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Substance requirements in the international taxation of intangible capital – a double edged sword?

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Substance Requirements in the International Taxation of Intangible Capital - A Double Edged Sword? *

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Abstract

The OECD's Base Erosion and Profit Shifting project has focused on income attributed to intangibles with an objective of curtailing perceived artificial profit shifting by multinational firms. A key part of this effort is a renewed emphasis on the concept of "economic substance." Economic substance standards require companies to have people functions (i.e., employees) in jurisdictions for companies to be able to report profits related to intangibles in such jurisdictions. Our analysis suggests that an emphasis on economic substance tied to people functions can have a significant impact on the scale as well as the location of economic activity (i.e., employees dedicated to the creation and use of intangibles). Furthermore, the likely implications on economic activity can be highly unfavorable for high-tax jurisdictions. Viewed from a U.S. perspective, this new international environment provides an explanation for the international provisions adopted as part of the U.S. tax reform of 2017.

Keywords: BEPS, economic substance, intangibles, international tax, transfer pricing, U.S. tax reform

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I. Introduction

In an attempt to reduce perceived tax avoidance through profit shifting, the Organization for Economic Co-operation and Development (OECD) reinforced the concept of “economic substance” in its Base Erosion and Profit Shifting (BEPS) project reports dealing with transfer pricing. This was aimed at securing one of the key objectives of the project: that multinational enterprises (MNEs) report taxable income in the jurisdictions that host the income-generating economic activity. The allocation of income associated with intangibles features prominently in these reports. The OECD has identified intangibles – a mobile form of capital that can be moved across jurisdictions without significant (non-tax) costs – as a key area where enhanced guidance can have a significant impact in limiting the ability of an MNE to “artificially” shift profits from high tax to low tax jurisdictions. The OECD’s new guidelines (New OECD Guidelines), presented in the report on BEPS Actions 8 through 10 (OECD, 2015), emphasize that when reporting profits related to intangibles in a certain jurisdiction, the MNE also should be able to demonstrate the location of employees necessary for the development, management, and exploitation of the relevant intangibles within that same jurisdiction.¹ This is intended to minimize (if not entirely eliminate) “artificial profit shifting” where the location of income attributed to a company’s intangibles is disassociated from the location of important people functions.

This paper explores the potential consequences of this evolving international tax regime, comprising newly defined standards on economic substance as well as their expected enforcement in an environment shaped by the BEPS project. In particular, we develop a theoretical model to analyze the impact of economic substance requirements on firms’ behavioral responses with regard

¹ The OECD guidance in this area of people functions related to intangibles has been summarized in terms of the acronym “DEMPE” which stands for development, enhancement, maintenance, protection and exploitation.

to both the scale and the location of intangible capital. The model also analyzes the corresponding scale and location of people functions necessary for the development, management, and exploitation of the firms' intangible capital under varying standards of economic substance. Such "complementary labor" is used as the measure of economic substance with regard to intangibles in this paper. This is the labor necessary for the creation and productive deployment of intangible capital.

Our analysis suggests that higher economic substance requirements can have a significant impact on the scale as well as the location of economic activity - i.e., employees dedicated to the creation and use of intangibles. Furthermore, this impact on economic activity can be highly unfavorable for high-tax jurisdictions. Viewed from a U.S. perspective, this new international environment provided one more impetus to strive for a reform of the corporate tax code to make it more competitive. It also helps explain the design and intent of some of the specific international tax provisions that were adopted as part of Public Law 115-97 (popularly known as the Tax Cuts and Jobs Act or TCJA) in December 2017. In the absence of such changes, the United States—which previously taxed corporate income at a rate higher than most developed economies—risked losing economic activity to other countries in the international system shaped by the BEPS project.

Two of the authors previously explored some of these issues as part of a commentary on the BEPS project and its potential for unintended consequences given evidence gleaned from the relevant economics literature (Singh and Mathur, 2013). These issues are explored more formally in this paper by way of a theoretical model. There are at least two strands of literature within international taxation that are related to this paper. One specifically deals with the impact of international tax differences on firms' decisions regarding intangibles and the related role of intercompany transactions. Grubert and Slemrod (1998), Grubert (2003), Karkinsky and Riedel (2009) and

Dischinger and Riedel (2011) are notable studies within this segment of the literature. While not specifically addressing location of intangible investment, the interaction of tax policy and firms' cross-border intercompany arrangements is the focus of studies such as Haufler and Schjelderup (2000), Eggert and Schjelderup (2003), Huizinga and Laeven (2008), and Gumpert, Hines and Schnitzer (2016) that constitute a second segment of the literature relevant to this paper. However, while dealing with related issues, none of these works specifically address the role of economic substance in shaping firms' decisions regarding the scale and location of intangible capital along with the associated people functions. Additionally, in relying on a theoretical formulation of intangible capital as a factor of production, the paper is also related to the literature on firm productivity. Starting with the seminal work of Griliches (1979) who accounted for the effect of research and development (R&D) in the production function, the related literature has since expanded to include marketing and organizational capital within the production function in studies of firm productivity.

The paper is organized as follows. Section II provides background on the fundamental nature of international tax planning involving intangible assets that the economic substance standards in the New OECD Guidelines seek to impact. Section III presents an analytical framework that models an MNE's decision-making across jurisdictions with tax differences. Section IV derives the solution to the model assuming a special case (and narrow class of intercompany arrangements) where there is no profit component (expressed as a mark-up on costs) on intercompany payments for services (i.e., performed by the employees of one company for the benefit of an affiliated company). Section V derives the solution with a positive markup and compares the effects of different substance requirements on total intangible capital and its optimal location. Section VI concludes with the main points of the analysis and identifies extensions of the analysis.

I. Background

International tax planning involving intangible assets is, at its core, about locating an MNE's above-normal profits (i.e., what economists call "rents") in a tax-advantaged jurisdiction so as to minimize the tax burden on such profits. The international consensus around allocation of an MNE's global taxable income between taxing jurisdictions relies on the arm's length principle (ALP). The ALP provides the basis for mutual agreement on taxing rights among jurisdictions by recognizing, for income tax purposes, separate entity accounting (SA) and transactions involving the transfer of goods, services, intangible rights, and capital among controlled entities (i.e., entities that make up a single MNE). The ALP requires that intragroup transactions be priced in a manner that emulates market outcomes. Further, as would be expected in market transactions, the pricing of transactions under the ALP is expected to result in the taxable income for a controlled entity that is reflective of its functions, assets and risks. Within this overarching framework, the ALP – and transfer pricing rules adopted by specific countries such as the United States – provide safe harbors in relation to certain types of intercompany arrangements. Important among these are cost sharing arrangements (CSAs) under which related parties in different jurisdictions can share in the costs and development of intangible assets.² The share of costs borne by a given party is determined in a manner such that this burden is proportionate to its "ownership" interest in the intangible assets covered by a CSA. Importantly, the "cost sharing transaction" involves an allocation of pure costs without a markup or other profit component as would be expected under a "pricing" of intragroup transactions under the ALP outside of this safe harbor. The OECD

² Section 1.482-7 of Treasury Regulations promulgated under section 482 of the U.S. Internal Revenue Code.

Guidelines contain guidance on the analogous form of intercompany arrangements referred to as “cost contribution arrangements” (CCAs).³

For many MNEs, intangibles – such as patents, trademarks, proprietary knowhow, etc. – are the most valuable assets they possess and account for a major proportion of the income they earn (particularly, the above-normal returns). Other things equal, the entity within the MNE group that owns important intangible assets of the group would be entitled to a commensurately high share of the MNE’s taxable income under the ALP. Additionally, intangible assets are relatively mobile in the context of an MNE group’s international operations. It is relatively easy and costless for an MNE to have a controlled entity within a tax-advantaged jurisdiction be the legally registered owner of valuable patents and trademarks (assuming a certain minimum standard of intellectual property (IP) laws within the jurisdiction). Similarly, non-protected forms of IP (e.g., knowhow, trade secrets) can be housed by an MNE in a controlled entity within a low-tax jurisdiction through intercompany contracts that are recognized under the ALP and SA concepts.

International tax planning involving intangibles thus relies on locating this mobile form of capital in a controlled entity in a low-tax jurisdiction and then relying on an application of the ALP to attribute a commensurately high share of the MNE’s worldwide income to that low-taxed entity. The aforementioned CSAs/CCAs are a common form of intercompany arrangements used to organize ownership of intangibles for tax purposes. The OECD (and other stakeholders behind the BEPS project) have viewed this aspect as problematic and a source of “artificial” profit shifting. Per this view, MNEs could locate their important intangible assets and taxable income in low-tax

³ Chapter VIII of the OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations (2017).

jurisdictions in a self-serving manner even when the low-tax jurisdiction did not house “real economic activity” – such as people, tangible property and final customers – that is less mobile.

This concern is reflected in so-called “cash boxes” – controlled group entities that have only capital and legal ownership of intangible assets (of the type described above) without any other indication of “real economic activity.” The new and reinforced standards of substance in the New OECD Guidelines are intended to make cash boxes, and other types of entities that resemble such cash boxes in terms of housing few employees, untenable. More generally, under these standards a controlled entity that is the legal owner of an MNE’s intangible assets (in a manner described above) cannot lay claim on MNE income solely by virtue of such legal ownership. Instead, in addition to such legal ownership it also needs to have a critical mass of the MNE employees involved in the “development, enhancement, maintenance, protection and exploitation” of the said intangibles (the “DEMPE” functions) in order for the MNE’s desired attribution of intangible-related income to be upheld for tax purposes.

The New OECD Guidelines don’t explicitly spell out what this threshold is and leave room for interpretation based on specific facts and circumstances. The OECD is a standard-setting body and as such, cannot determine the rules that different national governments and taxing authorities formulate and implement in their respective jurisdictions. The role of the OECD is to develop certain overarching standards for international taxation so that the local rules adopted by governments adhere to such standards in the interest of international consensus and consistency. These standards in the new OECD Guidelines now provide greater scope and justification for taxing authorities to disregard MNEs’ international intragroup arrangements centered on intangibles in low-tax jurisdictions when the controlled group entities in question are perceived to fail the “DEMPE functions” test.

MNEs differ in terms of the type of intangibles important to them. Whereas, the key intangible assets for a consumer products company may be the trademarks borne by its products, a portfolio of patented drugs is the most valuable asset for a pharmaceutical company. International tax planning for the two types of companies will differ in the type of intangibles that such tax planning is centered on – trademarks for one versus patents for the other. In each case the intent of the tax planning is to locate the intangible and associated taxable income within a controlled affiliate in a low-tax jurisdiction. Correspondingly, the DEMPE functions requirement will differ in terms of what types of employees the company will now have to locate within its low-taxed affiliate – e.g., sales, advertising and marketing professionals in the case of one versus R&D professionals in the other. But the substance standards will work analogously in the two cases and will require that the low-taxed affiliate in question also house the requisite employees with the correct functional profile (e.g., advertising or R&D) to complement its legal rights to the intangible assets (e.g., trademarks or patents). The principle extends to all types of intangibles assets that are valuable to a company in that they generate above-normal returns. We now turn to an analysis of these standards via a theoretical model.

III. Theoretical Framework

We model a representative multinational firm's decision regarding the magnitude and location of intangible capital across two jurisdictions – the domestic jurisdiction of the firm's incorporation (indexed by subscript “ d ”) and a foreign jurisdiction (indexed by subscript “ f ”). The rate of tax (τ) in each jurisdiction is as shown below.

Assumption 1

$$0 \leq \tau_f < \tau_d < 1$$

The lower effective rate of tax in the foreign jurisdiction may stem from the foreign jurisdiction having a lower statutory tax rate, intangible assets specifically benefiting from a preferred tax rate in the jurisdiction (e.g., patent or IP box regime), or a combination thereof. The firm's decisions involve choosing an overall level of intangible capital (K) as well as the location of such capital between the domestic (K_d) and foreign jurisdictions (K_f) to maximize total after-tax profits (π).⁴ While the decision regarding overall investment in intangible capital is a “real” one, the decision regarding the “location” of such capital – which has no physical manifestation – across jurisdictions is one dictated by income tax reporting considerations and any transaction costs entailed by that decision.

Assumption 2.

The firm's production function can be written as

$$f(K, L) \text{ where } L = \gamma K \text{ and}$$

$$f(0, L) = 0, f_L(K, L) = 0 \text{ for } L \neq \gamma K,$$

$$f_K(K, L) > 0 \text{ and } f_{KK}(K, L) < 0$$

where K refers to intangible capital and L refers to the complementary input, labor. This labor represents the total “economic substance” – covering the *full* spectrum of activities from the most

⁴ The decisions –with regard to the scale and location of investment and economic substance – that are modeled here represent those facing a firm at the outset of a project without any history of prior investment. However, the model can be readily adapted to capture situations where the firm's current decisions regarding the scale and location of intangible capital investment and substance have to be made in the context of a prior history of such choices previously made by the firm. While this will add some complexity to the model it will not detract away from any of the main conclusions.

routine to the highest valued-added – required to productively deploy intangible investments in this model.⁵

The amount of labor required to productively deploy each dollar invested in intangible capital is dictated by the inherent “production technology” available to the firm and is captured by a parameter (γ) in the model. This parameter represents the minimum (units of) labor required to successfully translate one dollar of investment in intangible capital into output. The parameter represents the full scope of *all* DEMPE functions by the firm to make its intangible capital investments productive. In particular, the firm’s choice of how much to invest in intangible capital will also dictate the level of labor needed as a complementary input.

Production functions with intangible capital as a factor of production feature in an extensive and established literature on firm productivity. For instance, the production function in Griliches (1979, 1998) has R&D and related knowledge capital as a factor of production while more recent work of Crass and Peters (2014) includes “innovative capital” associated with R&D, licenses and patents as well as “branding capital” associated with trademarks and marketing. The common feature of each of these studies is the use of Cobb-Douglas production functions. The literature survey by Mairesse and Sassenou (1991) found Cobb-Douglas to be the most widely used functional form for production functions. Our assumption on the production function – specifically on the fixity of the capital-labor ratio – is an obvious departure from the Cobb-Douglas form and one that has been made in the interest of simplicity. In particular, the assumption allows

⁵ Standards of economic substance truly compatible with the arm’s length principle (ALP) – the governing framework in apportioning an MNE’s income between jurisdictions for income tax reporting purposes – would generally be expected to fall short of requiring that the entire range of activities relevant to the intangible capital be performed by the entity claiming the intangible-related income. Instead, economic substance requirements under the ALP require that the entity claiming intangible-related income possess some requisite threshold of important functions related to control and management of the intangibles.

for a more tractable treatment and exposition of the primary issue covered here. In assuming away substitutability between capital and labor (as would exist in a Cobb-Douglas function) we are able to focus on the impact of substance requirements specifically on the scale and location of investment without having to address the implications for the capital-labor mix.

Assumption 3

Rate of Return on Capital: r

Firm Per Unit Labor Cost $w + c(L_f)$, where $c(0) = 0$, $c'(L_f) > 0$ and $c''(L_f) \geq 0$

The rate of return on intangible capital is denoted by r .⁶ The cost that the firm has to incur in deploying one unit of labor necessary to complement its intangible capital in the domestic jurisdiction is assumed to be constant and denoted by w .⁷ In contrast, the cost incurred by the firm in deploying one unit of the requisite quality of labor needed to complement its capital in the foreign jurisdiction is assumed to be higher on account of a non-tax transaction cost denoted by $c(L_f)$.

This component reflects the incremental cost that must be borne by the firm on account of its decision to locate labor in a jurisdiction different from its optimal location (i.e., from a non-tax perspective). Furthermore, this transaction cost is assumed to be increasing in the amount of labor

⁶ The entirety of this required rate of return – i.e., the firm's cost of intangible capital – is assumed to be non-deductible for tax purposes (e.g., as would be the case where the firm finances one hundred percent of its investment through equity capital). This is assumed for simplicity and without loss of generality. The results of this analysis would continue to hold as long as a part of this required return is non-deductible for tax purposes or (contrary to what is assumed below also for simplicity) less than one hundred percent of the firm's capital expenditures is currently deductible for tax purposes. Furthermore, the required rate of return is assumed to be the same across jurisdictions (e.g., as would be the case under perfect capital mobility between jurisdictions).

⁷ Labor cost in each jurisdiction is fully and currently tax deductible under the model.

located in the foreign jurisdiction such that the per-unit cost to the firm increases as it locates more labor away from its optimal source.

The firm may have to incur a higher per-unit cost of complementary labor when such labor is located in the foreign jurisdiction for a number of reasons. This could come about from the firm having to move the requisite employees from the domestic jurisdiction and the additional costs that come from such a disruption. This is likely to include the higher remuneration that the firm will likely have to pay the relevant employee(s). Alternatively, the higher per-unit cost of labor in the foreign jurisdiction can result from the firm having to incur the cost of identifying and employing person(s) with the requisite skills and fit with the rest of the organization (e.g., R&D or marketing, etc.) in a jurisdiction which otherwise would not be a labor source for the firm. More generally, added to all of this in each instance will be the cost of all disruptions that result from the firm having to organize its employees and affairs differently from the way it otherwise would have in the absence of tax considerations. For purposes of the model, all such incremental transaction costs are “internalized” in the per-unit cost of labor.

Assumption 4

Economic Substance Requirements captured by λ , with $0 \leq \lambda \leq \gamma$

Under globally enforced rules of taxation, attribution of revenue between jurisdictions must satisfy economic substance requirements. In particular, substance requirements are modeled in terms of a constraint that applies uniformly to each jurisdiction.⁸ For every unit of intangible capital purportedly located in a certain jurisdiction for income tax reporting purposes, the firm is required to have *a minimum of λ* units of labor in that jurisdiction as the necessary economic substance.

⁸ Although, as can be expected and as we show below, such a constraint will only be binding in the low tax jurisdiction.

This is the minimum threshold of DEMPE functions that a group entity needs to maintain under the applicable substance standards for its location of intangible capital in the said jurisdictions to be respected for tax purposes. Without any substance requirements to constrain its choices, the MNE's location of relevant intangible assets for tax purposes can be completely delinked from the location of complementary labor that performs the functions to develop and productively deploy the assets (e.g., a cash box entity case).

The stringency of substance requirements under a given regime of international taxation is thus captured by λ . International standards of substance that would accept cash boxes are represented by a value of zero for this parameter. On the opposite end of the spectrum, the regime with the strongest substance requirements is one where the minimum quantity of labor per unit of intangible capital required in each jurisdiction is equal to the overall ratio of labor to intangible capital for the global firm as a whole. In the model this is captured by the case where $\lambda = \gamma$. This is a natural upper bound on substance requirements if such requirements are to be consistent across all jurisdictions bound by a multilateral framework (developed and coordinated by the OECD in its capacity as a standard-setting body). Only if substance requirements are selectively applicable to one of the two jurisdictions (e.g., foreign) is it possible to have λ exceed γ . Such a requirement would force one jurisdiction to have more labor per unit of intangible capital located there than deployed by the firm as a whole. However, while such a measure may be implemented unilaterally (e.g., as an incentive mechanism) it is incompatible with an international tax regime that requires enforcement of minimum and *consistent* standards of economic substance for each jurisdiction. Thus, a regime with the most stringent substance requirements dictates that the firm's reported intangible capital in each jurisdiction be no higher than a fixed multiple of the labor located in in that jurisdiction where that multiple is the firm's overall worldwide ratio of capital to labor. A

formulary apportionment approach with income allocation based entirely on observable economic activity (i.e., labor in the present case) is an example of a regime that would yield this outcome.

Assumption 5

The share of a firm's global revenue (i.e., output) reported in a given jurisdiction is an allocable share of the global output in proportion to the intangible capital located in the jurisdiction:

$$\frac{K_i}{K} f(K, L).$$

The taxable income reported in a given jurisdiction is the share of the firm's global revenue reported in that jurisdiction less the cost of the two factors of production located there. Based on all of the above, the firm's after-tax profit is written as follows:

Equation 1

$$\begin{aligned} \pi = (1 - \tau_f) \left[\frac{K_f}{K} f(K, L) - K_f - (w + c(L_f)) L_f - ICP \right] \\ + (1 - \tau_d) \left[\frac{K_d}{K} f(K, L) + ICP - K_d - wL_d \right] - rK \end{aligned}$$

The firm maximizes total after-tax profits while satisfying the “technological constraints” imposed by the production function of choosing an overall level of investment in intangible capital (K) along with an allocation of that capital in the foreign (K_f) and domestic (K_d) jurisdictions. Alongside this decision, the firm decides on the location of the requisite labor across the two jurisdictions (i.e., L_f and L_d , respectively) needed to support the overall level of capital. Furthermore, the firm's choice with regard to the location of labor allows for one location to “outsource” services to labor located in the other jurisdiction. Such intercompany transactions are represented by a net intercompany payment (ICP) from the foreign jurisdiction to the domestic

jurisdiction.⁹ Because of the ALP, in order for labor in one location to support labor in the other location, the ICP to compensate that labor may need to include a profit markup $\mu \geq 0$ consistent with transfer pricing rules (specifically, intrafirm pricing consistent with the arm's length principle).

Whether the foreign jurisdiction only reimburses the domestic jurisdiction for the costs of the outsourced services or also needs to add a profit markup on such costs depends on the form of the intercompany arrangement. As mentioned previously, CSAs/CCAs are intercompany arrangements which – assuming other conditions being satisfied – allow for one party to comply with transfer pricing rules simply by reimbursing an affiliated entity for the latter's costs incurred on services that benefit the former.¹⁰ CSAs are a preferred and widely adopted international tax and intercompany arrangement by MNEs for purposes of attributing ownership of intangible assets among group entities.

In other instances (e.g., for intercompany “contract R&D services”) the intercompany transaction would not comply with the ALP if the service recipient entity were to only reimburse the related service provider entity at cost without a profit markup. The applicable markup that one entity needs to provide to the affiliated service provider is determined by benchmarking against independent (i.e., unrelated) “comparable” companies. The rates of markup on cost observed for such comparable companies serve as the benchmarks for related-party taxpayers under transfer pricing rules. As a practical matter, these rates are relatively low especially when allowances are

⁹ The net payment can be positive or negative although, as shown below, profit maximizing behavior on the part of the firm will preclude negative values (i.e., a net payment from the domestic jurisdiction to the foreign jurisdiction).

¹⁰ This is the case when, as assumed in the model, both parties are dealing with a new investment in intangible capital (i.e., no one party is making a previously developed intangible asset available to the other). In situations where one party previously developed and owned an intangible asset and made such an asset available to an affiliated party such a contribution would have to be separately valued under transfer pricing rules. The analysis in this paper specifically considers an investment in, and income attributable to, new intangible capital.

made (permissible, and even required, under transfer pricing rules) for differences between the circumstances of the third-party comparable companies and the intragroup services arrangement. Typical “unadjusted” markups for intercompany transactions of the type being considered here – where one member of an MNE group provides services of its employees to another – are likely to be in the range of approximately 2 percent to 8 percent.¹¹ When such markups are adjusted to enhance comparability between third-party benchmarks companies and the conditions of intercompany transactions (as alluded to above), the applicable transfer pricing markups that companies have to apply for purposes of complying with international transfer pricing rules are often even lower.¹²

The prevalence of CSAs/CCAs means that, in effect, the services of employees located in one jurisdiction are made available to a group affiliate in another jurisdiction at cost in a significant number of cross-border intercompany arrangements. In addition, rates of markup on costs for intercompany services arrangements required to comply with the ALP outside of CSAs/CCAs are generally low as well. For these reasons, μ should generally be considered small in magnitude (and insignificantly different from zero in a number of practically relevant scenarios) for purposes of this analysis.

Assumption 6

$$(1 - \tau_d)\mu w\gamma \leq r$$

This assumption imposes a limitation on potential after-tax profits for a domestic provider of services needed to complement the relevant capital. Generally, and beyond the reasons discussed above, if μ is a standard profit rate on providing services to capital without being exposed to all

¹¹ Kroppen (2004).

¹² Singh and Murphy (2014).

the risks associated with the investment of the capital, this assumption states that the market rate of return on investing in capital exceeds the rate of return on servicing capital. If the firm uses a markup less than a standard profit markup, then this should also hold. Note that if $r < (1 - \tau_d)\mu w$, then an investor could obtain strictly greater profits by hiring labor to service others' capital without bearing the attendant risks than by directly investing in capital.

Assumption 7

$$\lim_{K \rightarrow 0} (1 - \tau_d) (f_K(K, \gamma K) - 1 - (1 + \mu)w\gamma) > r$$

This assumption guarantees the existence of a strictly positive optimal capital regardless of where the firm locates that capital. Note that any production function satisfying an Inada condition would also satisfy this assumption.

Based on all of the above, the full problem for the firm can be expressed as below.

$$\begin{aligned} \max (1 - \tau_f) \left[\frac{K_f}{K} f(K, L) - K_f - (w + c(L_f)) L_f - ICP \right] \\ + (1 - \tau_d) \left[\frac{K_d}{K} f(K, L) + ICP - K_d - wL_d \right] - rK \end{aligned}$$

subject to

$$L = \gamma K$$

$$L = L_f + L_d \quad K = K_f + K_d$$

$$L_f \geq \lambda K_f$$

$$ICP = (1 + \mu)w(\gamma K_f - L_f)$$

The first constraint is that labor must be optimal, the second set are definitions of the aggregates, the third is the substance requirement for the foreign jurisdiction. The next constraint is based on the arms-length principle that labor from one jurisdiction servicing capital in another must receive remuneration consistent with transfer pricing rules.

For tractability, we solve two versions of this problem. In section IV, we assume that the required markup μ in the ICP is zero. This simplifies the problem and provides some insights into the solution. In section V, we allow for a strictly positive markup, and we compare the results with the solution for no markup.

IV. Solution with No Transfer Pricing Markup

For the reasons discussed above, the assumption of a zero markup conforms to (or closely approximates) a large number of practically relevant cases of international tax planning involving the location of intangible assets. Consequently, this simplifying assumption should not be viewed as particularly limiting.

a) General Solution

Using this simplifying assumption, we first consider the optimal labor allocation.

Proposition 1. *With $\mu = 0$, the firm will use the minimal foreign labor possible as dictated by substance requirements, with*

$$L_f = \lambda K_f$$

$$L_d = \gamma K_d + (\gamma - \lambda) K_f$$

$$ICP = w(\gamma - \lambda) K_f$$

The minimal level of labor located in the low tax jurisdiction is defined by the substance requirements under the prevalent regime of international taxation (as captured by the parameter λ in the model). Any residual labor needed for the foreign intangible capital to satisfy the technological constraint will be met by the labor located in the domestic jurisdiction. This implies that the foreign jurisdiction will import services from labor located in the domestic jurisdiction and correspondingly there will be a positive ICP between the foreign jurisdiction and the domestic jurisdiction. Under the assumption of $\mu=0$, this ICP equals the cost incurred by the firm on labor located in the domestic jurisdiction in support of the foreign capital.

The firm's objective function in Equation 1 can thus be modified where all its choice variables are expressed in terms of the aggregate level of intangible capital and its allocation across jurisdictions as shown below in Equation 2.

Equation 2

$$\begin{aligned} \pi = (1 - \tau_f) \left[\frac{K_f}{K} f(K, L) - \left[1 + \lambda (w + c(\lambda K_f)) + (\gamma - \lambda)w \right] K_f \right] \\ + (1 - \tau_d) \left[\frac{K_d}{K} f(K, L) + (\gamma - \lambda)wK_f - K_d - w[\gamma K_d + (\gamma - \lambda)K_f] \right] - rK \end{aligned}$$

In the above, the firm's choice of capital in the low tax jurisdiction and the substance requirements together dictate its choice of labor in that jurisdiction (λK_f). The level of labor located in the domestic jurisdiction can be viewed as having two components. The first (γK_d) is driven by the level of capital located there and the production technology. The second $((\gamma - \lambda)K_f)$ is the “slack” in the necessary labor related to the capital in the low tax jurisdiction. This slack has to be made up in the domestic jurisdiction to ensure that the technological constraint in relation to the labor-capital ratio is maintained in the aggregate across the two jurisdictions for the firm.

Using these results, we can rewrite the firm's objective function in terms of an optimal total investment K and an optimal allocation of that investment across jurisdictions, defining the foreign low tax jurisdiction's share as $\alpha = K_f/K$. Because optimal labor is based only on capital, we use $f(K) \equiv f(K, \gamma K)$ and $f'(K) = f_K(K, \gamma K)$ to simplify notation. The rewritten profit function is shown in Equation 3.

Equation 3

$$\pi(K, \alpha; \lambda) = \left(1 - \tau_d + \alpha(\tau_d - \tau_f)\right) (f(K) - K - \gamma w K) - (1 - \tau_f) \lambda \alpha K c(\lambda \alpha K) - r K$$

In this rewritten version of the equation, the firm has basic pre-tax profits $f(K) - (1 + \gamma w)K$, on which it pays an effective tax rate $\tau_d - \alpha(\tau_d - \tau_f)$. It also loses some profits to the higher costs of foreign labor. The firm thus solves the reduced problem:

$$\max_{K \geq 0, \alpha \in [0,1]} \pi(K, \alpha; \lambda)$$

This profit function from the reduced problem has the following derivatives.

Equation 4

$$\frac{d\pi(K, \alpha; \lambda)}{d\alpha} = (\tau_d - \tau_f)(f(K) - K - \gamma w K) - (1 - \tau_f)(\lambda K c(\lambda \alpha K) + \lambda^2 \alpha K^2 c'(\lambda \alpha K))$$

Equation 5

$$\frac{d\pi(K, \alpha; \lambda)}{dK} = \left(1 - \tau_d + \alpha(\tau_d - \tau_f)\right) (f'(K) - 1 - \gamma w) - (1 - \tau_f)(\lambda \alpha c(\lambda \alpha K) + \lambda^2 \alpha^2 K c'(\lambda \alpha K)) - r$$

To simplify the first order conditions, we define functions below.

Definition 1

$$h(\alpha; \lambda, K) \equiv \lambda K c(\lambda \alpha K) + \lambda^2 \alpha K^2 c'(\lambda \alpha K)$$

Definition 2

$$g(K; \lambda, \alpha) \equiv \lambda \alpha c(\lambda \alpha K) + \lambda^2 \alpha^2 K c'(\lambda \alpha K)$$

Given the substance requirement λ and a total capital K , h is the marginal deadweight loss of shifting some capital to the foreign jurisdiction, which we refer to as the marginal allocation inefficiency. Given the substance requirement λ and a share α of capital in the foreign jurisdiction, g is the marginal deadweight loss of increasing investment, which we refer to as the marginal expansion inefficiency. Using the properties of c from Assumption 3, these marginal deadweight loss functions have several useful properties. With no capital in the foreign jurisdiction, marginal deadweight loss is zero, with $h(0; \lambda, K) = g(K; \lambda, 0) = 0$. With no substance requirements (and thus no labor in the foreign jurisdiction), marginal deadweight loss is also zero, with $h(\alpha; 0, K) = g(K; 0, \alpha) = 0$. Both h and g are continuous, continuously differentiable, and strictly increasing in α , K and λ .

Using these, we write the first order conditions as shown below.

Equation 6

$$\frac{d\pi(K, \alpha; \lambda)}{d\alpha} = (\tau_d - \tau_f)(f(K) - K - \gamma w K) - (1 - \tau_f)h(\alpha; \lambda, K)$$

Equation 7

$$\frac{d\pi(K, \alpha; \lambda)}{dK} = (1 - \tau_d + \alpha(\tau_d - \tau_f))(f'(K) - 1 - \gamma w) - (1 - \tau_f)g(K; \lambda, \alpha) - r$$

The solution to this problem is characterized by three values of capital—denoted K_d^* , K_f^* and \bar{K} —that are defined as follows.

$$K_d^* = \arg \max_K \pi(K, 0; \lambda)$$

$$K_f^* = \arg \max_K \pi(K, 1; \lambda)$$

$$(1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r = (\tau_d - \tau_f) \left(\frac{f(\bar{K})}{\bar{K}} - f'(\bar{K}) \right)$$

K_d^* is the firm's optimal "domestic-only" capital level – i.e., optimal level of capital chosen by it when it is forced to locate all capital in the domestic jurisdiction. Analogously K_f^* is the optimal "foreign-only" capital level – i.e., the optimal level of capital when the firm only has the foreign jurisdiction as its available capital location choice. . $\bar{K} \in (0, K_d^*)$ is a threshold level of capital at which choosing $\alpha = 1$ is an unconstrained optimum. This is the overall level of capital such that the tax-rate arbitrage impact on revenue as a result of locating the marginal unit of capital in the foreign jurisdiction relative to the domestic jurisdiction is exactly offset by the after-tax profit from locating the marginal unit of capital in the domestic jurisdiction. Note that the threshold level of capital is independent of substance requirements.

Using these defined capital values, we add one final assumption.

Assumption 8

For $K < K_d^$, $\frac{f(K)}{K} - f'(K)$ is weakly increasing in K .*

Given the characteristics of $f(K)$ in Assumption 2, the concavity of f guarantees that this assumption will hold for small values of K , but it may not hold for sufficiently large values of K .

Assumption 8 explicitly assumes this for values of K up to K_d^* .

Using these definitions, the optimal level of capital K^* and allocation α^* for an international firm facing a given regime of substance requirements are defined below.

Theorem 1: *Using $\mu = 0$, if $K_f^* \geq \bar{K}$, then $\alpha^* = 1$ and $K^* = K_f^*$. If $K_f^* < \bar{K}$, then $\alpha^* \in (0,1)$, $K^* \in (\bar{K}, K_d^*)$ and*

$$\alpha^* = \frac{(1 - \tau_d)(f'(K^*) - 1 - \gamma w) - r}{(\tau_d - \tau_f) \left(\frac{f(K^*)}{K^*} - f'(K^*) \right)}$$

If the firm's optimal foreign-only capital choice is sufficiently large – i.e., for a given level of substance requirements, this level exceeds the threshold capital level – the firm will choose to locate all capital in the foreign jurisdiction when it has the choice of both jurisdictions available to it. In other instances, it will adopt a “split location” choice where it will have positive levels of capital in each jurisdiction. Even with non-tax transaction costs associated with locating labor in the foreign jurisdiction, the firm will never locate *all* capital in the domestic jurisdiction regardless of substance requirements.

Theorem 1 also allows us to consider the directional effect of substance requirements on aggregate investment.

Corollary 1. *Using $\mu = 0$, if $K_f^* > \bar{K}$, then total investment is strictly decreasing in λ for $\lambda > 0$.*

Where the firm's optimal location choice is to have all capital in the foreign jurisdiction (a situation that occurs when its foreign-only capital level is higher than the threshold level of capital that leads to a split location), increases in substance requirements lower the overall level of capital. This is on account of the higher substance requirements increasing the burden the firm must bear on account of the non-tax transaction costs from having to locate more labor in the foreign

jurisdiction. This means that starting from relatively low levels of substance requirements, increases in substance requirements will result in lowering overall investment (and through the relationship with capital, lower overall employment).

Corollary 2: *For higher substance requirements to alter the firm's optimal capital allocation decision α^* they need to exceed a threshold value $\hat{\lambda}$ that solves $K_f^* = \bar{K}$.*

Given how substance requirements can alter the firm's optimal capital location choice (i.e., by forcing the firm to bear a greater burden of the non-tax transaction costs from locating labor in the foreign jurisdiction) an increase in these requirements will fail to alter the capital location choice unless it exceeds a certain threshold (when the starting point is a regime of relatively low requirements). Alternatively, if the prevailing regime already has relatively high substance requirements (relative to the threshold for a firm), higher requirements will result in the firm locating more capital away from the foreign jurisdiction in favor of the domestic jurisdiction.

Corollary 3: *For any $\tau_f \in [0,1)$, there exists a sufficiently large domestic tax rate $\tau_d \in (\tau_f, 1)$ such that $\hat{\lambda} > \gamma$, so any substance requirements satisfying assumption 4 will have no impact on the firm's optimal capital location choice of $\alpha^* = 1$. The only impact on the domestic jurisdiction from higher substance requirements is a reduction in L_d^* .*

Where the domestic tax rate is sufficiently large relative to the foreign tax rate (and therefore there exists a sufficient tax benefit of locating capital in the foreign jurisdiction to its non-tax transaction cost disadvantage), the firm will locate all its capital in the jurisdiction even under a regime with the highest possible substance requirements. This means (from Corollary 1) that the only impact of higher substance requirements will be to reduce overall investment. This, together with the result from Proposition 1, means that the only impact of higher substance requirements on the

domestic jurisdiction will be a lower level of employment of domestic labor. This holds implications for the foreign jurisdiction's response (in relation to its choice of effective tax rate) to higher substance requirements as well as how such responses may differ across low-tax jurisdictions with different levels of non-tax transaction cost inefficiencies.

We now consider the two cases of substance requirements that represent the opposite ends of the possible spectrum so as to identify the implications of a change that increases substance from the lowest (i.e., no substance requirements) to the highest possible. Given the importance devoted to economic substance in the BEPS report on Actions 8 through 10, it is likely that the prevailing regime imposed very low substance requirements (was at least perceived as such).

a) Special Case: No Substance Requirements

Corollary 4. *With no substance requirements ($\lambda = 0$) and no transfer pricing markup, ($\mu = 0$), the firm locates all capital in the foreign jurisdiction ($\alpha^* = 1$), and undertakes the maximum possible level of investment which is strictly more than the domestic-only level ($K^* > K_d^*$).*

Together with Proposition 1, Corollary 2 means that with zero substance requirements (and when the foreign jurisdiction can procure the requisite services to complement its own capital from the domestic jurisdiction at cost), the domestic jurisdiction houses none of the firm's capital. If the firm were forced to locate all its capital in the domestic jurisdiction, it would do so at a lower level of investment. However, Proposition 1 ensures that the domestic jurisdiction employs all of the firm's labor and (from Corollary 4) that this is the highest possible level of employment.

b) Special Case: Maximal Substance Requirements

Proposition 2. *With maximal substance requirements ($\lambda = \gamma$) and no transfer pricing markup ($\mu = 0$), the firm locates some capital in the domestic jurisdiction if and only if*

$$g(\bar{K}; \gamma, 1) \geq f'(\bar{K}) - 1 - \gamma w - \frac{r}{1 - \tau_f}$$

Note that based on Theorem 1, if the firm locates *any* capital in the domestic jurisdiction, then it invests strictly less than a purely domestic firm. The firm also will continue to locate at least some capital in the foreign jurisdiction.

Proposition 3. *With maximal substance requirements ($\lambda = \gamma$) and no transfer pricing markup ($\mu = 0$), the firm invests at least as much as a purely domestic firm if and only if*

$$\frac{\tau_d - \tau_f}{1 - \tau_d} r \geq (1 - \tau_f) g(K_d^*; \gamma, 1)$$

Given these results we can also compare total domestic labor across these regimes.

Proposition 4. *The firm employs strictly more domestic labor with no substance requirements than with maximal substance requirements.*

Comparing the fate of the domestic jurisdiction under no substance requirements with that under the maximal requirements, there is no scenario under which it is unambiguously better off. There are, however, scenarios where it *is* unambiguously worse off. If the enhanced substance requirements are successful (from the perspective of the domestic jurisdiction) in making the firm locate more capital in (and thereby translating into more tax revenues for) the domestic jurisdiction this comes at a cost for the jurisdiction. The cost is lower employment of domestic labor. First, because of lower overall investment the overall level of employment is also lower. Second, because for every unit of capital deployed globally the firm has to locate more per unit in the

foreign jurisdiction, the domestic jurisdiction receives a lower share of the overall (reduced) employment.

And yet, there are circumstances such that a switch from zero substance requirements to the maximal possible level make no difference to the location choice of the firm with regard to capital. This follows from Corollary 3 and Proposition 2. If the conditions of Corollary 3 are met (i.e., those of Proposition 2 are not), the firm will choose to locate all capital in the foreign jurisdiction under the regime with no substance requirements as well that with the maximal level possible. Overall capital will be lower because of the deadweight loss from the non-tax transaction cost inefficiency incurred by the firm. Such a reduced overall level of investment will come without any redeeming gain for the domestic jurisdiction, which will experience a reduction in the employment of domestic labor without receiving any allocation of the firm's capital (and concomitant tax revenues).

V. Solution with Transfer Pricing Markup

With a strictly positive transfer pricing markup, the solution to the firm's problem cannot rely on the substance constraint binding. Substituting the expression for the ICP with positive μ into the firm's profit function and replacing $L_d = L - L_f$ gives equation 8.

Equation 8

$$\begin{aligned} \pi = (1 - \tau_f) & \left[\frac{K_f}{K} f(K, L) - K_f - (1 + \mu)w\gamma K_f + \mu w L_f - c(L_f)L_f \right] \\ & + (1 - \tau_d) \left[\frac{K_d}{K} f(K, L) - K_d - wL + (1 + \mu)w\gamma K_f - \mu w L_f \right] - rK \end{aligned}$$

Using ψ as the multiplier on the substance constraint in the foreign jurisdiction, the resulting first order condition with respect to L_f for a given level of K_f is shown below.

$$\psi + (\tau_d - \tau_f)\mu w = (1 - \tau_f)(c(L_f) + L_f c'(L_f))$$

Note that in this case, this equality requires $L_f > 0$. Solving this problem requires considering two cases, one in which the substance constraint is slack and the other in which it binds. From this first order condition, we can see that the constraint will bind ($\psi > 0$) if and only if

$$(\tau_d - \tau_f)\mu w < (1 - \tau_f)(c(\lambda K_f) + \lambda K_f c'(\lambda K_f))$$

a) Nonbinding Substance Constraint

We first consider the solution if the substance requirement λ is sufficiently small that the constraint is nonbinding. In this case, optimal foreign labor is fixed, denoted by L_f^* , and solves the equation below.

Equation 9

$$(\tau_d - \tau_f)\mu w = (1 - \tau_f)(c(L_f^*) + L_f^* c'(L_f^*))$$

As in section IV, we rewrite the profit function using total capital K and its foreign share α , as well as optimal total labor $L = \gamma K$. We denote the profit function assuming a nonbinding (i.e., slack) substance constraint as $\pi_s(K, \alpha)$.

Equation 10

$$\begin{aligned} \pi_s(K, \alpha) = & (1 - \tau_f)[\alpha f(K) - \alpha K - (1 + \mu)w\gamma\alpha K + \mu w L_f^* - c(L_f^*)L_f^*] \\ & + (1 - \tau_d)[(1 - \alpha)f(K) - (1 - \alpha)K - w\gamma K + (1 + \mu)w\gamma\alpha K - \mu w L_f^*] - rK \end{aligned}$$

The derivatives related to the first order conditions are shown below.

Equation 11

$$\frac{d\pi_s}{d\alpha} = (\tau_d - \tau_f)(f(K) - K - (1 + \mu)w\gamma K)$$

Equation 12

$$\frac{d\pi_s}{dK} = \left(1 - \tau_d + \alpha(\tau_d - \tau_f)\right)(f'(K) - 1) - \alpha(\tau_d - \tau_f)(1 + \mu)\gamma w - (1 - \tau_d)\gamma w - r$$

Note that with a nonbinding substance constraint, the first order conditions do not depend on λ . To distinguish the solutions that account for a positive transfer pricing markup from those without it, we denote the optimal total capital under nonbinding substance constraints as \hat{K}^* and the optimal foreign share of that capital as $\hat{\alpha}^*$.

Proposition 5. *With a nonbinding substance constraint, the firm locates all capital in the foreign jurisdiction ($\hat{\alpha}^* = 1$), and it invests strictly more than a purely domestic firm ($\hat{K}^* > K_d^*$). For values of λ such that the substance constraint does not bind, optimal capital is independent of λ .*

Because total capital is constant with respect to λ with a nonbinding substance constraint, there exists a threshold substance requirement such that the substance constraint for the foreign jurisdiction binds.

Proposition 6. *There exists $\bar{\lambda} > 0$ such that the substance constraint is slack if and only if $\lambda \leq \bar{\lambda}$. This threshold is characterized by*

$$(\tau_d - \tau_f)\mu w = (1 - \tau_f)\left(c(\bar{\lambda}\hat{K}^*) + \bar{\lambda}\hat{K}^*c'(\bar{\lambda}\hat{K}^*)\right)$$

Propositions 5 and 6 allow for a description of the firm's optimal capital and labor allocation choices across the two jurisdictions under the lowest possible level of substance requirements ($\lambda = 0$). Here, as when the transfer pricing markup was assumed to be zero, the firm chooses to

locate all its capital in the foreign jurisdiction. It will have some minimal (assuming a low materiality of the transfer pricing markup) employment in the foreign jurisdiction with the rest of the requisite labor all being employed in the domestic jurisdiction.

b) Binding Substance Constraint

If $\lambda \geq \bar{\lambda}$, then we can substitute into the profit function in equation 8 using $L = \gamma K$, $L_f = \lambda K_f$, and $\alpha = K_f/K$ to obtain a profit function with a binding substance constraint for the foreign jurisdiction.

Equation 13

$$\begin{aligned}\pi_b(K, \alpha; \lambda) = & \left(1 - \tau_d + \alpha(\tau_d - \tau_f)\right) (f(K) - K - \gamma wK) - (\tau_d - \tau_f)\mu w(\gamma - \lambda)\alpha K \\ & - (1 - \tau_f)\lambda \alpha K c(\lambda \alpha K) - rK\end{aligned}$$

The derivatives of this profit function are shown in the equations below.

Equation 14

$$\frac{d\pi_b(K, \alpha; \lambda)}{d\alpha} = (\tau_d - \tau_f)(f(K) - K - wK) - (\tau_d - \tau_f)\mu w(\gamma - \lambda)K - (1 - \tau_f)h(\alpha; \lambda, K)$$

Equation 15

$$\begin{aligned}\frac{d\pi_b(K, \alpha; \lambda)}{dK} = & (1 - \tau_d + \alpha(\tau_d - \tau_f))(f'(K) - 1 - \gamma w) - \alpha(\tau_d - \tau_f)\mu w(\gamma - \lambda) \\ & - (1 - \tau_f)g(K; \lambda, 1) - r\end{aligned}$$

We now define the optimal total capital for a firm locating all capital in the foreign jurisdiction with a binding substance constraint as:

$$\tilde{K}_f^* = \arg \max_K \pi_b(K, 1; \lambda)$$

To distinguish the solutions that account for a positive transfer pricing markup from those without it, we denote the optimal total capital under binding substance constraints as \tilde{K}^* and the optimal foreign share of that capital as $\tilde{\alpha}^*$.

Proposition 7. *With a binding substance constraint, if $\tilde{K}_f^* \geq \bar{K}$, then $\tilde{\alpha}^* = 1$ and $\tilde{K}^* = \tilde{K}_f^*$. If $\tilde{K}_f^* < \bar{K}$, then $\tilde{\alpha}^* \in (0,1)$, $\tilde{K}^* \in (\bar{K}, K_d^*)$ and*

$$\tilde{\alpha}^* = \frac{(1 - \tau_d) \left(f'(\tilde{K}^*) - 1 - \gamma w \right) - r}{(\tau_d - \tau_f) \left(\frac{f(\tilde{K}^*)}{\tilde{K}^*} - f'(\tilde{K}^*) \right)}$$

Note that this solution is nearly identical to the solution with no transfer pricing markup (Theorem 1) with the same threshold value \bar{K} as with $\mu = 0$. The only distinction between the solutions comes from the optimal foreign-only capital \tilde{K}_f^* being less than K_f^* and only being relevant for $\lambda > \bar{\lambda}$.

c) Comparing Against $\mu = 0$

We now compare the optimal amount of capital with $\mu > 0$ against the solutions with $\mu = 0$. We first consider the cases in which firm locates all of its capital in the foreign jurisdiction. Optimal foreign-only capital when $\mu = 0$ (K_f^*) is defined as shown below.

Equation 16

$$f'(K_f^*) - 1 - \gamma w = \frac{r}{1 - \tau_f} + g(K_f^*; \lambda, 1)$$

Optimal foreign-only capital (\tilde{K}_f^*) when $\mu > 0$ and $\lambda > \bar{\lambda}$ solves the equation below.

Equation 17

$$f'(\tilde{K}_f^*) - 1 - \gamma w = \frac{r}{1 - \tau_f} + g(\tilde{K}_f^*; \lambda, 1) + \frac{\tau_d - \tau_f}{1 - \tau_f} \mu w (\gamma - \lambda)$$

Optimal foreign-only capital (\hat{K}^*) when $\mu > 0$ and $\lambda \leq \bar{\lambda}$ solves the following.

Equation 18

$$f'(\hat{K}^*) - 1 - \gamma w = \frac{r}{1 - \tau_f} + \frac{\tau_d - \tau_f}{1 - \tau_f} \mu w \gamma$$

As can be seen from these conditions, the concavity of f and strictly increasing g give $K_f^* > \tilde{K}_f^*$.

Moreover, $\hat{K}^* = \tilde{K}_f^*$ only when $\lambda = \bar{\lambda}$, so for $\lambda \leq \bar{\lambda}$, we will also have that $K_f^* > \hat{K}^*$. Thus with no substance constraints, the requirement of a positive transfer pricing mark-up produces lower foreign-only investment level than when no markup is needed. Note that from a practical standpoint – as discussed above on account of low values of such markups – the difference discussed above may not be overly significant.

We can also compare these results when λ is sufficiently large that the firm locates capital in both jurisdictions. Then optimal capital (K^*) when $\mu = 0$ and $\alpha \in (0,1)$ solves the equation below.

Equation 19

$$\left(1 - \tau_d + \alpha(K^*)(\tau_d - \tau_f)\right) (f'(K^*) - 1 - \gamma w) = r + (1 - \tau_f)g(K^*; \lambda, \alpha(K^*))$$

Similarly, the optimal capital (\tilde{K}^*) when $\mu > 0$ and $\alpha \in (0,1)$ solves the equation below.

Equation 20

$$\begin{aligned} &\left(1 - \tau_d + \alpha(\tilde{K}^*)(\tau_d - \tau_f)\right) (f'(\tilde{K}^*) - 1 - \gamma w) \\ &= r + (1 - \tau_f)g(\tilde{K}^*; \lambda, \alpha(\tilde{K}^*)) + \alpha(\tilde{K}^*)(\tau_d - \tau_f)\mu w(\gamma - \lambda) \end{aligned}$$

In the specific case of maximal substance constraints ($\lambda = \gamma$), these produce $K^* = \tilde{K}^*$. Intuitively, with maximal substance constraints, there is no ICP, so the transfer pricing mark-up is irrelevant. Again, from Proposition 2 (which applies here unchanged for the reason above) it follows that firm may continue to choose to locate all capital in the foreign jurisdiction even with the highest possible substance requirements. Taken together with Propositions 5 and 6, this means that a move from the lowest substance requirements to a regime with highest possible requirements is not guaranteed to result in a greater allocation of capital (and consequently, tax revenues) to the domestic jurisdiction. Even if the domestic jurisdiction benefits from a positive allocation of capital this is a share of a lower level of overall capital than under the lowest possible substance requirements with consequent implications for domestic employment following.

VI. Conclusion

Given the substantial focus devoted to the subject in the BEPS report on Actions 8 through 10 and the approaches in tax administration adopted by many taxing authorities, MNEs' intercompany pricing arrangements involving intangibles undoubtedly will be required to meet a higher standard of economic substance in the post-BEPS international tax regime. There is a risk that some taxing authorities will push this concept beyond the bounds compatible with the arm's length principle such that the application of this concept may start to resemble formulary outcomes (i.e., allocations of intangibles-related income based purely on the location of people functions).

This paper presents an analytical framework to explore the implications of more stringent economic substance requirements on multinational firm behavior – specifically in relation to such firms' choices with regard to the scale as well as location of capital and labor. In modeling standards of economic substance, the framework establishes certain natural limits that would exist under an international regime that requires consistency of standards and enforcement as a necessary design feature. We find that a formal treatment of the subject of economic substance requirements has been missing from the literature, thereby hindering a grounded analysis of the change being ushered in by the OECD's BEPS project.

This paper finds that stronger economic substance requirements are not an unqualified panacea for revenue authorities in high-tax jurisdictions. While stronger standards of economic substance and their enforcement *may* result in firms' reporting a higher share of their intangible assets (and related income) in high-tax jurisdictions, this will likely come with a cost. This cost is the lower economic activity – in the form of the functions and jobs related to the development and management of the intangibles – generated in these jurisdictions. Some of the high-tax

jurisdiction's loss of such economic activity is the result of relocation to the low-tax jurisdiction. The remainder is simply a deadweight loss that results from the firm having to face a higher marginal cost of investment than it did previously. It may be argued that such deadweight loss is consistent with the "correct" income tax burden and one that the firm should have faced all along. However, such an argument does not alter the likely implications of higher substance requirements relative to a status quo where firms face a lower marginal cost of investment by virtue of their location of intangible assets. Finally, even with higher economic substance requirements, our results show that it is not guaranteed the quantum of intangible capital located in high-tax jurisdictions will rise. Whether it does so depends on a number of factors among which are the true starting point (i.e., existing requirements), the specific attributes of the low-tax jurisdictions (e.g., whether they have inherent non-tax disadvantages and how acute these are) as well as likely responses of such low-tax jurisdictions to higher substance requirements (e.g., lower effective tax rates in such jurisdictions, by widening the tax rate differential with high-tax jurisdictions, can negate the intended effect of higher substance requirements).

Although a welfare analysis of the change in substance requirements is out of the scope of this paper some thoughts are in order. If the owners of the representative firm are all assumed to be citizens of the domestic jurisdiction then a (simplistic) welfare function for the jurisdiction can be conceived as weighted sum of three components. The first of these is the revenue the government raises from taxing the firm's profits located in the jurisdiction. The second is the after-tax profits that accrue to the owners. Finally, the level of domestic employment (or the total wage income received by domestic workers, which is a linear function of employment in the simple framework adopted here). Our analysis suggests the following for the three components in the domestic jurisdiction's welfare function. First, the tax revenues are not guaranteed rise (on account of the

firm's capital location choice) although this is most likely component through which the domestic jurisdiction is likely to benefit from higher substance requirements. Second, the benefit via the first component will be tempered via reduced after-tax profits accruing the owners of the firm. Finally, the gain to the domestic jurisdiction will also be offset by – especially if the change in substance requirements is one that starts from a regime with very low requirements and takes this to one with very high requirements – possibly lower domestic employment. The net impact of all these changes will depend on the specific weights the jurisdiction applies to each of these components along with the actual direction and quantum of the changes themselves.

Certain limitations and caveats applicable to the analysis are in order. An important assumption of the model is that locating labor to meet substance requirements in a low-tax jurisdiction results in transaction costs. This is likely to be true (particularly, when transaction costs are looked at holistically) for a number of low-tax jurisdictions (e.g., Bermuda) but not necessarily for others (e.g., Ireland). Where this assumption is not met, substance requirements will not be as effective in making such a low-tax jurisdiction less attractive. The effect of such requirements on overall investment and employment will not be adverse as presented in this paper although it will be adverse for the domestic jurisdiction in the manner described here.

In future work, we hope to model more explicitly the impact on global versus national welfare. Some earlier work along these lines by Slemrod and Wilson (2006) and Hong and Smart (2010) suggests competing implications of international tax planning and income shifting on national welfare. Slemrod and Wilson (2006) find that the presence of income shifting to tax havens reduces welfare in high-tax countries. Our results similarly suggest significant implications for a relatively high-tax country like the United States. Prior to the enactment of the TCJA, the United States had one of the highest marginal corporate tax rates in the OECD (Pomerleau and Potosky 2016). Had

the rates remained out of line with those in other countries, the imposition of globally higher economic substance requirements would likely have exacerbated concerns around the loss of jobs and investment in the United States. Instead, with the rate reduction and new provisions – specifically, on global intangible low tax income (GILTI) and foreign derived intangible income (FDII) –directly targeted at the taxation of mobile capital, the TCJA has attempted to make it more punitive for U.S. MNEs to locate intangible capital overseas in low tax jurisdictions (via GILTI) while making it more attractive to locate it in the United States (via FDII).¹³ In an international tax environment where higher substance standards are likely to be the norm going forward, the changes brought about by the TCJA could not have come any sooner from a US perspective. Of course, there still remains ambiguity about the welfare impacts on the US under the new regime. As our results show, even for relatively low-tax countries, the imposition of economic substance requirements can result in higher marginal costs of production, resulting in lower aggregate levels of employment and capital formation. Hence the precise impacts of such a policy will need to be evaluated over a longer term.

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Appendix - Proofs

I. Proof of Proposition 1

For any choice of given total amount of capital K and location in each jurisdiction K_f and K_d the firm chooses total labor $L = \gamma K$. Using the definition of aggregate labor, we can replace $L_d = L - L_f$. Then the firm chooses L_f to solve

$$\begin{aligned} \max_{L_f} & (1 - \tau_f) \left(\frac{K_f}{K} f(K, L) - K_f - (w + c(L_f)) L_f - ICP \right) \\ & + (1 - \tau_d) \left(\frac{K_d}{K} f(K, L) + ICP - K_d - wL + wL_f \right) - rK \\ \text{s. t. } & L_f \geq \lambda K_f \\ & ICP = w(\gamma K_f - L_f) \end{aligned}$$

Substituting the expression for the ICP in the objective function, the problem can be expressed as below.

$$\begin{aligned} \max_{L_f \geq \lambda K_f} & (1 - \tau_f) \left(\frac{K_f}{K} f(K, L) - K_f - w\gamma K_f - L_f c(L_f) \right) \\ & + (1 - \tau_d) \left(\frac{K_d}{K} f(K, L) - K_d - wL + w\gamma K_f \right) - rK \end{aligned}$$

Using ψ as the multiplier on the substance constraint for L_f , the first order condition is

$$\psi = (1 - \tau_f) (c(L_f) + L_f c'(L_f))$$

If the substance constraint is slack, then $\psi = 0$ and $L_f > \lambda K_f \geq 0$. But if $L_f > 0$, then $c(L_f) + L_f c'(L_f) > 0$, which is a contradiction.

Therefore, the optimal allocation will have $L_f = \lambda K_f$. Using this and the optimal labor,

$$L_d = L - L_f = \gamma(K_d + K_f) - \lambda K_f = \gamma K_d + (\gamma - \lambda)K_f$$

Substituting $L_f = \lambda K_f$ into the ICP gives

$$ICP = w(\gamma K_f - L_f) = w(\gamma K_f - \lambda K_f) = w(\gamma - \lambda)K_f$$

□

II. Proof of Theorem 1.

This proof proceeds in the following steps, in which we show that

- 1) If $K^* \geq K_d^*$, then $\alpha^* = 1$
- 2) There exists a unique threshold \bar{K} such that $\alpha^* = 1 \Leftrightarrow K_f^* \geq \bar{K}$.
- 3) If $K_f^* < \bar{K}$, then $\alpha \in (0,1)$ and $K^* \in (\bar{K}, K_d^*)$, and we derive the equation relating them.

Claim 1. If $K^ \geq K_d^*$, then $\alpha^* = 1$.*

Proof of Claim 1. Suppose this is false, and that $\alpha = 0$ if $K^* \geq K_d^*$. If $\alpha = 0$ is optimal, then the firm's optimal capital must be K_d^* , which solves

$$(1 - \tau_d)(f'(K_d^*) - 1 - \gamma w) = r$$

Then using the equation 6, the expression above for K_d^* and the concavity of f ,

$$\begin{aligned}\frac{d\pi(K_d^*, 0; \lambda)}{d\alpha} &= (\tau_d - \tau_f)(f(K_d^*) - K_d^* - \gamma w K_d^*) > (\tau_d - \tau_f)(K_d^* f'(K_d^*) - K_d^* - \gamma w K_d^*) \\ &= r K_d^* \frac{\tau_d - \tau_f}{1 - \tau_d} > 0\end{aligned}$$

At $\alpha = 0$, profits are strictly increasing in α , so this cannot be optimal. Now suppose $\alpha > 0$. Then using that the optimal level of capital must solve $d\pi/dK = 0$, equations 6 and 7 give

$$\begin{aligned}\alpha \frac{d\pi}{d\alpha} &= \alpha \frac{d\pi}{d\alpha} - K \frac{d\pi}{dK} \\ &= \alpha(\tau_d - \tau_f)(f(K) - K f'(K)) - K((1 - \tau_d)(f'(K) - 1 - \gamma w) - r)\end{aligned}$$

Then

$$\frac{d\pi}{d\alpha} = (\tau_d - \tau_f)(f(K) - K f'(K)) - \frac{K}{\alpha}((1 - \tau_d)(f'(K) - 1 - \gamma w) - r)$$

Recall that by the concavity of f , $f(K) - K f'(K) > 0$ for all $K > 0$, and that

$(1 - \tau_d)(f'(K) - 1 - \gamma w) - r \leq 0$ for all $K \geq K_d^*$. Then if optimal capital is at least K_d^* , profits are strictly increasing in α , so the firm's optimal choice is to locate all capital in the foreign jurisdiction. \square

Note that as a result of this, the firm never locates all capital domestically.

Claim 2. There exists a unique threshold \bar{K} such that $\alpha^ = 1$ is the unconstrained optimum for $K^* = \bar{K}$.*

Proof of Claim 2. As shown in the previous proof, because $\alpha > 0$ and $K > 0$, we can write

$$\frac{d\pi}{d\alpha} = K \left[(\tau_d - \tau_f) \left(\frac{f(K)}{K} - f'(K) \right) - \frac{1}{\alpha} ((1 - \tau_d)(f'(K) - 1 - \gamma w) - r) \right]$$

Then $\alpha = 1$ is an unconstrained optimum for some amount of capital \bar{K} if and only if

$$\begin{aligned} \frac{d\pi(\bar{K}, 1; \lambda)}{d\alpha} &= 0 \\ \Leftrightarrow (\tau_d - \tau_f) \left(\frac{f(\bar{K})}{\bar{K}} - f'(\bar{K}) \right) - ((1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r) &= 0 \end{aligned}$$

From the proof to claim 1, this equality cannot hold for $\bar{K} \geq K_d^*$, so we must have $\bar{K} < K_d^*$.

Note that

$$\lim_{K \rightarrow 0} \frac{f(K)}{K} = f'(K)$$

Then using assumption 6,

$$\lim_{K \rightarrow 0} (\tau_d - \tau_f) \left(\frac{f(K)}{K} - f'(K) \right) - ((1 - \tau_d)(f'(K) - 1 - \gamma w) - r) < 0$$

Therefore, we must also have that $\bar{K} > 0$. Thus $\bar{K} \in (0, K_d^*)$ solves

$$(\tau_d - \tau_f) \left(\frac{f(\bar{K})}{\bar{K}} - f'(\bar{K}) \right) = (1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r$$

By assumption 8, because $\bar{K} < K_d^*$, the left-hand-side of this expression is weakly increasing in K , and by assumption 2 the right-hand-side is strictly decreasing in K , so the solution \bar{K} is unique. \square

Using this result, we now consider the optimal allocation of capital across jurisdictions based on K_f^* .

Claim 3. $\alpha^* = 1$ if and only if $K_f^* \geq \bar{K}$.

Proof of Claim 3. Let $K_f^* < \bar{K}$. If $\alpha = 1$, then

$$\begin{aligned} \frac{d\pi(K_f^*, 1; \lambda)}{d\alpha} &= K_f^* \left[(\tau_d - \tau_f) \left(\frac{f(K_f^*)}{K_f^*} - f'(K_f^*) \right) - ((1 - \tau_d)(f'(K_f^*) - 1 - \gamma w) - r) \right] \\ &< K_f^* \left[(\tau_d - \tau_f) \left(\frac{f(K_f^*)}{K_f^*} - f'(K_f^*) \right) - ((1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r) \right] \\ &\leq K_f^* \left[(\tau_d - \tau_f) \left(\frac{f(\bar{K})}{\bar{K}} - f'(\bar{K}) \right) - ((1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r) \right] = 0 \end{aligned}$$

The first inequality comes from assumption 2, and the second from assumption 8.

Therefore, $\alpha = 1$ could not be optimal, so $K_f^* < \bar{K} \Rightarrow \alpha^* \neq 1$. By definition of \bar{K} , if $K_f^* = \bar{K}$ then $\alpha^* = 1$. To show that $\alpha = 1$ if $K_f^* \in (\bar{K}, K_d^*)$, we form a Lagrangian

$$\mathcal{L} = (1 - \tau_d + \alpha(\tau_d - \tau_f)) (f(K) - K - \gamma w K) - (1 - \tau_f) \lambda \alpha K c(\lambda \alpha K) - rK + \eta(1 - \alpha)$$

Taking the first order conditions and solving for the multiplier η gives

$$\eta = (\tau_d - \tau_f)(f(K) - K f'(K)) - \frac{1}{\alpha}(1 - \tau_d)(K f'(K) - K - \gamma w K) + rK/\alpha$$

By complementary slackness, $\alpha = 1$ if $\eta > 0$, which occurs if

$$(\tau_d - \tau_f) \left(\frac{f(K)}{K} - f'(K) \right) > (1 - \tau_d)(f'(K) - 1 - \gamma w) - r$$

Then by assumption 8, $K_f^* > \bar{K}$ implies that

$$\begin{aligned} (\tau_d - \tau_f) \left(\frac{f(K_f^*)}{K_f^*} - f'(K_f^*) \right) &> (\tau_d - \tau_f) \left(\frac{f(\bar{K})}{\bar{K}} - f'(\bar{K}) \right) = (1 - \tau_d)(f'(\bar{K}) - 1 - \gamma w) - r \\ &> (1 - \tau_d)(f'(K_f^*) - 1 - \gamma w) - r \end{aligned}$$

Therefore, $K_f^* \in (\bar{K}, K_d^*) \Rightarrow \alpha^* = 1$. Finally, suppose $K_f^* \geq K_d^*$. Because the marginal expansion cost $g(K; \lambda, \alpha)$ is strictly increasing in α , we must have $K^* \geq K_f^*$. Then by

Claim 1, $\alpha^* = 1$. \square

We have now shown that if $K_f^* \geq \bar{K}$ then $\alpha = 1$, and that if $K_f^* < \bar{K}$ that $\alpha \in (0,1)$. If $\alpha \in (0,1)$,

then we must have $\frac{d\pi}{d\alpha} = 0$ in addition to $\frac{d\pi}{dK} = 0$, so

$$0 = \alpha \frac{d\pi}{d\alpha} - K \frac{d\pi}{dK} = \alpha(\tau_d - \tau_f)(f(K) - Kf'(K)) - K((1 - \tau_d)(f'(K) - 1 - \gamma w) - r)$$

Then defining α as a function of K for this interior solution, we have

$$\alpha(K) = \frac{(1 - \tau_d)(f'(K) - 1 - \gamma w) - r}{(\tau_d - \tau_f) \left(\frac{f(K)}{K} - f'(K) \right)}$$

Note that the numerator is decreasing in K while the denominator is increasing in K . Thus $\alpha(K)$ is decreasing in K .

Claim 4. If $\alpha \in (0,1)$, then $K^ \in (\bar{K}, K_d^*)$.*

Proof of Claim 4. From the definition of \bar{K} , if $K^* \leq \bar{K}$ then $(\tau_d - \tau_f) \left(\frac{f(K)}{K} - f'(K) \right) \leq (1 - \tau_d)(f'(K) - 1 - \gamma w) - r$, so $\alpha(K) \geq 1$. From the definition of K_d^* , if $K^* \geq K_d^*$, then $(1 - \tau_d)(f'(K) - 1 - \gamma w) - r \leq 0$, so $\alpha(K) \leq 0$. Thus claim 4 holds by contraposition. \square

These claims and the derivation of $\alpha(K)$ complete the proof of Theorem 1. \square

III. Proof of Corollary 1. If $K_f^* > \bar{K}$, then $\alpha^* = 1$ and total investment is $K^* = K_f^*$.

Recall that K_f^* solves

$$\frac{d\pi(K_f^*, 1; \lambda)}{dK} = (1 - \tau_f)(f'(K_f^*) - 1 - \gamma w) - (1 - \tau_f)g(K_f^*; \lambda, 1) - r = 0$$

Because both f' and g are continuously differentiable for $\lambda > 0$, K_f^* must also be continuously differentiable for $\lambda > 0$. We can write the above expression as

$$f'(K_f^*) - 1 - \gamma w - \frac{r}{1 - \tau_f} = g(K_f^*; \lambda, 1)$$

Differentiating both sides with respect to λ , we have

$$f''(K_f^*) \frac{dK_f^*}{d\lambda} = c(\lambda K_f^*) + 3\lambda K_f^* c'(\lambda K_f^*) + (\lambda K_f^*)^2 c''(\lambda K_f^*) + \left(2\lambda^2 c'(\lambda K_f^*) + \lambda^3 K_f^* c''(\lambda K_f^*) \right) \frac{dK_f^*}{d\lambda}$$

Thus for $\lambda > 0$,

$$\begin{aligned} \frac{dK_f^*}{d\lambda} & \left(2\lambda^2 c'(\lambda K_f^*) + \lambda^3 K_f^* c''(\lambda K_f^*) - f''(K_f^*) \right) \\ & = - \left(c(\lambda K_f^*) + 3\lambda K_f^* c'(\lambda K_f^*) + (\lambda K_f^*)^2 c''(\lambda K_f^*) \right) \end{aligned}$$

By assumptions 2 and 3, $c' > 0$, $c'' \geq 0$, and $f'' \leq 0$. Therefore, $\frac{dK_f^*}{d\lambda} < 0$ for $\lambda > 0$. \square

IV. Proof of Corollary 2. From corollary 1, K_f^* is strictly decreasing in λ . From Theorem 1, if $K_f^* > \bar{K}$, then $\alpha^* = 1$. Then defining $\dot{\lambda}$ as the substance requirement that makes $K_f^* = \bar{K}$, Theorem 1 gives that values $\lambda \leq \dot{\lambda}$ produce $K_f^* \geq \bar{K}$ and thus $\alpha^* = 1$, and values $\lambda > \dot{\lambda}$ produce $K_f^* < \bar{K}$ and thus $\alpha^* < 1$. Thus the optimal allocation of capital across jurisdictions is only affected for $\lambda > \dot{\lambda}$. \square

V. Proof of Corollary 3. From corollary 1, if $\dot{\lambda} > \gamma$, then any substance requirement $\lambda \in [0, \gamma]$ will produce $\alpha^* = 1$. Recall that $\dot{\lambda}$ defines

$$K_f^* = \bar{K} \Leftrightarrow \frac{d\pi(\bar{K}, 1; \dot{\lambda})}{dK} = 0 \Leftrightarrow (1 - \tau_f)(f'(\bar{K}) - 1 - \gamma w) - r = (1 - \tau_f)g(\bar{K}; \dot{\lambda}, 1)$$

Because $\bar{K} < K_d^*$,

$$(1 - \tau_f)(f'(\bar{K}) - 1 - \gamma w) - r > (1 - \tau_f)(f'(K_d^*) - 1 - \gamma w) - r = r \frac{\tau_d - \tau_f}{1 - \tau_d}$$

Note that $\lim_{\tau_d \rightarrow 1} r \frac{\tau_d - \tau_f}{1 - \tau_d} = \infty$. Because $g(\bar{K}; 0, 1) = 0$ and g is continuous differentiable and

increasing in λ , there exists τ_d such that

$$(1 - \tau_f)g(\bar{K}; \gamma, 1) \leq r \frac{\tau_d - \tau_f}{1 - \tau_f} < (1 - \tau_f)(f'(\bar{K}) - 1 - \gamma w) - r = (1 - \tau_f)g(\bar{K}; \lambda, 1)$$

$$\Rightarrow \dot{\lambda} > \gamma$$

If $\dot{\lambda} > \gamma$, for any $\lambda \in [0, \gamma]$, the solution has $\alpha^* = 1$ and $K^* = K_f^*$. With this solution, total capital is strictly decreasing in λ , so higher values of λ reduce total capital and thus total labor, and require the reallocation of labor from the domestic jurisdiction to the foreign jurisdiction. \square

VI. Proof of Corollary 4. With no substance requirements,

$$\frac{d\pi(K_d^*, 1; 0)}{dK} = (1 - \tau_f)(f'(K_d^*) - 1 - \gamma w) - r = \frac{1 - \tau_f}{1 - \tau_d} r - r = \frac{\tau_d - \tau_f}{1 - \tau_d} r > 0$$

Therefore, $K_f^* > K_d^*$, so $\alpha^* = 1$ and $K^* = K_f^* > K_d^*$. From corollary 2, if $\alpha^* = 1$ then K^* is strictly decreasing in λ . From Theorem 1, if $\alpha^* \in (0, 1)$, then $K^* \in (\bar{K}, K_d^*)$. Thus the largest possible value of K^* occurs for $\lambda = 0$. \square

VII. Proof of Proposition 2. From Theorem 1, the firm locates all capital in the foreign jurisdiction if and only if $K_f^* \geq \bar{K}$. Then for $\lambda = \gamma$,

$$\begin{aligned} K_f^* \geq \bar{K} &\Leftrightarrow \frac{d\pi(\bar{K}, 1; \gamma)}{dK} \geq 0 \Leftrightarrow (1 - \tau_f)(f'(\bar{K}) - 1 - \gamma w) - r \geq (1 - \tau_f)g(\bar{K}; \gamma, 1) \\ &\Leftrightarrow f'(\bar{K}) - 1 - \gamma w - \frac{r}{1 - \tau_f} \geq g(\bar{K}; \gamma, 1) \end{aligned}$$

□

VIII. Proof of Proposition 3. We first use Theorem 1 to show that $K^* \geq K_d^*$ if and only if $K_f^* \geq K_d^*$. We then derive the given condition. If $K_f^* \geq K_d^*$, then $\alpha^* = 1$ and $K^* = K_f^* \geq K_d^*$. If $K_f^* \in [\bar{K}, K_d^*)$, then $\alpha^* = 1$ and $K^* = K_f^* < K_d^*$. If $K_f^* \in [0, \bar{K})$, then $\alpha \in (0,1)$ and $K^* \in (\bar{K}, K_d^*)$.

Then for $\lambda = \gamma$,

$$\begin{aligned} K_f^* \geq K_d^* &\Leftrightarrow \frac{d\pi(K_d^*, 1; \gamma)}{dK} \geq 0 \Leftrightarrow (1 - \tau_f)(f'(K_d^*) - 1 - \gamma w) - r \geq (1 - \tau_f)g(K_d^*; \gamma, 1) \\ &\Leftrightarrow \frac{\tau_d - \tau_f}{1 - \tau_d} r \geq g(K_d^*; \gamma, 1) \end{aligned}$$

□

IX. Proof of Proposition 4. Let K^* and L_d^* denote total capital and domestic labor with no substance requirements, and K^{**} and L_d^{**} denote total capital and domestic labor with maximal substance requirements. Recall that $K^* > K_d^*$. If under the maximal substance requirements, $\alpha \in (0,1)$, then $K^{**} \in (\bar{K}, K_d^*)$, so $K^{**} < K_d^* < K^*$. If under the maximal substance requirements, $\alpha = 1$, then by Corollary 1, $K^{**} < K^*$.

Therefore,

$$L_d^{**} = \gamma K^{**} - \lambda \alpha^{**} K^{**} < \gamma K^{**} < \gamma K^* = L_d^*$$

□

X. **Proof of Proposition 5.** Note in equation 8 that $\frac{d\pi_s}{d\alpha}$ does not depend on α , so the

optimal solution will have $\hat{\alpha}^* = 1$ if $\frac{d\pi_s}{d\alpha} \geq 0$ and $\hat{\alpha}^* = 0$ if $\frac{d\pi_s}{d\alpha} \leq 0$. Note that

$$\frac{d\pi_s}{d\alpha} > 0 \Leftrightarrow f(K) - K - \gamma w K - \mu \gamma w K > 0$$

If $\hat{\alpha}^* = 0$, then optimal capital is K_d^* , so

$$\begin{aligned} \frac{d\pi_s(K_d^*, 0)}{d\alpha} &= (\tau_d - \tau_f)(f(K_d^*) - K_d^* - w\gamma K_d^* - \mu w\gamma K_d^*) \\ &> K_d^*(\tau_d - \tau_f)(f'(K_d^*) - 1 - w\gamma - \mu w\gamma) = K_d^*(\tau_d - \tau_f)\left(\frac{r}{1 - \tau_d} - \mu w\gamma\right) \geq 0 \end{aligned}$$

This is a contradiction, so $\hat{\alpha}^* \neq 0$. Therefore, so $\hat{\alpha}^* = 1$ is optimal. Using this solution, equation 9 becomes

$$\begin{aligned} \frac{d\pi_s(K, 1)}{dK} &= (1 - \tau_f)(f'(K) - 1) - (\tau_d - \tau_f)(1 + \mu)\gamma w - (1 - \tau_d)\gamma w - r \\ &= (1 - \tau_f)(f'(K) - 1 - \gamma w) - (\tau_d - \tau_f)\mu\gamma w - r \end{aligned}$$

Note that this does not include λ , so the optimal total capital will not be affected by changes in λ as long as the substance constraint is slack. This expression is also strictly decreasing in K .

Evaluating it at K_d^* , we have

$$\begin{aligned} \frac{d\pi_s(K_d^*, 1)}{dK} &= (1 - \tau_f)(f'(K_d^*) - 1 - \gamma w) - (\tau_d - \tau_f)\mu\gamma w - r = (\tau_d - \tau_f)\left(\frac{r}{1 - \tau_d} - \mu\gamma w\right) \\ &\geq 0 \end{aligned}$$

Therefore, $\hat{K}^* \geq K_d^*$. \square

XI. Proof of Proposition 6. The substance constraint is slack if and only if $\eta = 0$, which occurs if and only if $L_f^* \geq \lambda \hat{\alpha}^* \hat{K}^*$. Using the definition of L_f^* from its first order condition, this is equivalent to

$$(\tau_d - \tau_f)\mu w \geq (1 - \tau_f) \left(c(\lambda \hat{\alpha}^* \hat{K}^*) + \lambda \hat{\alpha}^* \hat{K}^* c'(\lambda \hat{\alpha}^* \hat{K}^*) \right)$$

The right-hand-side of this expression is strictly increasing in λ , so this will hold for all $\lambda \leq \bar{\lambda}$, where $\bar{\lambda}$ is defined as the value that makes this expression hold with equality. \square

XII. Proof of Proposition 7. This proof generally mirrors the proof of Theorem 1, with the additional use of assumption 5.

Claim 5. If $\hat{K}^* \geq K_d^*$, then $\hat{\alpha}^* = 1$.

Proof of Claim 5. Suppose this is false, and that $\alpha = 0$ if $\hat{K}^* \geq K_d^*$. If $\alpha = 0$ is optimal, then the firm's optimal capital must be K_d^* , which solves

$$(1 - \tau_d)(f'(K_d^*) - 1 - \gamma w) = r$$

Then using the concavity of f ,

$$\begin{aligned} \frac{d\pi_b(K_d^*, 0; \lambda)}{d\alpha} &= (\tau_d - \tau_f)(f(K_d^*) - K_d^* - \gamma w K_d^*) - (\tau_d - \tau_f)\mu w (\gamma - \lambda) K_d^* \\ &> (\tau_d - \tau_f)(K_d^* f'(K_d^*) - K_d^* - \gamma w K_d^*) - (\tau_d - \tau_f)\mu w (\gamma - \lambda) K_d^* \\ &= K_d^*(\tau_d - \tau_f) \left(\frac{r}{1 - \tau_d} - \mu w \gamma + \mu w \lambda \right) \geq K_d^*(\tau_d - \tau_f)\mu w \gamma > 0 \end{aligned}$$

At $\alpha = 0$, profits are strictly increasing in α , so this cannot be optimal. Now suppose $\alpha > 0$. Then using that the optimal level of capital must solve $d\pi/dK = 0$,

$$\begin{aligned}\alpha \frac{d\pi_b}{d\alpha} &= \alpha \frac{d\pi_b}{d\alpha} - K \frac{d\pi_b}{dK} \\ &= \alpha(\tau_d - \tau_f)(f(K) - Kf'(K)) - K((1 - \tau_d)(f'(K) - 1 - \gamma w) - r)\end{aligned}$$

Note that this expression does not contain μ . Then

$$\frac{d\pi_b}{d\alpha} = (\tau_d - \tau_f)(f(K) - Kf'(K)) - \frac{K}{\alpha}((1 - \tau_d)(f'(K) - 1 - \gamma w) - r)$$

Recall that by the concavity of f , $f(K) - Kf'(K) > 0$ for all $K > 0$, and that

$(1 - \tau_d)(f'(K) - 1 - \gamma w) - r \leq 0$ for all $K \geq K_d^*$. Then if optimal capital is at least K_d^* , profits are strictly increasing in α , so the firm optimally locates all capital in the foreign jurisdiction. \square

Because μ is not in the expression resulting from $\frac{d\pi_b}{d\alpha} = \frac{d\pi_b}{d\alpha} - \frac{K}{\alpha} \frac{d\pi_b}{dK}$, the definitions of \bar{K} and

$\alpha(K)$ are unchanged. Therefore, the same properties regarding α^* and K^* when $K_f^* < \bar{K}$ will also

hold for $\tilde{\alpha}^*$ and \tilde{K}^* when $\tilde{K}_f^* < \bar{K}$, with claims 2, 3 and 4 from the proof of theorem 1 also

holding here. \square