Oxford University Centre for Business Taxation

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June 2016

WP 16/08

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Working paper series | 2016

SAID BUSINESS SCHOOL
UNIVERSITY OF OXFORD

Revised: June 1, 2016

BALANCING ACT: WEIGHING THE FACTORS AFFECTING THE TAXATION OF CAPITAL INCOME IN A SMALL OPEN ECONOMY

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A revised version of this article is forthcoming in *International Tax and Public Finance.* We would like to thank Alan Auerbach and the participants at the 107th Annual Conference on Taxation of the National Tax Association, Santa Fe, NM, November, 2014 for helpful comments.

ABSTRACT

Alternative economic theories yield dramatically different prescriptions for optimal capital taxation in small open economies. On the one hand, foreign firms, including those with investments that yield firm-specific above-normal returns, have a large number of alternative investment opportunities; this suggests that the supply of foreign direct investment is highly elastic, which implies that small open economies should avoid imposing any source-based taxes on capital income. On the other hand, governments invariably want to tax any above-normal returns earned by location-specific capital, especially if the returns accrue to foreigners, and to take full advantage of the potential revenue increase from any "treasury transfer" effect that arises due to residence-based tax systems with foreign tax credits, such as that utilized by the United States. These factors suggest that investment is highly inelastic with respect to capital taxation, so that source-based capital income taxation is desirable; indeed, in one special case, the capital income tax rate for a small open economy should equal the relatively high US tax rate. Moreover, this difficult trade-off is in practice complicated by numerous additional factors: deferral of unrepatriated profits and cross-crediting of foreign tax credits for US multinationals, foreign direct investment from firms from countries that, unlike the United States, operate territorial systems, and the existence of opportunities for both international capital income shifting and labor income shifting. In this paper, we analyze optimal capital income taxation in a small open economy model that attempts to balance these conflicting factors.

JEL Codes: H21, H25

Key Words: *Optimal Taxation; Open Economy; Income Shifting; Corporate Taxation*

1. INTRODUCTION

Under the appropriate assumptions, optimal tax theory provides a striking result on the use of source-based taxes on capital income such as the typical corporate income tax: in a small open economy that cannot affect the after-tax return to internationally mobile capital or the prices of tradable goods, the optimal capital income tax rate is zero (Gordon 1986; Razin and Sadka 1991; Zodrow and Mieszkowski 1983).[1] This result does not rely on – although it is reinforced by – concerns about the negative effects of capital income taxation on domestic saving or the distortions of many types of investment decisions under the typical corporate income tax (Nicodème 2008), or the tendency toward under-provision of public services financed with capital income taxes in the presence of international tax competition (Zodrow and Mieszkowski 1986; Wilson 1986). Instead, the argument follows from the assumption that the small open economy faces a perfectly elastic supply of highly mobile international capital. In this case, the imposition of a source-based tax on capital income will simply cause internationally mobile capital to migrate to other countries until its after-tax return in the taxing country increases to the internationally determined rate of return. This emigration of capital lowers the productivity of the fixed factors in the taxing country – land, labor (or at least relatively immobile labor), and any immobile capital – so that local factors of production ultimately bear the entire burden of the capital income tax, including both the revenue raised and the efficiency costs of the tax due to capital emigration (as well as the other distortionary costs noted above). Indeed, Harberger (1995, 2008) argues that immobile labor and land may bear more than one hundred percent of a corporate income tax in a small open economy, once general equilibrium effects across business sectors are considered.

This argument is reinforced by two additional considerations in the modern global economy. The first is a straightforward extension of the basic argument, applied to investments by multinational corporations (MNCs) that generate significant firm-specific economic rents; such rents are attributable to factors unique to the firm such as specialized and patented technological knowledge, superior managerial skills or production techniques, or valuable product brands, trademarks, reputations, and other intangible assets (Dunning 1981). Moreover,

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[1] For further discussion, see Zodrow (2010a, b).

there is some empirical evidence that the relative importance of such rents is increasing over time, as Auerbach (2006) shows that the dispersion of relative profitability for US corporations has increased significantly in recent years, suggesting an increase in the importance of investments that generate above-normal returns made by a relatively small number of highly profitable firms. Because such firm-specific capital is likely to be especially mobile and also may have the potential for significant increases in the productivity of local factors (e.g., it is most likely to be associated with high levels of technology transfer, access to skilled labor including highly effective management, and the generation of other external benefits including the creation of a competitive environment that fosters invention and innovation), concerns about tax-induced emigration of mobile capital may be especially pronounced for such investments, reinforcing the standard zero-tax argument (Gordon and Hines 2002).

The second issue has been the focus of many recent policy discussions, most recently in the Base Erosion and Profit Shifting project of the Organisation for Economic Co-operation and Development (OECD) (2013). Specifically, the application of a relatively high corporate tax rate to the income of MNCs encourages them to engage in profit shifting, that is, to use various financial manipulations, including transfer pricing, the relocation of the ownership of intangibles, and the use of loan reallocations that facilitate interest stripping, to shift revenues to relatively low tax countries and deductions to relatively high-tax countries. There is considerable empirical evidence of income shifting (Clausing 2011, 2016; Dowd 2016), in particular that a relatively high statutory corporate tax rate encourages income shifting, since it is the statutory tax rate that determines the value to the firm of shifted revenues and deductions. Thus a desire to avoid creating incentives for income shifting also puts downward pressure on capital income tax rates.[2]

Despite these arguments, as well as empirical evidence of the importance of international tax competition (Devereux and Loretz 2013), corporate income tax rates in small open economies have not in practice converged to zero (although they have declined on average over time). A wide variety of arguments have been offered in support of corporate taxation, all of which qualify the argument that a small open economy should exempt capital income from tax.

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[2] Furthermore, a low statutory rate may make a country attractive for investment by MNCs simply because it creates the potential for additional income shifting (Slemrod 1997).

Although it is difficult to judge the relative importance of each of these qualifications, the pervasiveness of corporate income taxation around the world suggests that together these arguments have been taken seriously by policymakers.

Perhaps the most important argument in support of a relatively high level of source-based capital income taxation is that it allows the government to obtain significant revenues from the taxation of location-specific economic rents. Such rents, which may accrue to both domestically-owned firms and firms that are partially or fully owned by foreigners, can reflect resource rents as well as economic rents that arise because of factors such as local economies of agglomeration, productive government infrastructure, easier access to consumer markets (including those for financial services), lower transport costs, and inexpensive but relatively productive local factors of production including skilled labor – in addition to the ability to avoid trade barriers such as tariffs and quotas.

The taxation of location-specific economic rents provides an efficient and thus highly desirable source of revenue. Moreover, such taxes are especially attractive from the standpoint of domestic residents and thus from a political perspective if the rents accrue to foreigners (Mintz 1995). Empirical evidence suggests that a higher share of foreign ownership in a country tends to result in a higher average corporate income tax rate (Huizinga and Nicodème 2006).

A second argument is related to the prevalence of income shifting noted above. Specifically, although a high domestic corporate tax rate tends to encourage more income shifting, the existence of income shifting to some extent mitigates the negative effect of a high statutory tax rate on foreign direct investment by MNCs, since firms know they will be able to avoid some of the costs of a high tax rate in a host country by shifting income to lower tax countries. Indeed, to the extent that such tax avoidance opportunities are available primarily to MNCs and such firms are more mobile than domestic companies, a relatively high statutory rate may be desirable as part of a strategy that attracts FDI at minimal revenue cost by imposing a high tax burden on relatively immobile domestic capital but a low effective tax burden, taking into account tax avoidance activities, on relatively mobile international capital (Hong and Smart 2010; Gugl and Zodrow 2006). An aggressive version of this strategy would include lax enforcement of the many rules currently used to limit tax avoidance by MNCs or even explicit regulations that facilitate such tax avoidance – the new variation of international tax competition stressed by Altshuler and Grubert (2006), which they note is exemplified by the long-time existence of the “check-the-box” rules in the United States.

A third argument for a relatively high corporate tax rate in a small open economy was once believed to be compelling, but has been declining in importance over time. Specifically, the “treasury transfer” argument suggests that a host country that imports capital primarily from countries that use residence-based corporate income tax systems and grant foreign tax credits (FTCs) should raise its tax rate approximately to the rate utilized by those countries, since such a rate increase will essentially transfer revenues from the treasury of the home countries to the treasury of the host country without having any deleterious effects on FDI (since the combined host and home countries tax burden borne by the MNC is always determined solely by the statutory tax rate of the home country).

The prospect of such a “free” source of tax revenue is naturally appealing and has been stressed in many tax policy discussions. However, there are at least three reasons the treasury transfer effect is often argued to be of limited relevance in the modern economy. First, because both Japan and the United Kingdom have recently switched to “territorial” tax systems under which foreign-source income is largely tax exempt, the United States is now the only major industrialized country that utilizes a residence-based tax system with an FTC. Thus, the treasury transfer argument is potentially relevant only for countries that import significant amounts of capital from the United States.[3] Second, because of various limitations placed on the use of foreign tax credits, many US multinationals are in an “excess foreign tax credit” position – that is, they already have more credits than they can use currently, so that additional credits are of limited value and a lower host country tax rate should attract additional FDI. Third, the importance of the treasury transfer effect is limited by the fact that host country taxes are assessed currently but foreign tax credits in the home country are not granted until the funds are repatriated to the parent firm. Indeed, under certain circumstances, a home country repatriation tax has no effect on investment financed with the retained earnings of the subsidiary (Hartman 1985; Sinn 1987) – although the relevance in practice of this proposition has been the subject of

[3] Although the relative importance of FDI from the United States has of course declined in recent years, it is still significant in many countries. For example, the Economic Commission for Latin America and the Caribbean (2012) reports that the U.S. accounts for roughly a quarter of foreign direct investment in Latin America and the Caribbean.

debate; in particular, Grubert and Altshuler (2013, Appendix A) argue that the Hartman-Sinn model is based on very restrictive assumptions and its predictions are inconsistent with the empirical data on repatriations.

It is also interesting to note, however, that the importance of the treasury transfer effect may be increasing – currently and perhaps to a significantly greater extent in the near future – for host countries with relatively low tax rates. Specifically, many capital-exporting countries have become increasingly concerned about revenue losses due to income shifting by multinationals, especially to very low rate tax haven countries, and are enacting, or considering the enactment of, what are broadly referred to as "anti-base-erosion" provisions (OECD 2013). Although such provisions may take many forms, one common approach is to impose current home country taxes on income that is earned in relatively low-rate jurisdictions. For example, the new territorial tax system in Japan includes Controlled Foreign Company (CFC) provisions under which Japanese companies are required to report as domestic income taxable profits earned in any country with an effective tax rate of 20 percent or less (Deloitte 2014).

Similar provisions have been proposed in the context of reform of the system of international taxation in the United States. For example, the discussion draft put forward by Representative Dave Camp includes an anti-base-erosion provision under which foreign-source income from intangibles derived from sales to foreign markets would be taxed in the United States in the year earned at a 15 percent rate, subject to credits for foreign taxes paid, while foreign-source income from intangibles derived from sales to the US market would be taxed in the year earned at a 25 percent rate — all relative to a proposed general corporate statutory tax rate of 25 percent.[4] The discussion draft released by Senator Max Baucus would tax all passive and highly mobile foreign-source income, as well as foreign-source income earned from selling goods and services back to the U.S., in the year earned at the statutory corporate tax rate, subject to credits for foreign taxes paid. Foreign-source income from products and services sold abroad would similarly be taxed currently, although at reduced rates.[5] Both of these proposals could

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[4] Details of the Camp discussion draft are available at http://waysandmeans.house.gov/UploadedFiles/Statutory_Text_Tax_Reform_Act_of_2014_Discussion_Draft__022614.pdf.

[5] Details of the Baucus discussion draft are available at http://www.finance.senate.gov/imo/media/doc/Chairman's Staff International Discussion Draft Summary.pdf.

significantly increase the relevance of the treasury transfer effect, although within the context of a lower US corporate tax rate.

Numerous other arguments support some source-based capital income taxation, often in the form of a corporate income tax. From a domestic perspective, a corporate income tax is often deemed to be desirable as a "backstop" to the personal income tax; that is, depending on relative personal and corporate tax rates, a corporate income tax may be desirable to prevent individuals from incorporating and deferring personal income tax on labor income by retaining the earnings in corporate form while financing any desired consumption with loans from their companies. In addition, the small open economy assumptions may be too extreme for some countries; Gravelle and Smetters (2006) stress that the economic effects of corporate income taxes differ significantly if capital is imperfectly mobile or if traded and domestically-produced goods are imperfect substitutes. Finally, a corporate income tax may be politically indispensable in many countries.

Relatively few papers have examined the interactions of these competing effects on capital income taxation from the perspective of an open economy. Four papers are particularly relevant to our analysis.

Gordon and Mackie-Mason (1995) consider the interaction of domestic income shifting and international income shifting. In their model, an optimal tax system balances the cost from individuals disguising labor income as capital income when the capital income tax rate is lowered against the benefit of an increase in the tax base due to reduced international income shifting.[6]

Huizinga and Nielsen (1997) examine optimal rules for separate taxes on all capital income and on above-normal profits in a small open economy model where foreigners own some of the domestic capital stock. They show that, as long as above-normal profits are taxed at rates less than one hundred percent, some source-based taxation of capital income is desirable to extract rents from foreign owners of domestic capital.

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[6] See also Gordon and Slemrod (2000), who estimate the extent of income shifting between the personal and corporate income tax bases following the enactment of the Tax Reform Act of 1986, and Slemrod and Wilson (2009) who investigate the effects of such shifting in the presence of low-rate tax havens.

Becker and Fuest (2011) examine how differences in capital mobility and profitability affect the desirability of base broadening, rate reducing (BBRR) corporate reforms relative to introducing investment incentives. Specifically, they show that under certain circumstances a BBRR reform that involves a corporate rate reduction financed by less generous deductions for depreciation is preferable to increasing investment incentives if relatively more mobile firms are also more profitable than their relatively immobile competitors. The intuition is that a lower statutory rate is desirable to attract/retain the more mobile firms which are highly responsive to the statutory rate since that is the rate applied to its above-normal profits, even at the cost of reducing investment incentives (accelerated depreciation), which are relatively more important in determining the tax burden of the comparatively immobile less profitable firms.

Finally, Haufler and Schjelderup (2000) construct a model that includes foreign direct investment and the possibility of income shifting. Like Becker and Fuest (2011), they show that under certain circumstances a BBRR reform that involves a corporate rate reduction financed by less generous deductions for depreciation is desirable, as the gains from reducing income shifting are unambiguously larger than the costs of reducing investment incentives.

In a similar vein, we construct a simple theoretical model that illustrates how the government of a small open economy might balance some of the trade-offs involved in taxing capital income described above, and then simulate a more complicated version of the model to see how much optimal capital income tax rates might vary from zero under scenarios that take into account the interactions between the various factors analyzed.[7] We maintain the standard small open economy assumptions of perfect mobility (of certain forms of) capital and perfect substitutability of domestic and foreign tradable goods in our model. In our base analytical model, we focus on the trade-offs involved in balancing (1) the costs of taxing highly mobile capital, including firm-specific capital earning above-normal returns, and (2) the costs of

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[7] To simplify the analysis, we model a single "capital income tax rate" (t), which serves as a proxy for a combination of the various relevant tax rates. For example, the relevant capital income tax rate would be the statutory rate for equity-financed domestic investment under a system that measured real economic income accurately (e.g., with tax depreciation equal to inflation-adjusted economic depreciation and no other investment allowances). In practice, tax systems are far more complicated, with lower effective tax rates due to interest deductions for debt-financed investment and accelerated depreciation deductions, investment tax credits, etc. In addition, different tax rates are relevant at different margins – the statutory rate is most relevant for income shifting, some combination of the statutory rate and the effective tax rate is most relevant for investment of firm-specific capital, and the effective tax rate is most relevant for investment of ordinary capital. Note, however, that we do model explicitly the reduction in the effective capital income tax rate due to income shifting.

encouraging income shifting to lower-tax jurisdictions, against (3) the gains from taxing location-specific capital, some of which is foreign-owned, (4) the mitigating effects on tax-induced reductions of FDI of the presence income shifting possibilities, and (5) the potential for a treasury transfer effect. Our base model does not include explicit costs of income shifting or the potential for disguising labor income as capital income. However, we include these features in our computational model, which also includes ordinary capital in both production sectors, endogenous labor supply, a proportional labor income tax, and the possibility of direct taxation of location-specific capital. We describe the structure of our base model in the following section, and the characteristics of the solution for the optimal capital income tax rate in Section 3. The details of the expanded computational model are presented in Section 4, which also provides the results of simulating that model for the optimal capital income tax rate for a wide variety of parameter values. Conclusions and directions for future research are discussed in the final section.

2. THE BASE MODEL

Our base analytical model is designed to capture four of the primary factors that influence the optimal capital income tax rate in a small open economy: (1) immobile capital that earns location-specific rents, some of which may be owned by foreigners; (2) perfectly mobile foreign-owned capital that earns firm-specific rents; (3) the possibility of capital income shifting; and (4) the possibility of residual home country taxation of foreign-source income by countries that operate a residence-based system of taxation, such as the United States, or countries like Japan that have base erosion provisions that apply domestic tax on an accrual basis to income earned in host countries with sufficiently low tax rates, subject to foreign tax credits.

To capture these effects we construct a simple two-sector model. Sector one is a "domestic" sector that produces a non-traded good (X_1) using labor (L_1) and location-specific capital (*LSK*) that is fixed, immobile, and earns economic rents (ρ_L) that may be partially or completely foreign-owned. Sector two is a "multinational" sector that produces a traded good (X_2) using labor (L_2) and firm-specific capital (*FSK*) that is perfectly mobile, foreign-owned, and earns economic rents at an internationally determined rate of return (ρ_F). The price of the traded good (p_2) is also determined internationally, and it is possible that the small open economy may be either a net importer or a net exporter. The domestic good is produced using a constant returns to scale technology, $X_1 = F_1\left(L_1; LSK\right)$. The earnings of capital in the domestic sector are subject to capital income taxation at a statutory tax rate τ, so the profit-maximizing labor demand in sector one is the solution to $\max_{L_1}\left\{p_1 X_1 - wL_1\right\}$, where p_1 is the market price of good one and w is the market wage. In equilibrium, the before-tax economic rents earned by LSK are $\left(1+\tau\right)\rho_L LSK = p_1 X_1 - wL_1$. Note that in order to simplify the model, we treat the corporate tax simply as applying to all capital income, and thus do not consider many complicating and distortionary features of actual corporate income taxes, including deductions for economic depreciation, accelerated depreciation deductions, investment tax credits and other investment preferences, the treatment of inflation, as well as differential treatment of equity and debt finance, especially deductions for interest expense.

Production in the multinational or traded goods sector is a function of the amounts of labor (L_2) and FSK utilized, $X_2 = F_2\left(L_2, FSK\right)$.[8] The earnings of the firm-specific capital in the multinational sector are in principle also subject to the statutory capital income tax rate. However, a fraction $\left(\phi_S\right)$ of capital income in this multinational sector is shifted to a tax haven country with a relatively low tax rate τ_H; the fraction shifted is a function of the tax differential $\tau - \tau_H$. Only the unshifted share of capital income $(1-\phi_S)$ is subject to the domestic tax. In addition, a fraction ϕ_F of the unshifted income is also subject to a current residual tax imposed by the foreign (home) country at tax rate τ_F. We assume that none of the capital income shifted to the tax haven is subject to a residual tax.

Consequently, the effective capital income tax rate in the multinational sector, taking into account income shifting to tax havens and residual home country current taxation, is

[8] Following the approach used in the CORTAX computable general equilbrium model constructed by Bettendorf et al. (2009) and de Mooij and Devereux (2011), we model the factor generating firm-specific rents as an explicit production input characterized by "fixed management capacity." That is, we assume a fixed amount of firm-specific capital (which includes a combination of factors such as unique managerial skills, production processes, and intangible capital) that must be allocated among different locations around the world. A similar approach is used by Becker and Fuest (2011), who consider "ownership skill" that creates above-normal returns, assuming first that the amount of this skill is fixed and must be allocated across countries, and then extending the analysis to the case in which ownership skill is unlimited. Devereux, Fuest, and Lockwood (2014) consider both cases as well as intermediate possibilities.

$T_K = (1-\phi_S)\left[\tau + \phi_F \max(\tau_F - \tau, 0)\right] + \phi_S \tau_H$. Given any level of *FSK*, the multinational firms in sector two choose labor to maximize profit. The amount of firm-specific capital invested is the amount consistent with after-tax earnings equal to the internationally-determined rate of return ρ_F, taking into account the demand for labor as a function of *FSK*. That is, the amount of firm-specific capital invested in the country is such that $\rho_F = \left(p_2 X_2 - wL_2\right) / \left[\left(1+T_K\right) FSK\right]$, where both X_2 and L_2 are functions of the firm-specific capital invested.

In the base model, we assume a single representative resident with inelastic labor supply. Consequently, the individual allocates income across consumption goods to maximize utility, producing the indirect utility function

$$v\left(p_1, I\right) = \max_{C_1, C_2} \left\{ U\left(C_1, C_2\right) \mid I \geq p_1 C_1 + p_2 C_2 \right\}, \tag{1}$$

where C_i is the consumption of good i, p_i is the market price of good i, and I is the individual's after-tax income. We hold government services $\left(G\right)$ constant throughout the analysis and assume they are separable from consumption in the individual's welfare function. Income is composed of labor income and capital income, less any lump-sum taxes levied by the government, so that net income is

$$I = wL + \theta \rho_L LSK - t, \tag{2}$$

where t is the lump-sum tax, L is the fixed level of total labor supply, and θ is the share of location-specific capital that is owned domestically.

Government services are modeled as purchases of the tradable good, and government revenues are raised from capital income taxation of the returns to *LSK* and *FSK* and the lump-sum tax (which is a proxy for labor income taxation in the base model, given the assumption of an inelastic supply of labor). The government budget constraint is thus

$$p_2 G \leq \tau \rho_L LSK + \left(1 - \phi_S\right) \tau \rho_F FSK + t. \tag{3}$$

Finally, since total labor supply (*L*) is fixed, equilibrium in the labor market requires $L_1 + L_2 = L$, and equilibrium in the domestic good market requires $C_1 = X_1$. Combining these two conditions with the first-order conditions for the consumer and producer optimization problems fully specifies the equilibrium in the model.

3. PROPERTIES OF THE OPTIMAL CAPITAL INCOME TAX RATE

3.1 Characterizing the Optimal Capital Income Tax Rate

The government chooses its tax rates to maximize the utility of the representative resident while ensuring that revenues are sufficient to finance a fixed level of the separable public good (*G*), which is modeled as purchases of the output of the multinational sector. The government thus solves

$$\max_{\tau,\, t} \left\{ v\left(p_1, I\right) + \lambda\left[p_2 G - \tau\rho_L LSK - \tau\left(1-\phi_S\right)\rho_F FSK - t\right]\right\} ,$$

where $v\left(p_1, I\right)$ is the individual indirect utility function, the government budget constraint is $p_2 G = \tau\left[\rho_L LSK + \left(1-\phi_S\right)\rho_F FSK\right] + t = R + t$, and *R* is capital income tax revenue. Since the lump-sum tax is always available to the government, the capital income tax will be used only if it can successfully extract resources from foreign investors, that is, if some of the tax burden can successfully be "exported" abroad. Note that the capital tax is applied to all unshifted capital income earned in the country. Substituting from the government budget constraint, the government's problem becomes

$$\begin{aligned} &\max_{\tau} v\left(p_1, I\right); \\ &I = \left(wL + \theta\rho_L LSK\right) - \left\{ p_2 G - \tau\left[\rho_L LSK + \left(1-\phi_S\right)\rho_F FSK\right]\right\}. \end{aligned} \tag{4}$$

Thus, since income is defined to include the head tax, any revenue shortfalls that arise due to outmigration of *FSK* or any declines in the return to *LSK* associated with increases in the capital income tax rate must be offset with head tax increases.

The first-order condition for the optimal capital income tax rate is

$$\frac{\partial v(p_1, I)}{\partial \tau} = \frac{\partial v}{\partial p_1}\frac{\partial p_1}{\partial \tau} + \frac{\partial v}{\partial I}\frac{\partial I}{\partial \tau} = -C_1\alpha\frac{\partial p_1}{\partial \tau} + \alpha\frac{\partial I}{\partial \tau} = \alpha\left[\frac{1}{I}\frac{\partial I}{\partial \tau} - \left(\frac{p_1 C_1}{I}\right)\frac{1}{p_1}\frac{\partial p_1}{\partial \tau}\right] = 0$$

$$\frac{1}{\alpha}\frac{\partial v(p_1, I)}{\partial \tau} = \pi_I - \psi_{C_1}^{I}\pi_{p_1} = 0, \tag{5}$$

using Roy's Identity, and defining π_I and π_{p_1} as the tax semi-elasticities of the subscripted variables, $\psi^I_{C_1}$ as the expenditure share of good one, and α as the marginal utility of income. This condition reflects the standard result that the optimal capital income tax rate should be set to maximize the dollar value of individual utility at the margin, which requires that the change in real income, or the sum of the "sources" and "uses" effects on utility, equals zero. This expression can be interpreted in terms of several key tax semi-elasticities.

3.1.1 Tax Semi-elasticity of Income

The tax semi-elasticity of income is

$$\pi_I = \psi^I_L \pi_w + \left[\psi^I_{LSK} + \left(\frac{R}{I}\right)\psi^R_{LSK}\right]\pi_{\rho_L} + \left(\frac{R}{I}\right)\psi^R_{FSK}\left(\pi_{FSK} + \pi_{1-\phi_S}\right) + \left(\frac{R}{I}\right)\frac{1}{\tau}, \tag{6}$$

where the various ψ's are factor shares in income or total capital income tax revenue (*R*). The tax semi-elasticity of income is thus determined by the changes in the returns to the two fixed factors in response to an increase in the capital income tax and the change in the head tax, which equals the change in capital tax revenues, taking into account the effects of the tax on *FSK* and ρ_L.

3.1.2 Tax Semi-elasticity of the Wage

To obtain the tax semi-elasticity of the wage, recall that in the multinational sector the effective tax rate on *FSK* is $T_K = (1-\phi_S)\left[\tau + \phi_F \max(\tau_F - \tau, 0)\right] + \phi_S \tau_H$. We assume that $\tau_F > \tau$ for this derivation, so that

$$T_K = (1-\phi_S)(1-\phi_F)\tau + (1-\phi_S)\phi_F \tau_F + \phi_S \tau_H \ ,$$

which implies that

$$\frac{\partial T_K}{\partial \tau} = (1-\phi_S)(1-\phi_F) + (1-\phi_S)\left[(1-\phi_F)\tau + \phi_F\tau_F - \tau_H\right]\pi_{1-\phi_S} \tag{7}$$

is a constant determined by the extent of income shifting and residual taxation. With constant returns to scale in labor and *FSK* in the multinational sector, differentiating the unit cost function with respect to τ for fixed ρ_F yields $\chi_{L2}\pi_w + \chi_{FSK2}\pi_{\rho_{FG}} = 0$, where the χ terms are gross factor shares in production costs and $\pi_{\rho_{FG}} = (\partial T_K/\partial\tau)/(1+T_K)$ is the tax semi-elasticity of the gross rate of return to *FSK*. Thus, with a fixed commodity price and a fixed return to *FSK* in the multinational sector, any increase in the capital income tax burden is fully reflected in a reduction in wages – consistent with the traditional small open economy reasoning described above.

3.1.3 Tax Semi-elasticity of the Price of Good One

Similarly, with constant returns to scale in labor and *LSK* in the domestic sector,

$$\pi_{p_1} = \chi_{L1}\pi_w + \chi_{LSK1}\pi_{\rho_{LG}} = \chi_{L1}\pi_w + \chi_{LSK1}\left(\pi_{\rho_L} + \frac{1}{1+\tau}\right) \ . \tag{8}$$

Thus, the tax semi-elasticity of the price of the domestic good is determined by a weighted average of the tax semi-elasticities of the gross prices of the two inputs, labor and location-specific capital.

3.1.4 Tax Semi-elasticity of the Return to Location-specific Capital

Differentiating the consumer's first-order condition for the domestic good yields $\pi_{C_1} = \left(\varepsilon_{11} - \eta_1\psi^I_{C_1}\right)\pi_{p_1} + \eta_1\pi_I$, where ε_{11} is the compensated elasticity of demand for good one and η_1 is the income elasticity of demand for good one. Substituting from (8) yields the price and income effects on the tax semi-elasticity of consumer demand C_1

$$\pi_{C_1} = \left(\varepsilon_{11} - \eta_1\psi^I_{C_1}\right)\left\{\chi_{L1}\pi_w + \chi_{LSK1}\left[\pi_{\rho_L} + 1/(1+\tau)\right]\right\} + \eta_1\pi_I \ . \tag{9}$$

On the production side, differentiating the production function with fixed location-specific capital and solving for the tax semi-elasticity of labor demand yields

$$\pi_{X_1} = -\chi_{L1}\sigma_1\left(\pi_w - \pi_{\rho_{LG}}\right) \ . \tag{10}$$

Since the consumption and production tax semi-elasticities of the domestic good are equal, equating (9) and (10) and solving for the tax semi-elasticity of the net return to *LSK* yields

$$\pi_{\rho_L} = \frac{\left(\varepsilon_{11} - \eta_1\psi^I_{C_1} + \sigma_1\right)\chi_{L1}\pi_w + \eta_1\pi_I}{\chi_{L1}\sigma_1 - \chi_{LSK1}\left(\varepsilon_{11} - \eta_1\psi^I_{C_1}\right)} - \frac{1}{1+\tau} \ . \tag{11}$$

Note that in the case of Cobb-Douglas utility and production functions, this expression reduces to $\pi_{\rho_L} = \pi_I - 1/(1+\tau)$, which indicates that – apart from the effects of changes in income – the gross return to *LSK* is fixed so that the owners of *LSK* bear the burden of the capital income tax in that sector. Otherwise, the first term in (11) reflects the net general equilibrium effects on the return to *LSK* of changes in relative prices on consumer demands and factor demands.

Substituting (11) into (8) implies that the tax semi-elasticity of the price of the domestic good is

$$\pi_{p_1} = \chi_{L1}\pi_w + \chi_{LSK1}\left[\frac{\left(\varepsilon_{11} - \eta_1\psi_{C_1}^I + \sigma_1\right)\chi_{L1}\pi_w + \eta_1\pi_I}{\chi_{L1}\sigma_1 - \chi_{LSK1}\left(\varepsilon_{11} - \eta_1\psi_{C_1}^I\right)}\right]. \tag{12}$$

Note that an income increase thus results in an increase in the relative price of the domestic good (since the price of the multinational good is fixed).

3.1.5 Tax Semi-elasticity of Firm-specific Capital

To solve for π_{FSK}, calculate the tax semi-elasticity of the multinational sector good using the labor market equilibrium equation and the tax semi-elasticity of per-unit labor demand, and substitute into the expression for the tax semi-elasticity of demand for *FSK* to yield

$$\pi_{FSK} = \frac{\lambda_1}{\lambda_2}\sigma_1\left(\pi_w - \pi_{\rho_L} - \frac{1}{1+\tau}\right) + \sigma_2\left[\pi_w - \frac{1}{1+T_K}\left(\frac{\partial T_K}{\partial \tau}\right)\right], \tag{13}$$

where $\lambda_1 = L_1 / L$, $\lambda_2 = L_2 / L$, and σ_1, σ_2 are the elasticities of substitution in production in the domestic and multinational sectors, respectively. In the Cobb-Douglas case, this reduces to

$$\pi_{FSK} = \left(1 + \frac{\lambda_1}{\lambda_2}\right)\pi_w - \left(\frac{\lambda_1}{\lambda_2}\right)\pi_I - \frac{1}{1+T_K}\left(\frac{\partial T_K}{\partial \tau}\right). \tag{14}$$

The first term indicates that an increase in the wage reduces the relative price of *FSK* (since the price of the multinational good is fixed) and thus increases demand for *FSK*. The second term reflects the fact, noted above, that an increase in income results in an increase in the relative price of the domestic good and thus the demands for the factors producing that good, while decreasing relative factor demands for the factors producing the multinational sector good, thus putting downward pressure on the demand for *FSK*. The more general case reflects the additional net general equilibrium effects on the demand for *FSK* of changes in relative prices on consumer demands and factor demands.

3.1.6 Solving for the Optimal Tax Rate in the Cobb-Douglas Case

To make these expressions more tractable in solving for the optimal τ, suppose that the production functions are Cobb-Douglas with constant labor shares χ_{L1}, χ_{L2}, and the utility function is also Cobb-Douglas with constant expenditure shares $\psi^I_{C_1}, \psi^I_{C_2}$. In this case, the various tax semi-elasticities reduce to

$$\frac{\partial T_K}{\partial \tau} = (1-\phi_S)(1-\phi_F) + (1-\phi_S)\left[(1-\phi_F)\tau + \phi_F \tau_F - \tau_H\right]\pi_{1-\phi_S}$$

$$\pi_w = -\frac{\chi_{FSK2}}{\chi_{L2}(1+T_K)}\left(\frac{\partial T_K}{\partial \tau}\right)$$

$$\pi_{\rho_L} = \pi_I - \frac{1}{1+\tau}$$

$$\pi_{p_1} = \chi_{L1}\pi_w + (1-\chi_{L1})\pi_I$$

$$\pi_{FSK} = \left(1+\frac{\lambda_1}{\lambda_2}\right)\pi_w - \left(\frac{\lambda_1}{\lambda_2}\right)\pi_I - \frac{1}{1+T_K}\left(\frac{\partial T_K}{\partial \tau}\right)$$

$$\pi_I = \psi^I_L \pi_w + \psi^I_{LSK}\pi_{\rho_L} + \left(\frac{R}{I}\right)\left[\psi^R_{LSK}\pi_{\rho_L} + \psi^R_{FSK}\left(\pi_{FSK} + \pi_{1-\phi_S}\right) + \frac{1}{\tau}\right].$$

Substituting for π_{ρ_L} and π_{FSK} and solving for the tax semi-elasticity of income yields

$$D\tau\pi_I = \frac{R}{I} + \left[\psi^I_L + \left(\frac{R}{I}\right)\psi^R_{FSK}\left(\frac{\lambda_1}{\lambda_2} + \frac{1}{\chi_{FSK2}}\right)\right]\tau\pi_w - \left[\psi^I_{LSK} + \left(\frac{R}{I}\right)\psi^R_{LSK}\right]\left(\frac{\tau}{1+\tau}\right) + \left(\frac{R}{I}\right)\psi^R_{FSK}\tau\pi_{1-\phi_S}, \quad (15)$$

where $D = 1 - \psi^I_{LSK} - \left(\frac{R}{I}\right)\psi^R_{LSK} + \left(\frac{R}{I}\right)\left(\frac{\lambda_1}{\lambda_2}\right)\psi^R_{FSK}$. Substituting $\pi_{p_1} = \chi_{L1}\pi_w + (1-\chi_{L1})\pi_I$ into the government's first-order condition for τ (5) and multiplying by $D\tau$ yields

$$D\tau\,\pi_I - D\left(\frac{\psi^I_{C_1}\chi_{L1}}{1-\psi^I_{C_1}\chi_{LSK1}}\right)\tau\pi_w = 0 \ . \quad (16)$$

Substituting from the Cobb-Douglas tax semi-elasticity expressions above yields

$$\frac{R}{I} - \Omega_R\left(\frac{R}{I}\right) = \psi^I_{LSK}\left(\frac{\tau}{1+\tau}\right) + \Omega_{T_K}\left(\frac{\tau}{1+T_K}\right)\left(\frac{\partial T_K}{\partial \tau}\right), \quad (17)$$

where

$$\Omega_R = \psi_{LSK}^R \left(\frac{\tau}{1+\tau} \right) + \psi_{FSK}^R \left[\frac{\lambda_1}{\lambda_2} \left(\frac{\chi_{FSK2}}{\chi_{L2}} \right) + \frac{1}{\chi_{L2}} - \tau \pi_{1-\phi_S} \right]$$

$$\Omega_{T_K} = \left[\psi_L^I - \frac{D\psi_{C_1}^I \chi_{L1}}{1-\psi_{C_1}^I \chi_{LSK1}} \right] \left(\frac{\chi_{FSK2}}{\chi_{L2}} \right)$$

$$T_K = (1-\phi_F)(1-\phi_S)\tau + \left[(1-\phi_S)\phi_F \tau_F + \phi_S \tau_H \right].$$

Thus, at the capital income tax rate optimum, the static increase in revenue due to an increase in the tax rate (the first term in (17), R/I) is exactly offset by the net effect on real income, including endogenous adjustments in the head tax ($\Omega_R R/I$), and the increase in taxation of capital in the domestic sector (the second-to-last term in (17)) and in the multinational sector (the last term in (17)).

3.2 Properties of the Optimal Capital Income Tax Rate

In this section, we show that our optimality condition is consistent with the basic results discussed in the introduction on (1) zero capital income taxation, and (2) capital income taxation at the residual tax rate. First, divide the optimality condition (17) by τ and apply $R = \tau\left[\rho_L LSK + (1-\phi_S)\rho_F FSK \right]$ so that the optimality condition is well defined at $\tau = 0$,

$$\frac{\rho_L LSK + (1-\phi_S)\rho_F FSK}{I} - \left[\psi_{LSK}^I + \left(\frac{R}{I} \right) \psi_{LSK}^R \right] \left(\frac{1}{1+\tau} \right) + \left(\frac{R}{I} \right) \psi_{FSK}^R \pi_{1-\phi_S}$$
$$- \left[\frac{D\psi_{C_1}^I \chi_{L1}}{1-\psi_{C_1}^I \chi_{LSK1}} - \psi_L^I - \left(\frac{R}{I} \right) \psi_{FSK}^R \left(\frac{\lambda_1}{\lambda_2} + \frac{1}{\chi_{FSK2}} \right) \right] \pi_w = 0. \tag{18}$$

When there is a zero capital income tax rate, $\psi_{LSK}^R = \psi_{FSK}^R = T_K = 0$ and (18) simplifies to

$$\frac{\rho_L LSK + (1-\phi_S)\rho_F FSK}{I} - \psi_{LSK}^I = \left[\frac{\left(1-\psi_{LSK}^I\right)\psi_{C_1}^I \chi_{L1}}{1-\psi_{C_1}^I \chi_{LSK1}} - \psi_L^I \right] \pi_w. \tag{19}$$

Assuming that the tax rate in the tax haven is non-zero, $\tau_H > 0$, firms will not shift income to the tax haven if the change from $\tau = 0$ is small enough, $\pi_{1-\phi_S} = 0\big|_{\tau=0}$. Additionally, at $\tau = 0$, no income shifting occurs ($\phi_S = 0$), reducing the wage expression to

$$\pi_w = -\frac{\chi_{FSK2}}{\chi_{L2}}\left(1-\phi_F\right). \tag{20}$$

Recognizing that $\psi_{C_1}^I \chi_{LSK1} = \psi_{LSK}^I / \theta$, $\psi_{C_1}^I \chi_{L1} = \psi_L^I \lambda_1$, and $\chi_{FSK2}/\chi_{L2} = \rho_F FSK / wL_2$ at $\tau = 0$, we can multiply this entire expression by $IL_2 / \rho_F FSK$ to get

$$\frac{\psi_{LSK}^I I}{\rho_F FSK}\left(\frac{1-\theta}{\theta}\right)L_2 + L_2 = \left[L - \left(\frac{1-\psi_{LSK}^I}{1-\psi_{LSK}^I/\theta}\right)L_1\right]\left(1-\phi_F\right), \tag{21}$$

which is the condition under which a zero capital tax rate is optimal. If all location-specific capital is owned domestically ($\theta = 1$), the optimality condition becomes

$$L_2 = \left(L - L_1\right)\left(1-\phi_F\right)$$

and a zero capital income tax is optimal only if there is no foreign residual tax.

To consider the case where a portion of location-specific capital is not owned domestically, $\theta < 1$, rewrite the optimality condition to the form

$$\frac{\psi_{LSK}^I I}{\rho_F FSK}\left(\frac{1-\theta}{\theta}\right)L_2 = \left[L - \left(\frac{1-\psi_{LSK}^I}{1-\psi_{LSK}^I/\theta}\right)L_1\right]\left(1-\phi_F\right) - L_2 . \tag{22}$$

As long as $\theta < 1$, $1-\psi_{LSK}^I > 1-\psi_{LSK}^I/\theta$ so that $L - \left(\frac{I-\theta\rho_L LSK}{I-\rho_L LSK}\right)L_1 < L_2$. Since $\left(1-\phi_F\right) \le 1$, this suggests the right-hand side of (22) is strictly negative, while $\theta < 1$ implies the left-hand side of (22) is strictly positive. Consequently, optimality condition (22) never holds if $\theta < 1$. This suggests that as long as any location-specific capital is foreign-owned, the optimal capital tax rate is non-zero, as a portion of location-specific capital represents immobile, foreign-owned, above-normal returns (assuming a non-zero tax rate in the tax haven). However, if all location-specific capital is owned domestically, the optimal capital tax rate is zero if there is no residual tax, under the baseline assumption $\tau_H > 0$.

We can also characterize the optimal capital income tax rate under full residual taxation. If all capital income earned in sector two is subject to residual taxation ($\phi_F = 1$) and the domestic tax rate is lower than the residual tax rate ($\tau < \tau_F$), the optimality condition (17) reduces to

$$\frac{1+\tau}{\theta+\tau}=\frac{\rho_L LSK}{\rho_L LSK+\left(1-\phi_S\right)\rho_F FSK}. \tag{23}$$

By definition, $0\leq\theta\leq 1$ and the expression in (23) cannot hold as long as some income is unshifted, $\phi_S<1$. Consequently, if there is full residual taxation, $\tau<\tau_F$ is not optimal as long as any capital income in sector two is unshifted when $\tau=\tau_F$.

4. EXTENDED MODEL, PARAMETER VALUES, AND SIMULATION RESULTS

4.1 Extended Model

In this section, we simulate an extended version of the model to obtain an idea of the magnitudes of the effects of the various factors on the optimal capital income tax rate. Specifically, we expand the individual's optimization problem to include endogenous labor supply, converting the head tax to a proportional tax on labor, and allow for the possibility of endogenous labor income shifting to the capital income tax base. Further, we add another factor in both production sectors – "ordinary" capital (*K*) that earns a normal rate of return (*r*); we assume that this factor is also perfectly mobile so that *r* is fixed. This implies that domestic production also includes internationally mobile capital, so that both production sectors are affected by the capital tax rate. Both sectors thus now employ three factors in production, which we model using CES production functions. Finally, we consider the effects on the optimal capital income tax rate of adding an explicit tax on location-specific capital as an additional tax instrument available to the government.

In the computational model, we use a utility function that enables calibration of the income elasticity of labor:

$$\begin{gathered} v\left(p_1,I\right)=\max_{C_1,C_2,L}\left\{\alpha_{C1}\left(\frac{C_1^{1-1/\gamma_1}}{1-1/\gamma_1}\right)+\alpha_{C2}\left(\frac{C_2^{1-1/\gamma_2}}{1-1/\gamma_2}\right)+\alpha_L\left(\frac{\left(H-L\right)^{1-1/\gamma_L}}{1-1/\gamma_L}\right)\right\} \\ s.t.\quad I=wL+\theta\rho_L LSK+rK_d>p_1C_1+p_2C_2;\quad H\geq L. \end{gathered} \tag{24}$$

All variables correspond to those used in the analytical model above, with the additional terms K_d and H indicating domestic ownership of capital and the labor endowment, respectively, with leisure defined as *H*–*L*. The wage rate in the individual problem remains net of tax and, as will be discussed below, includes any wages that are shifted to the business income tax base and thus subject to the capital income tax.

Both CES production functions now account for ordinary capital (K_1 and K_2), or

$$X_1 = \left[\alpha_1 K_1^{(\xi_1 - 1)/\xi_1} + \alpha_2 L_1^{(\xi_1 - 1)/\xi_1} + \left(1 - \alpha_1 - \alpha_2\right) LSK^{(\xi_1 - 1)/\xi_1} \right]^{\frac{\xi_1}{\xi_1 - 1}} \tag{25}$$

$$X_2 = \left[\beta_1 K_2^{(\xi_2 - 1)/\xi_2} + \beta_2 L_2^{(\xi_2 - 1)/\xi_2} + \left(1 - \beta_1 - \beta_2\right) FSK^{(\xi_2 - 1)/\xi_2} \right]^{\frac{\xi_2}{\xi_2 - 1}}, \tag{26}$$

where ξ_1 and ξ_2 are the elasticities of substitution in production for sectors one and two.

Turning next to extensions of the modeling of income shifting, Grubert and Altshuler (2013) argue that the costs associated with international income shifting are roughly quadratic.[9] Accordingly, we assume that multinationals engage in income shifting to maximize the increment in after-tax profits attributable to such shifting, subject to quadratic adjustment costs. Thus, the proportion of capital income shifted to a tax haven $\left(\phi_S\right)$ satisfies

$$\phi_S \in \max_{0 \le \phi_S \le 1} \left\{ \left[\left(\tau + \phi_F \max\left\{ \tau_F - \tau, 0 \right\} - \tau_H \right) \phi_S - \eta \phi_S{}^2 \right] \left(rK_2 + \rho_F FSK \right) \right\}, \tag{27}$$

and the total per-unit cost of both types of capital to the multinational sector with income shifting is $1 + \left(1 - \phi_S\right)\left[\tau + \phi_F \max\left(\tau_F - \tau, 0 \right) \right] + \phi_S \tau_H + \eta \phi_S^2$.

In the domestic economy, some individuals are assumed to be able to shift labor income to the business tax base when the capital income tax rate is lower than the labor income tax rate. Such shifting maximizes the associated increment in after-tax wage income, again subject to quadratic adjustment costs. Only a limited portion (ω_I) of labor income, corresponding roughly to the share of labor income earned from self-employment or in small closely-held corporations, can potentially be shifted. Consequently, the proportion of labor income shifted to the capital income tax base $\left(\phi_I\right)$ satisfies

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[9] Most of this discussion is included in their online Appendix A, http://econweb.rutgers.edu/altshule/Fixing-appendices.pdf.

$$\phi_I = \omega_I a \Big| a \in \max_{0 \le a \le 1} \left\{ a\left(\tau_L - \tau\right) wL - \mu a^2 wL \right\}. \tag{28}$$

With ϕ_E indicating the share of wage income exempt from labor taxation, the gross wage rate, including shifting costs, is $w_G = \phi_E w + \left(1-\phi_E\right) w\left[\left(1-\phi_I\right)\left(1+\tau_L\right)+\phi_I\left(1+\tau\right)+\mu\phi_I^2\right]$. Government revenue comes from three tax instruments: a capital income tax, a labor income tax, and (in some cases) a direct tax on location-specific capital. A fixed share $\left(\phi_{LSK}\right)$ of *LSK* is subject to the direct tax, and any of these taxes paid are deductible from the capital income tax base, so the total tax revenue raised from location-specific capital income is $R_{LSK} = \phi_{LSK}\left[\tau_{LSK} + \tau\left(1-\tau_{LSK}\right)\right]\rho_L LSK + \left(1-\phi_{LSK}\right)\tau\rho_L LSK$. Accounting for income shifting behavior, total revenue raised from the taxation of labor income is $R_L = \tau_L\left(1-\phi_I\right)wL + \tau\phi_I wL$ and total revenue raised from ordinary and firm-specific capital income is $R = \tau\left\{r\left[K_1 + \left(1-\phi_S\right)K_2\right] + \left(1-\phi_S\right)\rho_F FSK\right\}$. In our simulations, we treat the location-specific capital tax rate as exogenous, effectively assuming there is a maximum feasible level of *LSK* taxation. The welfare-maximizing government chooses the capital income tax rate and the labor income tax rate according to

$$\max_{\tau_L, \tau} \left\{ v\left(p_1, I\right) \Big| p_2 G = R_L + R_{LSK} + R \right\}. \tag{29}$$

4.2 Parameter Values

In this section, we describe the parameter values used in our model. In the simulations, we consider a wide range of values for numerous key parameters.

<u>4.2.1 Production Function Parameters</u>

The appropriate value for the elasticity of substitution in production is a contentious issue. Many simulation studies (e.g., Altig et al., 2001; Fehr et al., 2013) assume Cobb-Douglas production functions, and a relatively large degree of substitutability seems appropriate for our model given that two of our inputs are different types of capital. Accordingly, in our benchmark case, we assume a Cobb-Douglas production function, that is, a unitary elasticity of substitution in production. However, Chirinko (2002) argues that a much lower elasticity of substitution between capital and labor is appropriate; his preferred estimate is 0.4. Accordingly, we calibrate our simulation model for a wide range of substitution elasticities, varying from the Cobb-Douglas case $(\xi_1 = \xi_2 = 1)$ to an elasticity of substitution in production as low as $\xi_1 = \xi_2 = 0.25$ (Table 1).

In a recent paper that documents the decline in the labor share of income since the 1980s, Karabarbounis and Neiman (2014) estimate a global corporate labor share of around 60 percent, and an overall labor share of around 52.5 percent. We assume that the labor share in sector one (the domestic sector) corresponds to the global share ($\alpha_2 = 0.525$) and the labor share in sector two (the multinational corporate sector) corresponds to the global corporate share ($\beta_2 = 0.60$).

Cronin et al. (2013) estimate that roughly 63 percent of corporate income is due to above-normal returns. Given a corporate labor income share of 60 percent, we choose the shares of ordinary capital and firm-specific capital to be consistent with the Cronin et al. estimate. That is, we choose our parameters so that the ratio of the total earnings attributable to above-normal returns to *FSK*, defined as the excess of actual returns to *FSK* over the returns to ordinary capital, to the total earnings from the normal returns to ordinary capital is 1.7 (=0.63/(1–0.63)). This in turn implies that the ordinary capital and *FSK* shares in the MNC production function are $\beta_1 = 0.148$ and $1 - \beta_1 - \beta_2 = 0.252$. Similarly, assuming a labor share of 52.5 percent in the domestic sector implies $\alpha_1 = 0.176$ and $1 - \alpha_1 - \alpha_2 = 0.299$.

To calibrate the relative rate of return to *FSK*, we consider the literature studying the rate of return to investment in research and development. In a study of UK firms, Greenhalgh and Rogers (2006) find that the ratio of the shadow value of intangible to tangible assets is 3.5, but that this ratio varies considerably by sector, from 2.34 for software firms to 7.97 for production intensive firms. Following their baseline result, we set $r = 0.1$ and $\rho_F = 0.35$.

It is less clear how the rate of return to *LSK* should compare to the return to ordinary capital. Hou and Robinson (2006) find that in the United States firms in more concentrated markets earn lower stock market returns, while Gallagher, Ignatieva, and McCulloch (2015) find that in Australia firms in more concentrated markets are able to earn excess returns. Gallagher, Ignatieva, and McCulloch hypothesize that a more rigorous regulatory environment in United States explains this difference. Given this ambiguity, we choose a rate of return to *LSK* that is only 25 percent higher than the rate earned by ordinary capital, $\rho_L = 0.125$.

4.2.2 Utility Function Parameters

In 2012, foreign-controlled enterprises produced 37 percent of total GDP in the EU countries.[10] Accordingly, the MNC produces 37 percent of GDP in our base case. To achieve this, we set the consumption share parameters for the representative resident at $\alpha_{C1} = 6.15$ and $\alpha_{C2} = 4.08$. The various γ parameters determine the responsiveness of consumption and labor supply to changes in prices (including the wage) and income. We calibrate our demand price elasticity for the multinational good to –1.1 ($\gamma_2 = 1.22$), consistent with Senhadji's (1998) estimate that the average long-run price elasticity of import demand is slightly higher than one. Seale and Regmi (2006) estimate price elasticities across good types for a wide selection of countries; we select an intermediate value for the uncompensated price elasticity of the domestic good of –0.8 ($\gamma_1 = 0.615$).

Turning to the labor supply parameters, in a Congressional Budget Office survey of recent research on labor supply elasticities, McClelland and Mok (2012) conclude that the substitution elasticity of labor supply for the total population in the U.S. is between 0.1 and 0.3, and that the income elasticity is between –0.1 and zero. Accordingly, we set the parameters of our utility function so that the labor supply substitution elasticity is 0.2, and the income elasticity is –0.05; this implies $\gamma_L = 0.413$ and $\alpha_L = 7.3$. Note that these parameter values yield an uncompensated labor supply elasticity of 0.15, a value that is consistent with the consensus estimates in McClelland and Mok (2012) and comparable to the value of 0.18 used by Jacobs (2009).

4.2.3 Government Spending and Tax Rates

We fix government services, which are assumed to be separable from the individual utility function, at roughly 16 percent of national income. This is consistent with the average

[10] Authors' calculations based on data from Eurostat, http://ec.europa.eu/eurostat/data/database, "GDP and main components" and "Foreign control of enterprises by economic activity and a selection of controlling countries."

level (16.2 percent) reported by The World Bank's World Development Indicators for high-FDI countries between 2000 and 2013.[11]

As discussed above, our "capital income tax rate" is a proxy for several concepts of capital income taxation, including statutory and various effective tax rates. We calibrate our model at a capital tax rate of $\tau/(1+\tau)=0.18$, which reflects the average effective business-level capital income tax rate estimated by PricewaterhouseCoopers (2011) for high-FDI countries.[12] Under our base case assumption that the elasticity of substitution in production is $\xi_1=\xi_2=1.0$, this implies a labor tax rate of $\tau_L/(1+\tau_L)=0.22$. This labor tax rate, which is endogenously determined to balance the government budget constraint, assumes that 35 percent of labor income is exempted from the tax base ($\phi_E=0.35$), reflecting provisions such as standard deductions, personal exemptions, and a variety of other deductions and exclusions. For example, in 2013, about 69 percent of the income reported on US tax returns was taxable, a figure that overstates the share of taxable income since filers with very low income levels are not required to file US tax returns.[13]

Globally, taxes on domestic natural resources vary considerably. In a recent survey, the International Monetary Fund (2012) reports high average effective tax rates on extractive industries. For the petroleum industry, these rates are generally between 65 and 85 percent of net present value. For mining industries, rates are somewhat lower, ranging from 45 to 65 percent. Accordingly, in our benchmark case, the direct tax on location-specific capital is set at 60 percent $(\tau_{LSK}=0.6)$. We initially assume that none of the location-specific capital subject to this tax, $\phi_{LSK}=0$, since *LSK* does not necessarily represent extraction activity, but consider the full range of possible values in our simulations $(0\le\phi_{LSK}\le 1)$.

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[11] We identify high-FDI countries as those whose average (2000–2013) foreign direct investment (FDI) net inflows as a share of GDP are in the top 50% reported internationally. This corresponds to countries whose FDI net inflows average above 3.7% of GDP between 2000 and 2013. These data were obtained from http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

[12] The unweighted average of effective tax rates for high-FDI countries (as defined in footnote 11) in this study is 17.5%, rising to 19.2% if the samples is restricted to countries with at least 10 observations.

[13] See IRS SOI Tax Statistics, "Table 1.1 All Returns: Selected Income and Tax Items, Tax Year 2013," https://www.irs.gov/uac/SOI-Tax-Stats---Individual-Statistical-Tables-by-Size-of-Adjusted-Gross-Income.

As discussed in the introduction, in most circumstances the fraction of firm-specific capital that is subject to residual taxation in the home country (ϕ_F) is likely be relatively small. However, it may be significant for (1) countries attempting to attract a significant share of their foreign direct investment from US-based MNCs that are not (and are not likely to be) in an excess foreign tax credit position, or (2) countries with tax rates that are (or will become with reform) sufficiently low that they trigger current residual home country taxation under various anti-base-erosion provisions—a category that may increase over time as more countries adopt such provisions. In our base case, we assume that the fraction of firm-specific capital that is subject to residual taxation is very small $(\phi_F = 0.01)$ and subject to a gross residual tax rate of 20 percent. However, we simulate a wide variety of potential residual taxation scenarios, including $0.05 \le \tau_F / (1+\tau_F) \le 0.30$ and $0 \le \phi_F \le 0.30$, corresponding to the range of values that might arise under anti-base-erosion provisions.

Finally, we assume that the effective tax haven rate is $\tau_H / (1+\tau_H) = 0.05$, reflecting a combination of very low tax haven rates coupled with the costs of shifting income and deferring repatriation, which Grubert and Altshuler (2013) suggest range from 1–7 percent.

4.2.4 Income Shifting Parameters

There is considerable disagreement about the fraction of capital income that is currently shifted abroad. Riedel (2014) surveys the literature on international tax avoidance and reports a range of 5 percent (found in the United Kingdom by HMRC (2014)) to 30 percent (found in the United States by Clausing (2011)). In her most recent work, Clausing (2016) estimates that the amount of income shifted from the US corporate income tax base is 32–46 percent of current revenues. In our benchmark case, we adopt a fairly conservative assumption that income shifting is 15 percent of the corporate tax base ($\phi_S / (1-\phi_S) = 0.15$ or $\phi_S = 0.13$).[14, 15] Under the tax rates

[14] This aligns closely with the Dyreng and Markle (2015) estimate that income shifting the United States is roughly 13 percent of revenues – although they note that because their sample size is relatively small, their estimate is not necessarily inconsistent with larger estimates such as those found by Clausing (2011).

[15] Estimates of the tax semi-elasticity of income shifting provide another indicator of the degree of uncertainty about the extent of income shifting. For example, Clausing notes that her larger estimate implies a tax semi-elasticity of 3.3. This value, however, is relatively large in comparison to most others found in the literature; for example, Heckemeyer and Overesch (2013) argue that the consensus estimate of the tax semi-elasticity of income shifting is

assumed in the model, this implies that the capital income shifting parameter is $\eta = 0.65$. However, given the uncertainty about the extent of income shifting, we simulate a wide range of values for the share of income that is shifted abroad, $0.05 \le \phi_S / (1-\phi_S) \le 0.50$.

There is considerably less literature on the shifting of labor income to the corporate income tax base. However, we expect the share of labor income shifted to be modest, as relatively few individuals both have the capability to shift labor income and potentially benefit from it. The two groups most likely to engage in labor income shifting are the self-employed and individuals working in small corporations. According to The World Bank's World Development Indicators, about 35 percent of the employed population in high-FDI countries is self-employed, while in a sample of 20 OECD countries, around 24 percent of individuals work for companies with 10 or fewer employees.[16] Accordingly, in our benchmark case we set $\omega_I = 0.35$ and also consider cases where up to 50 percent of labor income can potentially be shifted. Given our assumption that 35 percent of labor income is exempt from taxation, we then assume 75 percent of remaining labor income is taxed at a rate exceeding the capital income tax rate. Additionally, we simply assume that a quarter of this potentially shiftable income is actually shifted to the corporate tax base. This calculation suggests that about 7 percent of labor income is shifted to the corporate tax base ($\phi_I / (1-\phi_I) = 0.07$), implying $\mu = 0.16$. With 7 percent of labor income shifted to the corporate tax base, 8.7 percent of revenue raised by the capital tax reflects revenue raised from taxation of shifted labor income. This figure is slightly below the range of 10 to 17 percent labor income shifting estimated in for the EU by de Mooij and Nicodème (2006).[17]

0.8, although Clausing (2016) argues that most of the papers cited in this study use data that does not adequately capture income shifting to tax havens.

[16] This calculation is based on values from OCED (2012). The 20 countries with available data include Austria, Belgium, Brazil, the Czech Republic, Denmark, Finland, Germany, Hungary, Italy, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom.

[17] Our estimates may be conservative. Gordon and Slemrod (2000) estimate that a one percentage point decrease in the differential between the labor income and businesss tax rates leads to a fairly large 2.9 percent increase in personal income. When we simulate the effects of a small change in this tax rate differential at the initial equilibrium in our model, we obtain a smaller tax semi-elasticity of –1.36.

4.2.5 Other Parameters

Sercu and Vanpée (2007) examine a sample of 42 countries and estimate that the share of domestically-owned equity capital in total market capitalization is 80 percent. Accordingly, we assume in our benchmark case that the domestically-owned share of the location-specific capital is $\theta = 0.8$. In the simulations, we consider the full range of possibilities for this parameter, $0 \le \theta \le 1$.

4.3 Simulation Results

As mentioned above, we calibrate our model for various values of the elasticity of substitution in production, ranging from $\xi_1 = \xi_2 = 1$ to $\xi_1 = \xi_2 = 0.25$, using the Cobb-Douglas formulation as the benchmark. In Table 1, we present the parameters used for calibration and welfare analysis for each 0.15 increment over this range of the production substitution elasticity.

Note that as the elasticity of substitution in production declines, the optimal capital income tax rate rises, as capital income taxation is less distortionary if capital-labor substitution in production is more difficult. For example, when the elasticity of substitution in production is $\xi_1 = \xi_2 = 1$, the optimal capital income tax rate is $\tau^* /(1+\tau^*) = 0.160$, but as the production elasticity declines to $\xi_1 = \xi_2 = 0.25$, the optimal capital income tax rate increases by nearly 18 percent to $\tau^* /(1+\tau^*) = 0.188$.

In addition, as the optimal capital income tax rate approaches the level in our baseline, $t/(1+t) = 0.180$, the welfare gains associated with reform – defined as moving from the benchmark initial equilibrium to the optimal capital income tax rate – naturally approach zero. For example, at the substitution elasticity $\xi_1 = \xi_2 = 0.40$, the optimal capital income tax rate $t^*/(1+t^*) = 0.182$ is very close to the observed rate, so that capital income tax reform produces negligible welfare gains. By comparison, moving to the optimal capital income tax rate in the Cobb-Douglas case increases welfare by 0.53 percent of CIT revenues. Alternatively, consider the effects of moving from no taxation of capital income to the optimal capital income tax rate. In the Cobb-Douglas case, this results in a welfare gain of 4.97 percent of CIT revenues. However, at lower elasticities of substitution in production, the distortionary effects of capital income taxation are smaller, so the welfare gains associated with introducing a positive capital income tax rate are generally larger; for example, moving to the optimal capital income tax rate results in a welfare gain equal to 8.75 percent of CIT revenues in the case of an elasticity of substitution in production of 0.25.

In our benchmark calibration, 35 percent of labor income can be potentially be shifted ($\omega_I = 0.35$), only 1 percent of MNC capital income is subject to residual taxation ($\phi_F = 0.01$), there is no direct taxation of *LSK* ($\phi_{LSK} = 0$), and 20 percent of *LSK* is foreign-owned ($\theta = 0.8$). In this case, the optimal capital income tax rate is $t^*/(1+t^*) = 0.160$ and the labor income tax rate, which is determined as a residual from the government budget constraint, is $\tau_L/(1+\tau_L) = 0.241$.

The results of various simulations of the model are shown in Figures 1–7, where the benchmark calibration is indicated with a triangle. The basic variations on the benchmark result are illustrated in Figures 1a-c, which show the optimal capital income tax rates for various assumptions about the share of *LSK* owned by foreigners $(1-\theta)$, the share of labor income that can be feasibly shifted (ω_I), and the fraction of unshifted income subject to residual taxation (ϕ_F). Note that, in contrast to our main result in the analytical model, the optimal capital income tax rate is not zero even when all location-specific capital is owned domestically and there is no residual taxation, since a portion of the capital income tax base (*LSK*) is inelastic.[18] However, the optimal capital income tax rate is small when there is no residual taxation, no potential for labor income shifting, and no foreign ownership of *LSK*, as the optimal rate is less than 3 percent, $\tau^*/(1+\tau^*) = 0.027$ (not shown). Thus, considered in isolation, the opportunity to tax immobile location-specific rents accruing to domestic residents does not provide much of a rationale for capital income taxation in the model.

With only 1 percent of capital in the multinational sector subject to residual taxation and no labor income shifting, Figure 1a shows that the optimal capital income tax rate is roughly linear with respect to the share of *LSK* that is owned by foreigners, beginning at $\tau/(1+\tau) = 0.03$ when the foreign-owned share of *LSK* is zero and reaching a maximum of $\tau/(1+\tau) = 0.26$ when

[18] Tests removing *LSK* from domestic production indicate that the optimal capital tax rate is zero (with no residual taxation) as long as all capital investment is perfectly mobile, since the elasticity of labor supply is finite but non-zero. Note also that the presence of *LSK* does not produce a positive optimal capital income tax rate in our analytical model because the alternative of taxing fixed labor supply has no distortionary cost in that case.

all of *LSK* is foreign-owned. Thus, the opportunity to tax foreign rents may provide an important rationale for taxing capital income, as stressed by Huizinga and Nielsen (1997). At the benchmark level of foreign ownership of 20 percent (with minimal residual taxation and no income shifting), the optimal capital income tax rate is $t^*/(1+t^*) = 0.077$, which implies a labor income tax rate of $\tau_L / \left(1+\tau_L\right) = 0.293$.

Figure 1a also shows that adding the possibility of a treasury transfer effect by including residual taxation increases the optimal capital income tax rate, but only until the domestic tax rate equals the assumed residual tax rate of 20 percent. Recall that in the analytical model with full residual taxation, the optimal capital tax rate is at least as high as the foreign tax rate. By expanding the model to include ordinary capital in both sectors, we include some mobile capital that we assume is not subject to residual taxation (K_1). Although this diminishes the importance of the underlying treasury transfer effect, the presence of a residual tax still moves the optimal capital income tax rate toward the foreign tax rate. In all cases, the optimal tax rate plateaus at the assumed residual tax rate — $\tau_F / \left(1+\tau_F\right) = 0.20$. Once this limit is reached, the optimal capital income tax rate remains constant until the foreign-owned share of *LSK* is large enough (in excess of 70 percent) to justify further increases, up to the maximum rate of 26.4 percent which occurs when all *LSK* is foreign-owned.

The same general pattern occurs in Figures 1b and 1c. However, these figures show that the sensitivity of the optimal capital income tax rate to foreign ownership of *LSK* depends heavily on the opportunity for labor income shifting. In all cases, the optimal capital income tax rate is 26.4 percent when all *LSK* is foreign-owned. However, at lower values of the foreign-owned share of *LSK*, the optimal capital income tax rate generally increases as labor-income shifting opportunities increase, as increased capital income taxation allows lower labor income tax rates, both of which reduce the incentive for labor income shifting, which reduces revenues and incurs costs. For example, when 35 (50) percent of labor income can be feasibly shifted to the capital income tax base, the optimal capital income tax rate rises to $\tau^*/(1+\tau^*) = 0.153$ (0.172), even with minimal residual taxation and no foreign-ownership of *LSK*. This of course reduces the sensitivity of the optimal capital income tax rate to variation in the share of *LSK* that is foreign-owned.

Figure 2 illustrates that if some direct taxation of location-specific capital is available (under the assumption that direct taxes paid on location-specific rents are deductible from the capital income tax), the optimal capital income tax rate declines significantly. As discussed above, this occurs because an alternative tax instrument can be used to extract rents from the owners of location-specific rents, including foreigners, without the negative consequences on capital flight and capital income shifting associated with use of the capital income tax. For example, under our base-case assumption that 20 percent of location-specific capital is foreign-owned, the optimal capital income tax rate drops from $t^*/(1+t^*) = 0.16$ or 16 percent to 7.1 percent if all rents from *LSK* can be taxed directly.[19] And, if all *LSK* is foreign-owned, the optimal capital income tax rate drops from 26.4 percent to 9.4 percent. In addition, the sensitivity of the optimal capital income tax rate with respect to foreign ownership of *LSK* declines with direct taxation, since rents earned by foreigners can be taxed directly. Indeed, in the extreme case in which all location-specific capital can be taxed directly, the optimal capital income tax barely increases with the foreign-owned share of *LSK* (from $t^*/(1+t^*) = 0.066$ with $\theta = 1$ to $t^*/(1+t^*) = 0.094$ with $\theta = 0$). This slight increase occurs because above-normal returns to foreign-owned *LSK* are still included in the capital income tax base, with the direct tax on *LSK* deductible.

We turn next to the sensitivity of the results to changes in firm production function parameters. Figure 3 examines the interaction of the relative capital shares in the production of the domestic good with the availability of a direct tax on *LSK*. Specifically, consider an increase in the production cost share of *LSK* coupled with a reduction in the production cost share of ordinary capital. When there is no direct taxation of *LSK*, this increases the optimal capital income tax rate, as *LSK* is a greater share of the capital tax base. However, when *LSK* is taxed directly, any increases in the relative cost share of *LSK* increase the revenue raised from the direct taxation of *LSK*, lowering the optimal capital income tax rate (as well as the corresponding labor income tax rate since more revenue is available). For example, in the absence of direct *LSK*

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[19] The optimal capital income tax rate does not drop to zero because it is still desirable to raise capital income revenue, reducing the labor income tax rate and the corresponding incentive for labor income shifting. If labor income shifting were impossible, the optimal capital income tax rate would be very near zero in this case (1.7 percent), even with variable labor supply. This small amount of capital taxation persists because *LSK* is still included in the capital income tax base (although the direct tax on *LSK* is fully deductible).

taxation, increasing the cost-share ratio for *LSK* to ordinary capital from 0.5 to 3.0 (the benchmark value is 1.7) increases the optimal capital income tax rate from $t^*/(1+t^*) = 0.147$ to $\tau^*/(1+\tau^*) = 0.172$, while the labor income tax rate (not shown) declines from $\tau_L/(1+\tau_L) = 0.259$ to $\tau_L/(1+\tau_L) = 0.229$. However, if all *LSK* is taxed directly, the optimal capital income tax rate declines from $t^*/(1+t^*) = 0.103$ to $t^*/(1+t^*) = 0.059$ and the labor income tax rate declines from $\tau_L/(1+\tau_L) = 0.224$ to $\tau_L/(1+\tau_L) = 0.123$.

Figure 4 demonstrates that the amount of residual taxation is generally more influential in determining the optimal capital income tax rate than the residual tax rate. Changes in the residual tax rate have no effect on the optimal capital income tax rate so long as the residual tax rate is less than the domestic optimal capital income tax rate, which, in our base case, is as long as $\tau_F/(1+\tau_F) \leq 0.160$. However, once the residual tax rate exceeds 16 percent, the optimal capital income tax rate equals the residual tax rate until the level of capital income taxation takes maximum advantage of the treasury transfer effect for the given amount of income subject to residual taxation (the kink point in each of the four graphs lies in the range $0.16 \leq \tau_F/(1+\tau_F) \leq 0.20$). Beyond that point, the optimal capital income tax rate increases only slightly with increases in the residual tax rate.

In our benchmark calibration, 35 percent of labor income is exempt from labor taxation, producing a base-case optimal capital income tax rate of $t^*/(1+t^*) = 0.160$ and a corresponding labor income tax rate of $\tau_L/(1+\tau_L) = 0.241$. However, Figure 5 shows that as the amount of taxable labor income declines, higher marginal tax rates on labor income are needed to raise revenue, increasing the labor-leisure distortion and the amount of labor income shifting associated with labor taxation. For example, with the 35 percent exemption, labor income shifting is calibrated to $\phi_I/(1-\phi_I) = 0.07$ (or 7 percent), but if 25 percent of income is exempt, shifted labor income decreases to 4.8 percent of taxable unshifted income. With these decreases in the distortionary cost of labor taxation, the optimal capital income tax rate also decreases modestly (from 16 percent to 15 percent). Consequently, as the amount of exempt labor income increases, both the optimal capital income and labor income tax rates increase. However, Figure 5 demonstrates that the labor income tax increases more in response to labor exemptions than does the optimal capital income tax rate, which is only moderately sensitive to changes in the share of exempt labor income.

Finally, and perhaps surprisingly, differences in opportunities for international income shifting have relatively little effect on the optimal capital income tax rate in the model. The simulation results presented in Figure 6 examine the effects of changes in the share of capital income shifted to the tax haven – achieved by changing the international income shifting cost parameter – on the optimal capital income tax rate, for three levels of residual taxation. Holding all other parameters at their base-case values and adjusting capital income shifting costs so that the share of capital income shifted to a tax haven in the base case increases from 5 percent to 50 percent, the optimal capital income tax declines only from $t^*/(1+t^*) = 0.162$ to $t^*/(1+t^*) = 0.155$.

This relatively small effect reflects three offsetting effects of an increase in international income shifting opportunities on the optimal capital income tax rate. First, as international income shifting increases due to lower shifting costs, the size of the domestic capital income tax base decreases so that the revenue raised by the capital income tax declines; the government's desire to avoid this revenue loss puts downward pressure on the optimal capital income tax rate. Second, since location-specific capital cannot be shifted internationally, increased capital income shifting implies a larger share of the capital income tax base is immobile; this makes capital income taxation relatively more attractive and puts upward pressure on the optimal capital income tax rate. Third, as international capital income shifting increases, the negative effect on foreign direct investment of higher capital income taxes is muted, as foreign MNCs recognize that the cost of a higher domestic statutory tax rate is diminished by the potential to shift some of the income earned to a low tax jurisdiction – the cost of capital in the multinational sector is less affected by the statutory rate in the presence of income shifting, implying foreign direct investment is less sensitive to the capital income tax rate. This makes capital income taxation less costly to the government and puts upward pressure on the optimal capital income tax rate.

These three effects are illustrated in Figures 7a-c. Figure 7a shows the capital tax base, relative to the base case, as a function of the capital income tax rate for different levels of international income shifting costs. It demonstrates that lower shifting costs, which lead to more capital income shifting, result in a smaller capital income tax base and thus revenue losses for the domestic government, putting downward pressure on the optimal capital income tax rate.

Figure 7b shows the *LSK* share of the capital income tax base as a function of the capital income tax rate for different levels of international income shifting costs. It demonstrates that lower shifting costs, which lead to more capital income shifting, result in a larger relative share of the capital tax base for *LSK*, making capital income taxation more attractive and thus putting upward pressure on the optimal capital income tax rate.

Finally, Figure 7c shows MNC investment, relative to the base case, as a function of the capital income tax rate for different levels of international income shifting costs. It demonstrates that lower shifting costs, which lead to more capital income shifting, result in slightly more investment at each value of the capital tax rate, as the potential for income shifting dampens the effect of capital income taxation on MNC investment. Figure 6 indicates that the last two factors are not large enough to offset the first factor described above, so that the optimal capital income tax rate declines, but only slightly, as the amount of international income shifting increases.

5. CONCLUSION

In this paper, we analyze the optimal taxation of capital income for a small open economy that is attempting to balance the wide variety of factors that bear on the decision to impose a source-based tax on capital. On the one hand, the standard argument – the burden of a capital income tax imposed on internationally mobile capital will be borne entirely by local factors – suggests that the optimal capital income tax rate is zero. This argument is reinforced by concerns that mobile capital may include highly productive firm-specific capital owned by MNCs that earns above-normal returns, and that high capital income tax rates may induce international income shifting by MNCs that will reduce revenues, perhaps significantly. On the other hand, some capital income taxation is desirable even in a small open economy to tax above-normal returns earned by location-specific capital, especially to the extent that capital is owned by foreigners, to limit the shifting of labor income to the capital income tax base, and to take advantage of any "treasury transfer" effects that may be available. An additional complicating factor is that the opportunity to shift income internationally may mitigate the negative effects of higher capital income tax rates on FDI (since MNCs will know that the effects of a relatively high tax rate will be dampened via income shifting) and will increase the relative capital share of location-specific capital, increasing the relative desirability of more capital income taxation.

Our base analysis confirms the standard results: if all foreign-owned capital is perfectly mobile and there is no residual taxation, the optimal capital income tax rate is zero, while with full residual taxation, the optimal capital income tax rate never falls below the foreign residual tax rate as the government takes maximum advantage of the treasury transfer effects. But in the more relevant and more general cases, the optimal capital income tax rate falls between these two extremes, and is typically below the tax rate applied to labor income.

The simulation results of course depend on the model specification and parameter values used. Subject to that caveat, the simulations provide several noteworthy results. First, although the opportunity to tax immobile location-specific rents accruing to domestic residents does not provide a significant rationale for capital income taxation in our benchmark case, the optimal capital income tax rate increases approximately linearly as the fraction of location-specific rents that accrue to foreigners increases, in some cases exceeding the tax rate on labor income. Second, an operative treasury transfer effect provides a strong rationale for capital income taxation – an effect that currently is not likely to be very important, but may become much more relevant over time, especially as domestic capital income tax rates decline, if more countries enact strict anti-base-erosion provisions. Third, the potential for labor income shifting puts upward pressure on capital income tax rates to reduce the labor-capital income tax differential, and also tends to reduce the variation in capital income tax rates. Fourth, the availability of a separate tax on the income earned by location-specific capital significantly reduces optimal capital income tax rates; for example, in the resource sector, this could be a separate income tax on *LSK* earnings or a resource rent tax (or any cash flow-based tax) that would apply tax only to the rents earned in that sector. Fifth, the optimal capital income tax rate is only moderately sensitive to wide variations in the shares of location-specific and ordinary capital. Sixth, the amount of residual taxation is generally more influential in determining the optimal capital income tax rate than the residual tax rate. Seventh, several offsetting effects of international income shifting imply that the optimal capital tax rate is only marginally sensitive to the costs of international income shifting, declining slightly as such costs decrease and the amount of income shifting increases.

These simulations suggest that determining the optimal level of source-based capital income taxation is indeed a difficult problem.[20] For many countries, various factors are likely to make the standard argument for complete exemption of capital income from source-based taxation an incomplete guide to tax policy, as some taxation of capital income is desirable under most circumstances. The primary exception is when a separate tax can be applied to much or all of the income of location-specific capital (or such capital is an insignificant factor in production); in this case, optimal capital income tax rates are quite low, and administrative concerns suggest that maintaining capital income taxation only to tax capital income at a very low rate may not be desirable.

At the same time, the optimal level of capital income taxation in our simulations is typically significantly below the tax rate applied to labor income, especially as the share of labor income exempt from taxation decreases, suggesting that the standard comprehensive income tax approach is not likely to be desirable either. Instead, more flexible tax systems, such as the dual income tax systems observed in several Nordic countries and elsewhere, may be optimal as they can achieve a balance between capital and labor income taxation that is best suited to the circumstances of a particular country – assuming that income shifting from the relatively highly taxed labor income base to the relatively lowly taxed capital income tax base can be controlled.

We note that the prospect of residual taxation can potentially play an important role in determining the optimal capital income tax rate. This is currently a relatively unimportant issue, since the United States is the only major country with a residence-based system and tempers its effects by allowing deferral of tax until funds are repatriated to a US parent and allowing generous cross-crediting of foreign tax credits. Nevertheless, residual taxation may become a more important factor, especially at relatively low levels of domestic capital income taxation, if more countries introduce current residual taxes as part of anti-base-erosion measures.

We close by noting that our results are generated in a static setting, and thus ignore some interesting dynamics that might affect the optimal capital income tax rate and should be the subject of further research. For example, Coates (1993) highlights the importance of imperfect

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[20] There are of course numerous other factors not considered in our model that would also impact this decision (see, for example, Auerbach (2008) and Zodrow (2007)); in particular, we consider only business level taxation and ignore equity concerns. One particularly interesting factor is the extent to which capital income taxation can serve as a proxy for welfare-enhancing age-specific taxation (Erosa and Gervais, 2002; Weinzierl, 2011).

capital mobility in a repeated game, arguing that the relative immobility of capital that could be attracted to a region puts further downward pressure on the capital income tax rate. However, the overall impact of dynamic considerations on capital tax competition is not obvious. Cardarelli, Taugourdeau, and Vidal (2002) acknowledge the reality that competition for mobile capital is a repeated game and consider the potential impacts of cooperation in rate setting. By employing trigger strategies, countries may be able to increase capital taxes simultaneously, raising revenue without generating capital outflows – although the gains from cooperation are limited by asymmetry between countries.

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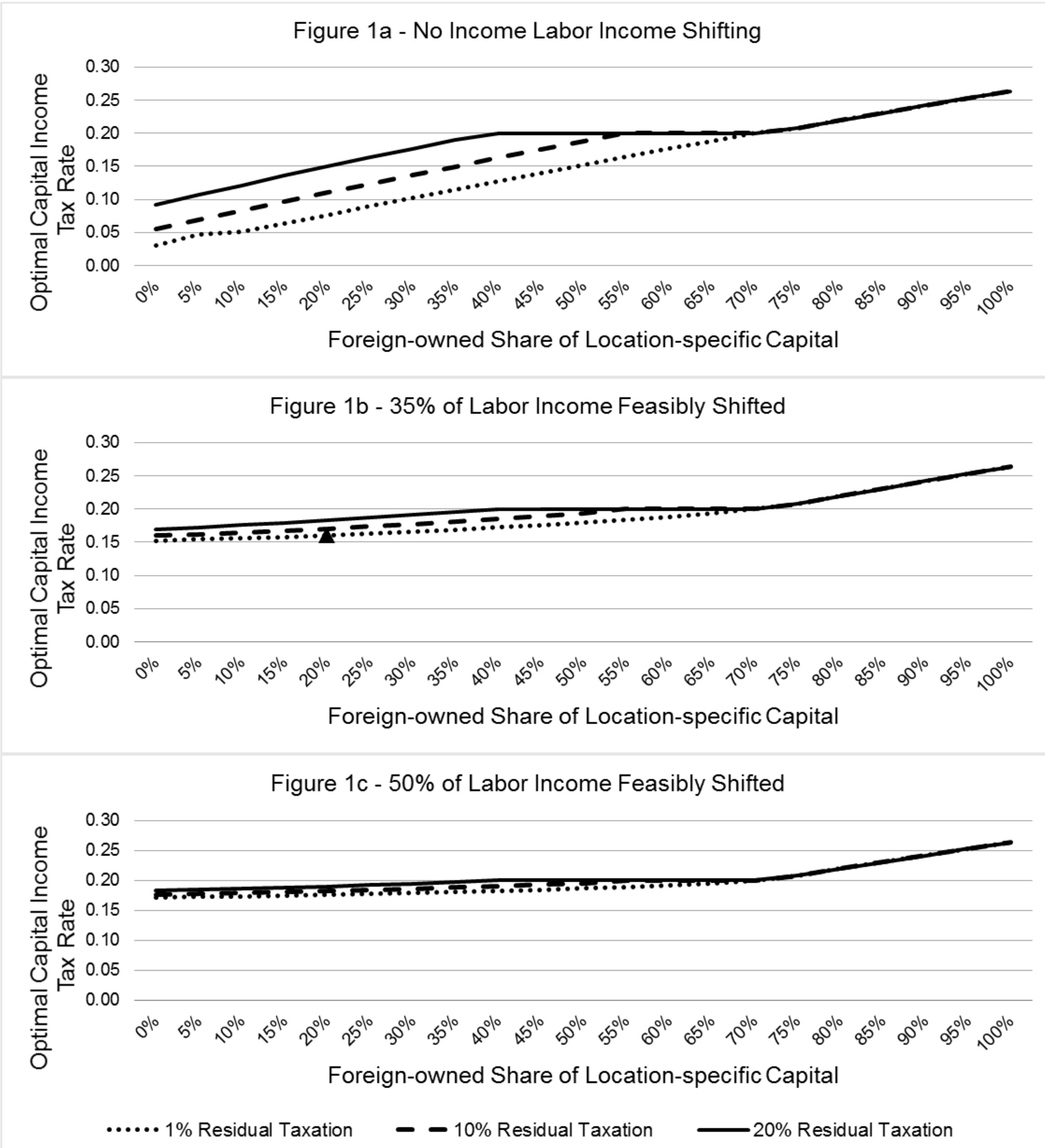
Table 1
Optimal Capital Taxation Model, Optimal Tax Rates, and Welfare Effects, as a Function of the Elasticity of Substitution in Production

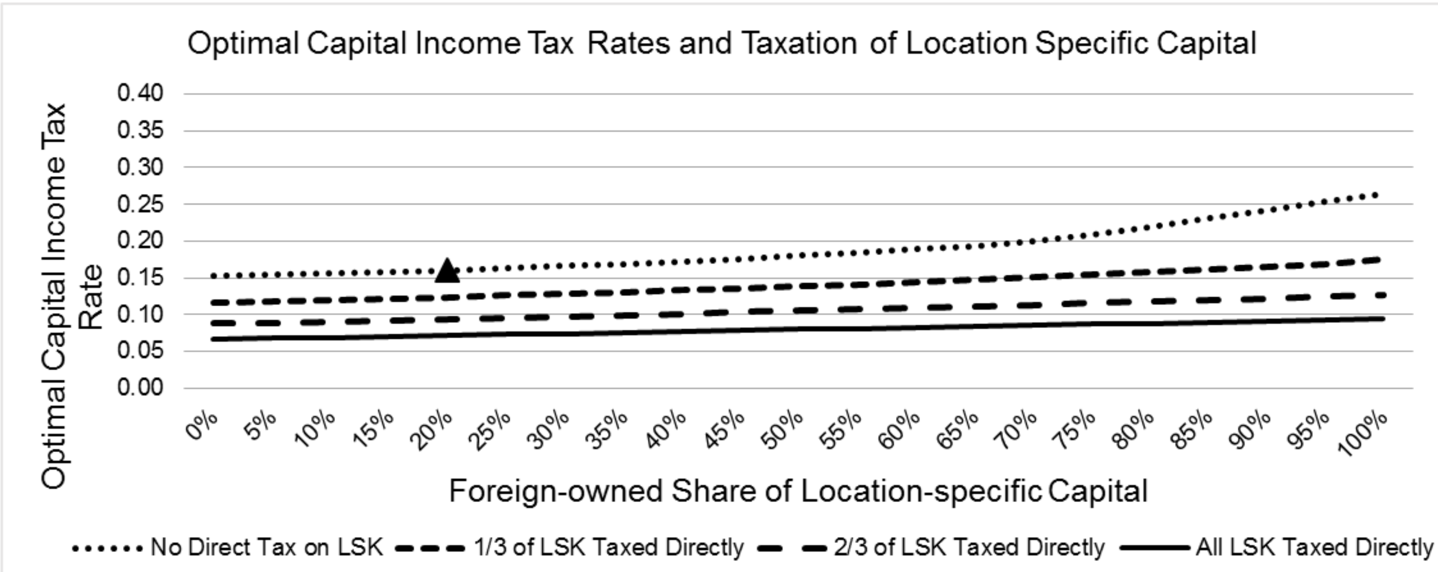
Varying the Elasticity of Substitution						
	$\xi_i = 1.00$	$\xi_i = 0.85$	$\xi_i = 0.70$	$\xi_i = 0.55$	$\xi_i = 0.40$	$\xi_i = 0.25$
G	0.198	0.2012	0.2055	0.211	0.217	0.2247
K_d	4.5	4.55	4.6	4.62	4.68	4.73
LSK	1.37	1.39	1.42	1.46	1.495	1.528
α_1	0.176	0.176	0.176	0.176	0.176	0.176
α_2	0.525	0.509	0.482	0.437	0.353	0.185
β_1	0.148	0.152	0.157	0.162	0.177	0.208
β_2	0.6	0.62	0.65	0.69	0.725	0.753
a_L	7.3	7.3	7.3	7.3	7.3	7.3
a_{C1}	6.15	6.15	6.15	6.15	6.15	6.15
a_{C2}	4.08	4.05	3.96	3.8	3.65	3.38
γ_1	0.615	0.615	0.615	0.615	0.615	0.615
γ_2	1.22	1.22	1.22	1.22	1.22	1.22
γ_L	0.413	0.412	0.415	0.417	0.418	0.421
Invariant Parameters						
$\tau_F/(1+\tau_F) = 0.20$		$p_2 = 0.9$	$\phi_{LSK} = 0$	$\theta = 0.8$	$\mu = 0.16$	$\omega_I = 0.35$
$\tau_H/(1+\tau_H) = 0.05$		$r = 0.1$	$\phi_E = 0.35$	$H = 2.85$	$\eta = 0.65$	
$\tau_{LSK}/(1+\tau_{LSK}) = 0.375$		$\rho_F = 0.35$	$\phi_F = 0.01$			
Optimal Tax Rates						
$t^*/(1+t^*)$	0.160	0.165	0.170	0.177	0.182	0.188
$t_L^*/(1+t_L^*)$	0.241	0.236	0.230	0.223	0.216	0.210
Excess Burden as a Percent of Capital Income Tax Revenue (At Initial Calibration Point)						
$\tau/(1+\tau) = 0.18$	0.53%	0.29%	0.11%	0.00%	0.00%	0.06%
$\tau/(1+\tau) = 0.00$	4.97%	5.92%	7.03%	8.08%	8.64%	8.75%
Capital Investment Changes Under Reform ($\tau = 0.00 \rightarrow \tau^*$)						
$\%\Delta(K_1 + K_2)$	-29.36%	-24.90%	-20.28%	-15.60%	-11.04%	-6.33%
$\%\Delta FSK$	-46.31%	-39.41%	-32.34%	-25.22%	-18.35%	11.08%

Figure 1



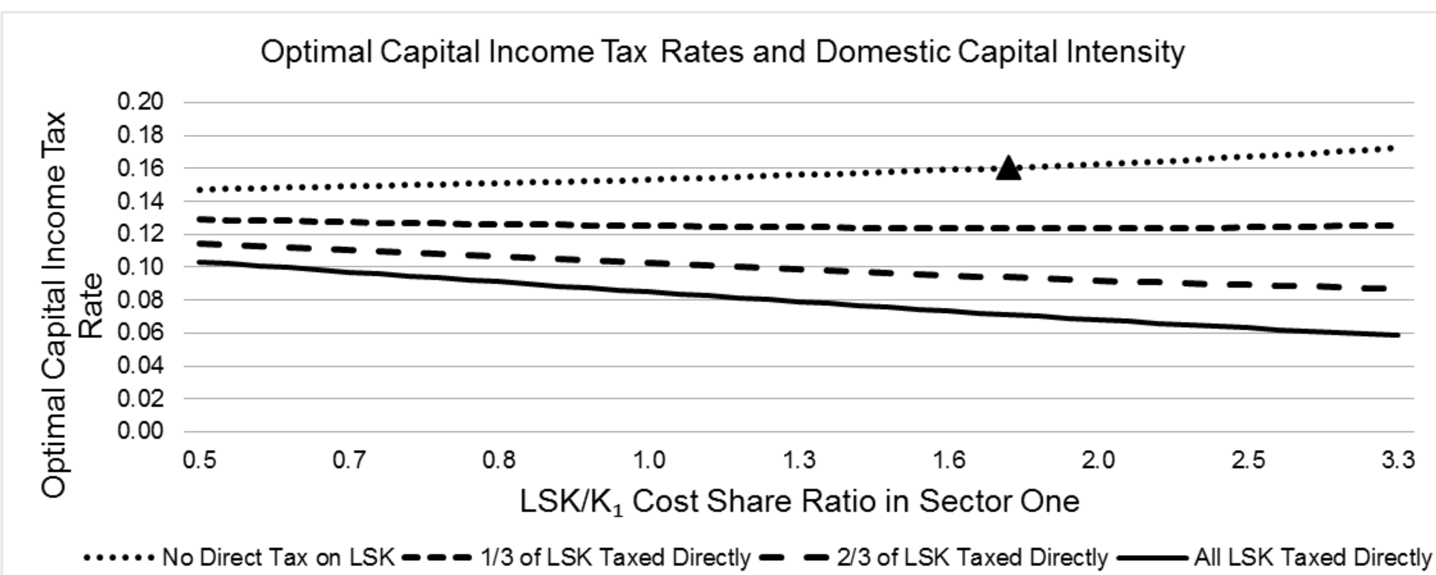
Note: All parameters are set to base-case values unless otherwise indicated. For these figures, this implies that there is no direct taxation of *LSK*, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, the gross residual tax rate is 20%, and 1% of capital in the multinational sector is subject to residual taxation.

Figure 2



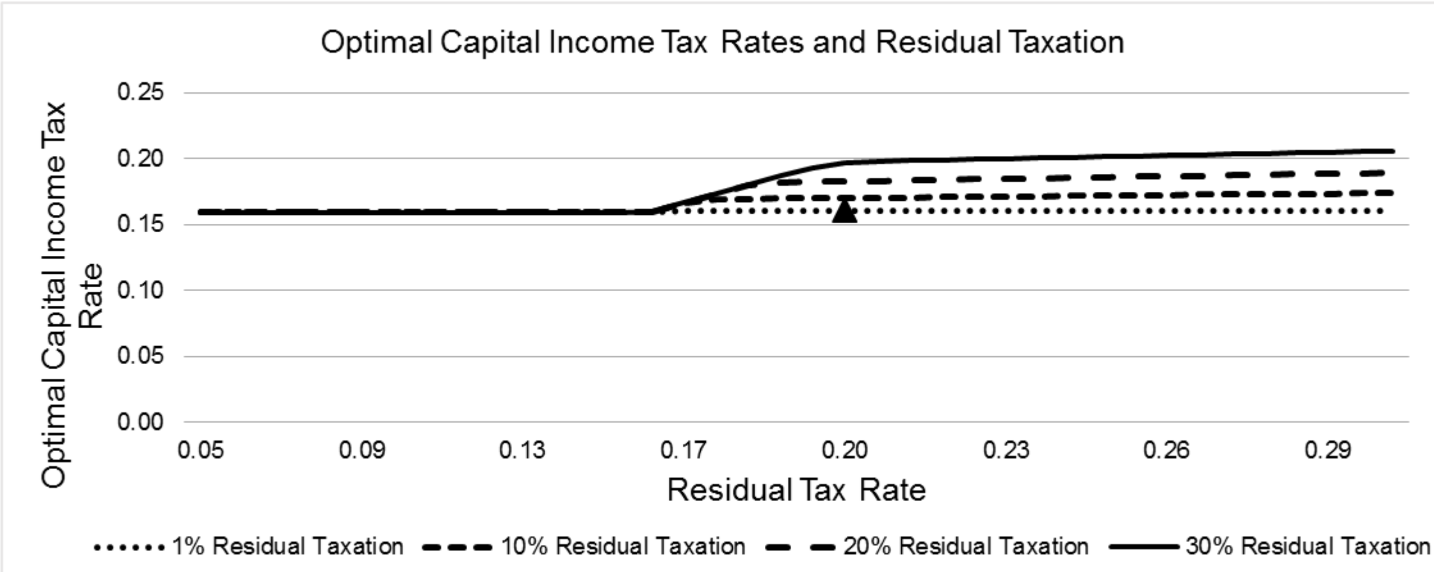
Note: All parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, the gross residual tax rate is 20%, and 1% of capital in the multinational sector is subject to residual taxation.

Figure 3



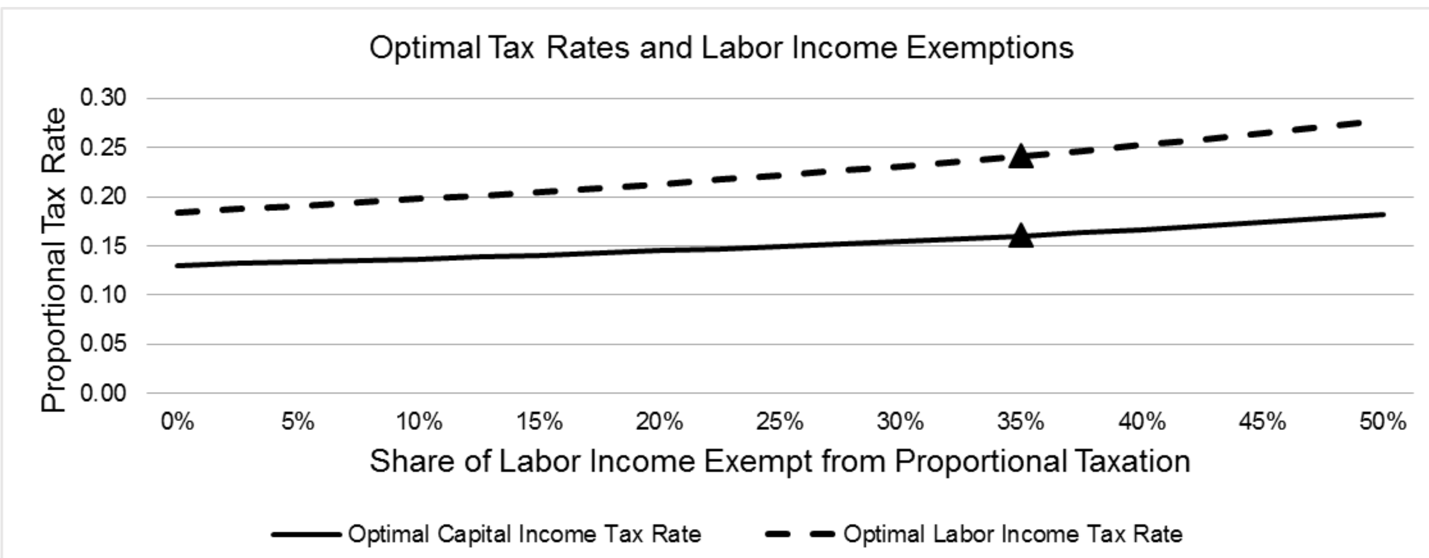
Note: All parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 20% of *LSK* is foreign-owned, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, the gross residual tax rate is 20%, and 1% of capital in the multinational sector is subject to residual taxation.

Figure 4



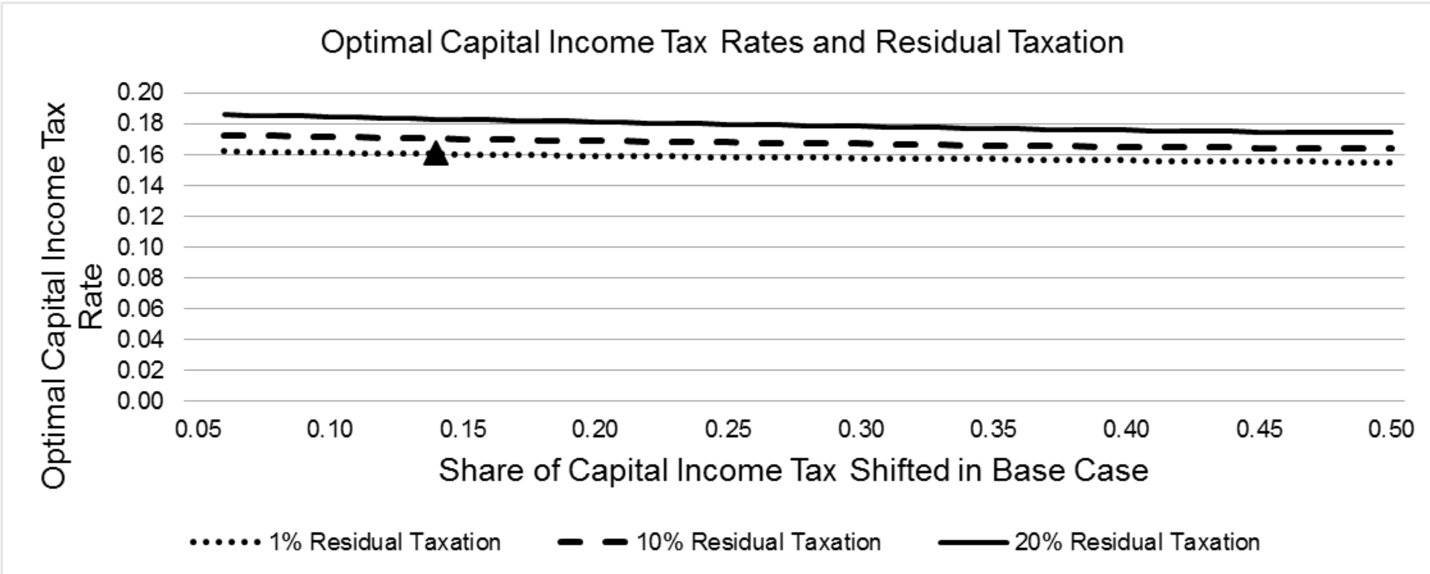
Note: All parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, 20% of *LSK* is foreign-owned, and there is no direct taxation of *LSK*.

Figure 5



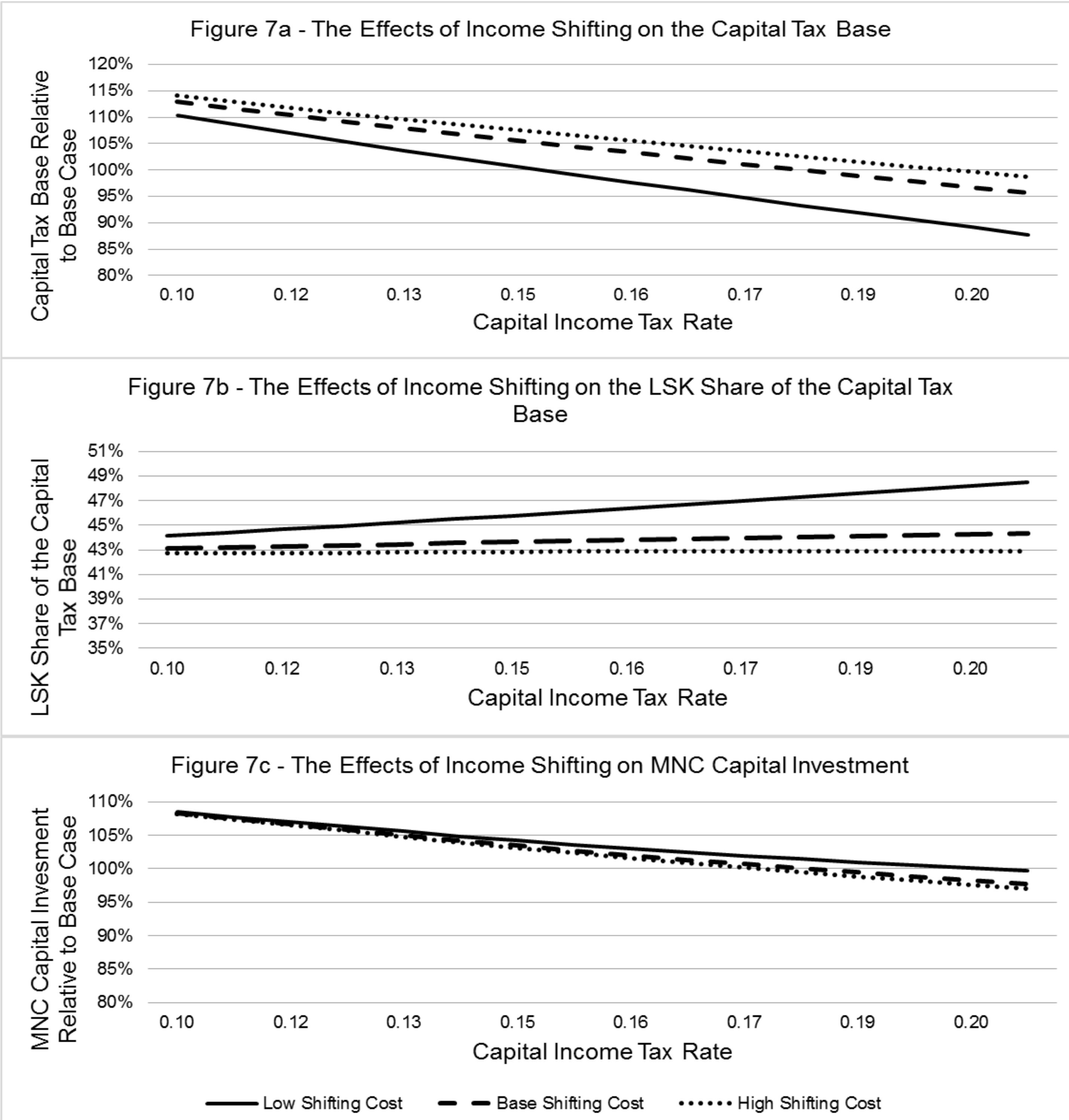
Note: All parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, 20% of *LSK* is foreign-owned, there is no direct taxation of *LSK*, the gross residual tax rate is 20%, and 1% of capital in the multinational sector is subject to residual taxation.

Figure 6



Note: Adjustments to the share of capital income shifted in the base case are achieved by adjusting the shifting cost. All other parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, 20% of *LSK* is foreign-owned, there is no direct taxation of *LSK*, and the gross residual tax rate is 20%.

Figure 7



Note: All parameters are set to base-case values unless otherwise indicated. For this figure, this implies 35% of labor income can be feasibly shifted, 35% of labor income is exempt from taxation, the elasticity of substitution in production is one, 20% of *LSK* is foreign-owned, there is no direct taxation of *LSK*, the gross residual tax rate is 20%, and 1% of capital in the multinational sector is subject to residual taxation. The low shifting cost is chosen so 50% of capital income is shifted internationally in the base case. The high shifting cost is chosen so 5% of capital income is shifted internationally in the base case.

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