Economic Studies* 58, 43-61.

Haufler, A. and M. Runkel (2012), Firms' financial choices and thin capitalization rules under corporate tax competition, *European Economic Review* 56, 1087-1103.

Heijdra, B. J. (2009), *Foundations of Modern Macroeconomics*, 2nd Edition, Oxford University Press, New York, NY.

Hines J. R. Jr. (2005), Do tax havens flourish? *Tax Policy and the Economy* 19, 65-99.

Hines J. R. Jr. (2006), Will social welfare expenditures survive tax competition? *Oxford Review of Economic Policy* 22, 330-348.

Hong, Q. and M. Smart (2010), In praise of tax havens: International tax planning and foreign direct investment, *European Economic Review* 54, 82-95.

Johannesen, N. (2010), Imperfect tax competition for profits, asymmetric equilibrium and beneficial tax havens, *Journal of International Economics* 81, 253-264.

Jones, L. E., R. Manuelli and P. Rossi (1993), Optimal taxation in models of endogenous growth, *Journal of Political Economy* 102, 485-513

Koethenbuerger, M. and B. Lockwood (2010), Does tax competition really promote growth? *Journal of Economic Dynamics and Control* 34, 191-206.

Krautheim, S. and T. Schmidt-Eisenlohr (2011), Heterogeneous firms, 'profit shifting' FDI and international tax competition, *Journal of Public Economics* 95, 122-133.

Lai, Y. B. (2009), Is a double dividend better than a single dividend? *Journal of Institutional and Theoretical Economics* 165, 342-363.

Lindbeck, A. and D. J. Snower (1994), How are product demand changes transmitted to the labour market? *The Economic Journal* 104, 386-398.

OECD (1998), Harmful tax competition: an emerging global issue, Organisation for Economic Co-operation and Development, Paris, France.

Ott, I. and S. J. Turnovsky (2006), Excludable and non-excludable public inputs: Consequences for economic growth, *Economica* 73, 725-748.

Romer, P. (1990), Endogenous technological change, *Journal of Political Economy* 98, S71-S102.

Slemrod, J. and J. D. Wilson (2009), Tax competition with parasitic tax havens, *Journal of Public Economics* 93, 1261-1270.

Stöwhase, S. (2005), Asymmetric capital tax competition with profit shifting, *Journal of Economics* 85, 175-196.

Turnovsky, S. J. (2000), Fiscal policy, elastic labor supply, and endogenous growth, *Journal of Monetary Economics* 45, 185-210.

Turnovsky, S. J. and W. H. Fisher (1995), The composition of government expenditure and its consequences for macroeconomic performance, *Journal of Economic Dynamics and Control* 19, 747-786.

Zeng, J. and J. Zhang (2007), Subsidies in an R&D growth model with elastic labor, *Journal of Economic Dynamics and Control* 31, 861-886.