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The economics of the global minimum tax

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Abstract
This paper shows that OECD's Pillar Two may increase employment and investment in low-tax countries due to the Substance-based Income Exclusion (SBIE). The SBIE allows to tax-deduct payroll costs and user costs of tangible assets twice from the tax base of the top-up tax owed by subsidiaries in low-tax countries. Consequently, it implies that a 15% minimum corporate tax for low-taxed subsidiaries is not achieved if the SBIE is positive. We show that Pillar Two dampens tax-motivated transfer pricing, but changes the employment, investment and import incentives, and that for a sufficiently large cost share of labor and/or capital, the SBIE is equivalent to a production subsidy.

Keywords Corporate taxation · BEPS · Pillar two · Minimum tax

JEL Classification F23 · F55 · H25 · H73

1 Introduction

The 137 participating countries that have signed up to the OECD inclusive framework for a 15% global minimum tax may choose whether they wish to adopt the OECD Pillar Two Model Rules or must accept the application of Pillar Two Rules by other countries. The agreement sets out Global Anti-Base Erosion (GloBE) rules designed to ensure that large multinational businesses with consolidated revenues in excess of 750 million Euro pay a minimum effective rate of tax of 15% on "excess profits" arising in a jurisdiction whenever the effective tax rate, determined on a jurisdictional basis, is below the minimum rate. Groups with an effective tax rate

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below the minimum in any particular jurisdiction would be required to pay top-up taxes either to their head office location or to the low-tax jurisdiction. The global minimum tax attempts to limit both tax competition over investment capital and profit shifting by introducing a globally uniform floor for corporate taxes.

This paper studies the design of the OECD inclusive framework of Pillar Two that should implement a global minimum corporate tax of 15% (OECD, 2021a). Our analysis focuses on how the top-up tax owed by subsidiaries in low-tax countries is calculated. We show that Pillar Two has at least two effects on multinational firm behavior. First, the tax base for the top-up tax implies a production subsidy in low-tax countries that may replace imports by foreign direct investment. Second, the minimum tax makes transfer pricing less attractive and thus imposes a cost on an importing subsidiary. Which of these effects dominate is crucial for how Pillar Two works. The production subsidy will favor capital-intensive industries more than labor-intensive industries, and it is the main reason why the minimum tax will not be able to achieve an effective rate of 15%.

To arrive at these conclusions, we model the profit-maximizing behavior of a multinational firm based on how the top-up tax is calculated. The multinational uses labor, capital and a material input, and shifts profits to a low-tax country by a transfer price on the material input. We bring key empirical findings on capital structure and tax deductible depreciation rates into the modeling framework to understand the full effect of Pillar Two. Our analysis indicates that low-tax countries could benefit from Pillar Two. Affiliates of multinationals in low-tax countries that are shell companies stand to lose because they do not receive a reduction in the tax base based on "real activity" (referred to as the Substance-based Income Exclusion in the OECD jargon).

2 Related literature

Our study relates to different strands of literature, foremost the literature on coordinated tax reform, the international tax competition literature and the literature on profit shifting. Pillar Two aims to change the rules of the game of international tax competition, and lessons from the above strands of literature on how countries respond to changes in the corporate tax is a central part of assessing the effects and desirability of the minimum tax.

In the tax coordination literature, Konrad and Schjelderup (1999) study how a group of countries can gain from harmonizing their capital income taxes if the rest of the world does not follow suit. They show that cooperation among the subgroup of countries is beneficial if tax rates in the initial fully non-cooperative Nash equilibrium are strategic complements.[1] A key question, therefore, is how countries react to changes in corporate tax rates. Vrijburg and de Mooij (2016) show that the response

[1] Related to this study is Keen and Konrad (2013) who provide a survey of the tax coordination literature. Based on this literature they argue that it could be a good idea if a group of countries could agree on a minimum rate above the lowest observed outcome.

to a tax increase abroad may to be reduce the domestic tax rate if the degree of substitutability between the domestic public good and private consumption is sufficiently low. Put differently, from a theoretical perspective strategic complementarity is by no means assured. The empirical literature as surveyed in Brueckner (2003); Leibrecht and Hocgatterer (2012) and most recently (OECD, 2020), however, suggests that statutory corporate tax rates are strategic complements.

If successful, the minimum tax should induce firms to reduce profit shifting, further boosting government revenue and curbing the wasteful use of resources for tax planning. The empirical profit shifting literature estimates the sensitivity of profits reported in non-havens to tax differentials. Heckemeyer and Overesch (2017), for example, find a semi-elasticity around 0.8. There is also evidence supporting the notion that lower effective corporate tax rates are associated with higher levels of reported profits when compared with different indicators of real economic activity (Garcia-Bernardo et al., 2021), and that profit shifted to low-tax jurisdictions is highly sensitive to the low-tax jurisdiction's own rate Garcia-Bernardo and Janský, (2022). These studies suggest that—if the global minimum tax rate increases the corporate tax rate in low-tax countries—less profits will be shifted to low-tax countries with the potential effect to dampen tax competition.

The main purpose of the minimum tax is to alter the dynamics of tax competition across countries. The design of the tax base for the top-up tax is crucial for how Pillar Two affects tax competition as pointed out by Devereux et al. (2021). As shown by Devereux et al. (2022), the way the top-up tax is calculated puts a downward pressure on the corporate tax rate in low-tax (source) countries, and the ability to collect the top-up tax by the source country itself provides source countries with a strong incentive to collect the top-up tax (see also Perry (2023)). Devereux et al. (2022) conclude that Pillar Two effectively creates a floor on source country tax competition.

Hebous and Keen (2021) assume that firm's profits are fixed, while the location of reported profits is endogenous due to profit shifting. They study the welfare effect of the minimum tax in a model of tax competition using a two-country framework with asymmetric countries based on Kanbur and Keen (1993). They show that a haven country may either benefit from or be harmed by a minimum tax at just above the rate they set in the initial equilibrium. If tax rates are strategic complements as suggested by empirical research, both haven and non-haven countries may gain from the minimum tax (with the case for the latter being stronger).

Johannesen (2022) considers an arbitrary number of haven and non-haven countries and assumes that capital is fixed in countries and across firms. Paper profits are mobile and can be shifted to tax haven countries. He finds that low-tax countries will respond to the global minimum tax by increasing their own corporate tax rate. This curbs profit shifting and reduces after-tax profits of multinationals. The net welfare effect is generally ambiguous from the perspective of non-havens. Since the owners of multinational firms are assumed to be located in high-tax countries, welfare may fall in non-havens if the benefit of less profit shifting (and higher tax revenue) is less than the loss in after-tax profits by multinationals.

Janeba and Schjelderup (2022) use a model with one tax haven country and two non-haven countries. Capital is mobile across countries and between firms. By

manipulating transfer prices, multinationals can shift profits to the tax haven country, and firms can choose their location in one of the two high-tax countries, depending on tax advantages and other location specific benefits and costs. The global minimum tax is modeled as an exogenous increase in the tax rate of the tax haven country, and the focal point of their analysis is on strategic tax setting effects that affect tax revenue and welfare. They show that the direct effect from less profit shifting following the minimum tax is to increase revenues in non-haven countries, but that the secondary effect of the rise in tax revenue is that the value of attracting foreign investments increases. This effect intensifies tax competition among non-havens. When competition is by tax rates, revenues (and welfare) may increase, while when governments compete via firm-specific or uniform subsidies, the revenue gains from less profit shifting are exactly offset by higher subsidies.

A key difference between the model of Johannesen (2022) and Janeba and Schjelderup (2022) is that in Johannesen (2022) a change in the tax rate of non-haven country i affects only country i and the lowest-tax country. In Janeba and Schjelderup (2022), a change in the tax rate of the non-haven country i affects country i, the haven country via transfer pricing (which is comparable to Johannesen's lowest-tax country) and the non-haven country j. The effect on country j's tax setting behavior is a real relocation effect that matters for incentives to compete among non-haven countries. This effect is not present in Johannesen (2022).

The effect of Pillar Two on low-income countries is disputed. Kurian (2022), for example, claims that some developing countries do not possess the expertise to implement Pillar Two and that this will have profound implications on how Pillar Two plays out. Hindriks and Nishimura (2022) model international tax competition with heterogeneous countries and show that the minimum tax changes the dynamics of tax competition together with the enforcement incentives. In this broader framework, they find that the low-tax country always gains and that a critical threshold exists for the minimum tax where the high-tax country is worse off.

Our study sets itself apart from the literature by studying how Pillar Two affects investments in low-tax countries. To do so, we embed the design of Pillar Two in a model of a multinational firm that can shift profit to a low-tax country. This enables us to study how the global minimum tax affects investments, factor demand and profit shifting to low-tax countries.

In the next section, we describe the design of Pillar Two and how the top-up tax is calculated. The purpose of this section is to prepare the analysis in the following two sections. Section 4 introduces a model in which a multinational firm uses capital, labor and material imports for the output of a subsidiary located in a low-tax country. Section 5 shows how Pillar Two changes employment, investment and import incentives in the subsidiary, and section 6 offers some concluding remarks.

3 The design of pillar two rules

Under Pillar Two, a top-up tax will arise only if a group pays an insufficient amount of corporate income taxes at a jurisdictional level. In order to know if top-up tax is owed, rules are needed to calculate the Effective Tax Rate (ETR) in each jurisdiction

where the multinational enterprise operates. This requires first a calculation of the income that a subsidiary in a low-tax country has (called GloBE income), and second, a calculation of the tax (referred to as "covered taxes") on that income. The ETR is then found by dividing the tax amount by the tax base (GloBE Income). Once the effective tax rate is calculated, the top-up tax rate percentage is the difference between the 15% minimum rate and the subsidiary's ETR. Income taxed at less than 15% would be targeted for additional taxation. That top-up tax percentage is then applied to the GloBE income in the jurisdiction, after deducting a Substance-based Income Exclusion (SBIE). The SBIE reduces the exposure to the minimum tax and is calculated as a percentage mark-up on tangible assets and payroll costs. Profits after the deduction of the SBIE are called excess profits, and the top-up tax owed is found by multiplying excess profits by the top-up tax rate.

In principle, the top-up tax can be collected by the country where the headquarters of the multinational reside (the resident country) or by the low-tax country (the source country). The latter happens if the low-tax country has a domestic minimum tax consistent with the Pillar Two Model. This is called a qualified domestic minimum top-up tax (QDMTTs for short). Once a domestic minimum tax meets the QDMTT conditions, any QDMTT paid by an entity will be fully creditable against any liability under Pillar Two rules. This means that a QDMTT will effectively change the order in which jurisdictions are entitled to charge top-up taxes where the effective tax rate of an entity within Pillar Two falls below the 15% global minimum rate.

The operation of Pillar Two can be illustrated by a stylized numerical example. A parent company located in a high-tax country has a subsidiary in a low-tax country with a GloBE income of USD 1000. The subsidiary pays USD 50 in covered taxes so the ETR of the subsidiary is given by $t^{\mathrm{ERT}} = 50/1000 = 0.05$.. Since the ETR is 5%, the top-up tax rate is $t^{\mathrm{TOP}} = 15 - 5 = 10\%$. The top-up rate is multiplied with excess profits, which is GloBE income (USD 1000) minus the Substance-based Income Exclusion (SBIE). The SBIE is calculated as 10% of the eligible payroll costs and 8% of the carrying value of eligible tangible assets. These rates will be reduced to 5% over a ten-year period. We shall assume that payroll costs are USD 500, and that the value of tangible assets is equal to USD 7500. The SBIE is then equal to $0.1 * 500$ plus $0.08 * 7500 = 650$. Excess profits are $E = 1000 - 650 = 350$ and the top-up tax owed is $E \times t^{\mathrm{TOP}} = 350 * 0.1 = 35$. The subsidiary pays 50 in domestic taxes and 35 in top-up taxes so the total tax burden is USD 85 ($= 50 + 35$), which means that the *true* effective tax rate of the subsidiary is 8.5%.

The example shows that Pillar Two will not bring the total amount of taxes paid on an MNC's excess profit in a low-tax jurisdiction up to the minimum rate of 15% as long as the Substance-based Income Exclusion is positive. How close one gets to the minimum tax depends on the size of the elements in the SBIE calculation and the percentage share used. If we had used the long-term share of 5% to calculate the SBIE in our example, the effective rate of tax would increase to 11.5%, still falling short of 15%. Thus, the SBIE allows countries to continue to compete over tangible investments—in both capital assets and labor—up to a certain point. It will benefit low-tax countries where affiliates of multinationals have "real" activity and hurt pure shell companies in traditional tax havens where there

is little "real" activity (see Schjelderup (2016)). Low-tax countries that harbor real investments like Ireland and Hungary stand to be less affected by the minimum tax because their SBIEs will be substantial.

An interesting question is who will collect the top-up tax. While jurisdictions are not required to implement a QDMTT, there is a clear incentive for low-tax countries to do so and collect the top-up tax themselves. Businesses would pay the same level of tax on their profits whether there was a QDMTT or not. Thus, rather than allow another country to collect that tax, implementing a QDMTT would ensure the tax is paid to the domestic government in the low-tax country. Even better, the low-tax country can collect the top-up tax without altering its headline corporate tax rate.

The Substance-based Income Exclusion is crucial for the understanding of how the minimum tax works. In the next sections, we explore this in detail within a model of a multinational firm that has a subsidiary in a low-tax country. The subsidiary uses labor, capital and material input, and the multinational firm can shift profits by a transfer price on the material input. We put the model to use by drawing on key empirical findings in the literature to assess the implications of Pillar Two.

4 The model

We consider a subsidiary that is located in a low-tax country and which can generate a revenue either sold to consumers or within the multinational network. In order to be able to deal with the differential tax treatment of different inputs, we consider a subsidiary producing with a general Cobb-Douglas production function given by

$$x = AF(L, K, M) = AL^{\lambda}K^{\kappa}M^{\mu}, \tag{1}$$

where $\alpha \equiv \lambda + \kappa + \mu \leq 1$ and where $A = \left(\lambda^{\lambda}\kappa^{\kappa}\mu^{\mu}\right)^{\frac{1}{\alpha}}/\alpha$ normalizes output. We employ the Cobb-Douglas production function as it will allow us to use a minimum set of assumptions on cost shares and effective factor price changes.

The subsidiary uses three inputs L, K and M, which denote labor, capital and material input, respectively. We allow the sum of production elasticities α to be smaller or equal to one, so the firm produces under decreasing or constant returns to scale. Labor is sourced locally, and labor costs are fully tax-deductible. The cost of capital in form of interest payments for debt is also fully tax-deductible, but the degree to which capital depreciation is tax-deductible depends on the specific depreciation rules in the host country. The material input is sourced from the location of the headquarters, and thus, the headquarters must specify a transfer price for this form of intra-firm trade.

In what follows, we will rewrite after-tax costs such that we can use a simple profit maximization approach to investigate the effects of Pillar Two. To do so, we consider w, r and q as the respective *effective* factor prices, that is, the effective wage, the effective rental and the effective transfer price of the material input. Cost minimization implies that the cost function can be given by

$$C(w,r,q,x) = \left(w^{\lambda} r^{\kappa} q^{\mu} x\right)^{\frac{1}{\alpha}} \tag{2}$$

and the marginal costs are given by

$$\frac{\partial C(w,r,q,x)}{\partial x} \equiv C' = \frac{1}{\alpha} x^{\frac{1}{\alpha}-1} \left(w^{\lambda} r^{\kappa} q^{\mu}\right)^{\frac{1}{\alpha}}. \tag{3}$$

In what follows, we will rewrite after-tax profits as $(1-t^*)[R(x)-C(w,r,q,x)]$, where $R(x)$ denotes the revenue generated by the subsidiary for which $dR(x)/dx > 0, d^2R(x)/dx^2 \leq 0$ and $d^2R(x)/dx^2 < 0$ if $\alpha = 1$ holds, and where t^* denotes the host country's effective tax rate. Profit maximization implies an optimal output x^* such that $dR(x^*)/dx = dC(w,r,q,x^*)/dx$ holds. With w, r and q as effective factor prices, factor demands are given by

$$L = \frac{\lambda}{\alpha w} \left(w^{\lambda} r^{\kappa} q^{\mu} x\right)^{\frac{1}{\alpha}} = \frac{\lambda}{\alpha} w^{-\frac{\alpha-\lambda}{\alpha}} (r^{\kappa} q^{\mu} x)^{\frac{1}{\alpha}}, \tag{4a}$$

$$K = \frac{\kappa}{\alpha r} \left(w^{\lambda} r^{\kappa} q^{\mu} x\right)^{\frac{1}{\alpha}} = \frac{\kappa}{\alpha} r^{-\frac{\alpha-\kappa}{\alpha}} \left(w^{\lambda} q^{\mu} x\right)^{\frac{1}{\alpha}}, \tag{4b}$$

$$M = \frac{\mu}{\alpha q} \left(w^{\lambda} r^{\kappa} q^{\mu} x\right)^{\frac{1}{\alpha}} = \frac{\mu}{\alpha} q^{-\frac{\alpha-\mu}{\alpha}} \left(w^{\lambda} r^{\kappa} x\right)^{\frac{1}{\alpha}}. \tag{4c}$$

In order to determine the effective factor price, we have to develop the economic profit and the corporate tax base of the subsidiary. The economic profit is given by

$$\pi^* = R(x) - \omega L - \phi i K - (1-\phi)\rho K - \delta K - qM,$$

where ω denotes the wage rate in the host country of the subsidiary and q denotes the import price of material input produced at the headquarter location. Capital costs have three components: ρ denotes the opportunity cost of a unit of capital financed by debt, i is the opportunity cost of equity and δ denotes the economic depreciation rate while ϕ denotes the equity share. Without the global minimum tax, the corporate tax base is given by

$$\pi_t^* = R(x) - \omega L - (1-\phi)\rho K - \tilde{\delta} K - qM,$$

where $\tilde{\delta}$ denotes the tax-deductible depreciation rate. Furthermore, only the capital cost of debt can be deducted from the tax base π_t^*. We will refer to taxable profits π_t^* as GloBE income in what follows. Consequently, the after-tax profit of the subsidiary before the introduction of the global minimum tax is given by

$$\Pi^* = \pi^* - t^* \pi_t^* = (1-t^*)\left[R(x) - \omega L - \left[(1-\phi)\rho + \tilde{\delta} + \frac{\phi i + (\delta - \tilde{\delta})}{1-t^*}\right] K - qM\right]. \tag{5}$$

The after-tax profit of the headquarter firm that produces the material input is denoted by π and is equal to

$$\pi = (1-t)M\left[q-\gamma-\frac{\beta(q-\gamma)^2}{2}\right],$$

where γ is the cost of producing the material input, β is a cost parameter to be explained below, and t is the corporate tax rate at the headquarter location. To derive the effective factor prices at the subsidiary location, we can write the aggregate after-tax profit of the multinational as the sum of headquarter and subsidiary profits after tax, that is, $\Pi = \Pi^* + \pi$ as

$$\begin{aligned}\Pi =&(1-t^*)\left[R(x)-\omega L-\left[(1-\phi)\rho+\tilde{\delta}+\frac{\phi i+(\delta-\tilde{\delta})}{1-t^*}\right]K-qM\right]\\&+(1-t)M\left[q-\gamma-\frac{\beta(q-\gamma)^2}{2}\right].\end{aligned} \tag{6}$$

Equation (6) helps us to develop the effective factor prices. We begin with material input that is an import from the headquarters to the subsidiary. The headquarters are located in a high-tax country with tax rate t while the subsidiary is located in the low-tax country with a tax rate t^* such that $t > t^*$. The transfer price per unit of material input is the effective factor price q, and the headquarters can set a lower transfer price than the true cost γ. As is common in the tax literature, we model transfer pricing in form of concealment costs that the headquarters will have to carry.[2] In more detail, reducing the transfer price from γ to q has a concealment cost of size $\beta(\gamma-q)^2M/2$ where $\beta > 1/\gamma$ will guarantee that the transfer price will be positive.[3] The concealment costs are tax-deductible in the headquarter country. Thus, the multinational firm maximizes the after tax value of transfer pricing, that is,

$$(1-t)M\left[(q-\gamma)-\beta\frac{(\gamma-q)^2}{2}\right]-(1-t^*)qM$$

w.r.t. q where we—reasonably—assume that transfer pricing will not bring the headquarters into a loss position since the headquarters will receive dividend payments from all locations and may also make profit with local sales. Maximization yields the optimal and effective transfer price

$$q^* = \gamma - \frac{t-t^*}{\beta(1-t)} < \gamma.$$

If $(t-t^*)=0$, the profit shifting incentive vanishes and the transfer price is set equal to the true cost (γ). Since $t > t^*$, the firm in the headquarter country is in the high-tax country and it under invoices the material input ($\gamma > q$). To get a better feel for how tax differences ($t > t^*$) affect the transfer price, consider $\gamma = 1, \beta = 2, t = 30\,\%$

[2] For papers using the concealment cost approach, see Haufler and Schjelderup (2000) and Nielsen et al. (2008, 2010, 2014)).

[3] Our results do not change if tax authorities accepted a transfer price of size $\tilde{q} > \gamma$ without cost. In this case, the concealment cost applies to $(\tilde{q}-q)$ instead of $(\gamma-q)$.

and $t^* = 5$ %, in which case $q^* = 0.82$.[4] When the tax rate in the low-tax country is smaller than in the high-tax country (here by a magnitude of 25 basis points), the headquarters deflate the transfer price by 18 % compared to the true cost.[5]

The effective cost of capital depends on both the debt-equity structure and the depreciation allowance. As well documented in the literature (see, for example, Egger et al. (2014)), the multinational firm can create an internal credit market in which the headquarters and the subsidiaries are lenders and borrowers. In addition to this internal debt, it can raise external debt by issuing bonds and/or receiving loans from banks. In both cases, internal and external debt costs are tax-deductible while the opportunity cost of equity is not. At the same time, thin capitalization rules and collateral requirements imply that some equity must be held at the location of the subsidiary. ρ is the opportunity cost of a unit of capital financed by (internal or external) debt within the multinational network that is tax-deductible, and i is the opportunity cost of equity that is not tax-deductible. Thin capitalization rules and/or collateral requirements impose that the subsidiary must secure a fraction ϕ of the tangible assets K by equity and is allowed to finance a fraction $1 - \phi$ by debt. Thus, $(1 - \phi)\rho$ of the per unit capital cost is tax-deductible at the location while ϕi are not.

As for depreciation, we know that tax-deductible and economic depreciation rates differ. The main distinction is between buildings and machinery for which economic depreciation rates are estimated at an annual 3.61% and 12.25%, respectively (see Egger et al. (2009)). In a sample of 3364 observations for countries which apply the Straight Line Method, the average tax-deductible depreciation rates for buildings and machinery is respectively equal to 5.41% and 17.76%, and in a sample of 729 observations for countries that apply the Declining Balance Method we find an average rate of 7.78% and 24.97%, respectively.[6] It is thus fair to say that—on average—the applied depreciation rules act as an investment subsidy.

Summarizing, the after-tax cost per unit of capital is given by

$$(1 - t^*)((1 - \phi)\rho + \tilde{\delta}) + \delta - \tilde{\delta} + \phi i = (1 - t^*)r^*$$

where

$$r^* \equiv (1 - \phi)\rho + \tilde{\delta} + \frac{\delta - \tilde{\delta}}{1 - t^*} + \frac{\phi i}{1 - t^*} = (1 - \phi)\rho + \frac{\delta - t^*\tilde{\delta}}{1 - t^*} + \frac{\phi i}{1 - t^*}$$

denotes the effective rental. Without Pillar Two, the wage rate is also the effective wage rate such that $w^* = \omega$, where ω denotes the wage rate in the host country.

[4] If the concealment cost was to be tax-deducted in the subsidiary country, $q^* = \gamma - (t - t^*)/[\beta(1 - t^*)]$, leading to $q^* = 0.87$ in our example.

[5] While there is a lot of evidence that transfer pricing plays an important role (see for example Davies et al. (2018), it is not easy to estimate by which factor multinational firms inflate or deflate transfer prices as the arm's length price is not observable. An exemption is Wier (2020) who finds for South-African data that the transfer price compared to related imports from low-tax countries is 31% larger on average. Thus, our example is completely within the range of the empirical literature.

[6] These data are part of the RSIT International Tax Institutions Database, see Wamser et al. (2023). Note that the tax-deductible rates are derived from a world-wide data set, but the economic depreciation rates originate from industrialized countries.

In the next section, we investigate how Pillar Two will change the effective factor prices and its implications on factor demands and marginal costs.

5 The effects of pillar two

As outlined in Section 3, the Substance-based Income Exclusion (SBIE) of the Global Anti-Base Erosion Model Rules allows a multinational firm to deduct (carve-out) a fraction of the wage bill and of the stock of tangible assets from the GloBE income (π_t^*) of the low-taxed subsidiary. The resulting tax base is called excess profit and is the tax base for the top-up tax. We denote excess profit by the variable E. The carve-out rate differs for payroll and tangibles at an early stage, but will be equal to 5% for both eventually. Thus, we do the analysis for a common fraction, but our main results do not change with differential treatment. In what follows we shall denote σ as the carve-out fraction and let T be the minimum tax.

Excess profit is given by $E = \pi_t^* - \sigma(wL + K)$, where the last term is the SBIE. The SBIE is made up of the wage bill (a flow variable) and capital (a stock variable). The relative size of the two subsidy elements depends on the rental rate of capital and elements of the tax system that affects employment and the stock of capital (such a depreciation rates, the interest rate and the debt equity ratio in a firm). If $\pi_t^* - \sigma(\omega L + K) \leq 0$, the after tax profit will remain unchanged and the minimum tax will be inconsequential. Given that $\sigma = 5\%$, we can expect that some manufacturing subsidiaries that use tangible capital as a main input will remain unaffected by the minimum tax. This is not necessarily true for wholesale subsidiaries that use imported material as a main input. It will definitely affect shell companies that do not use any input unless they will be turned into output-generating subsidiaries. In what follows, we confine the analysis to the response of subsidiaries for which $\sigma(\omega L + K) < \pi_t^*$ continues to hold. It should be clear, however, that the response that we will identify may lift some subsidiaries beyond this threshold such that we may expect some bunching at $\sigma(\omega L + K) = \pi_t^*$.

If $\pi_t^* - \sigma(\omega L + K) > 0$, the term $\sigma(\omega L + K)$ is a combined subsidy for labor and capital. Note carefully that this subsidy rateσ—which will be equal to 5% in the long run—is applied to a flow variable (labor) and a stock variable (tangible assets) at the same time.[7] It thus depends on the relative size of the payroll cost compared to the stock of tangible assets to which extent this subsidy affects labor and investment decisions of subsidiaries. To shed more light on these effects, we now explore how Pillar Two will change the effective factor prices.

[7] Conceptually, it is not standard to apply a common rate on both a flow and a stock variable, but we could not find any rationale except that countries should be allowed to offer tax incentives for what the OECD calls "substantive activities" (see OECD (2021), page 3). Why these different "substantive activities" are subsidized by this rate, and a common rate in the future is not explained.

For this purpose, we observe that the after-tax profit of the low-taxed subsidiary under the global minimum tax is equal to $\pi^* - t^*\pi_t^* - (T - t^*)E$ and can be rewritten as $\pi^* - T\pi_t^* + (T - t^*)\sigma(wL + K)$.[8] In more detail, we obtain

$$\begin{aligned}\Pi^* =& \pi^* - T\pi_t^* + (T - t^*)\sigma(wL + K)\\ =&(1 - T)\left[R(x) - \left[\omega - \frac{\sigma(T - t^*)\omega}{1 - T}\right]L - qM\right]\\ &- (1 - T)K\left[(1 - \phi)\rho + \tilde{\delta} + \frac{\phi i + (\delta - \tilde{\delta})}{1 - T} - \frac{\sigma(T - t^*)}{1 - T}\right].\end{aligned} \tag{7}$$

Equation (7) replaces Eq. (5) after the global minimum tax has been introduced and helps us to develop the new effective factor prices.[9] First, since wage costs are completely tax-deductible, this provision is equivalent to a wage subsidy as wage costs can be deducted twice. Consequently, the wage cost per unit of labor is now given by

$$(1 - T)\omega - \sigma(T - t^*)\omega = (1 - T)w^{**}$$

where

$$w^{**} \equiv \omega\left(1 - \frac{\sigma(T - t^*)}{1 - T}\right) < w^*$$

is the effective wage rate that is lower than the initial wage w^*. We can determine the maximum size of this subsidy since $\sigma(T - t^*)/(1 - T) < \sigma T/(1 - T) = 0.88\%$ for $\sigma = 0.05$ and $T = 0.15$, so the wage subsidy is moderate.

Second, the minimum tax T makes transfer pricing less attractive since the new effective transfer price is now given by

$$q^{**} = \gamma - \frac{t - T}{\beta(1 - t)} > q^*.$$

For our example from Section 4 in which we assume $\gamma = 1, \beta = 2, t = 30\%$, the transfer price will increase by 8.7% from 0.82 to 0.89.

The impact on the effective rental is more complex. First, as we could see from above, $\delta < \tilde{\delta}$ is likely to hold such that the depreciation allowance already worked like an investment subsidy, and this effect will become stronger under Pillar Two. Second, the opportunity cost of equity is now larger since it cannot be deducted from a larger minimum tax. Finally, an important detail of Pillar Two is that the firm is able to deduct a fraction of the capital stock from the tax base for the difference between the minimum tax rate and the host country's tax rate due to the

[8] It is interesting to note that the tax paid by the multinational firm under Pillar Two is $t^*\pi_t^* + (T - t^*)(\pi_t^* - \sigma(wL + K))$ which is equal to $T\pi_t^*$ if $L = K = 0$, that is, if the subsidiary has no genuine economic activity. In this case, the effective tax rate is just the minimum tax.

[9] The after-tax profit of the headquarter firm of producing the material input is still given by $\pi = (1 - t)M\left[q - \gamma - (\beta(q - \gamma)^2)/2\right]$.

Substance-based Income Exclusion. Consequently, the after-tax cost per unit of capital is now given by

$$(1-T)((1-\phi)\rho+\tilde{\delta})+\delta-\tilde{\delta}-\sigma(T-t^*)+\phi i=(1-T)r^{**}$$

where

$$r^{**}\equiv(1-\phi)\rho+\frac{\delta-T\tilde{\delta}}{1-T}-\frac{\sigma(T-t^*)}{1-T}+\frac{\phi i}{1-T}$$

denotes the new effective rental. In general, it is not clear whether r^{**} is smaller or larger than r^*. In order to explore whether the Substance-based Income Exclusion works like an investment subsidy, we can write the difference as

$$r^{**}-r^*=-\frac{(T-t^*)[\overbrace{(1-t^*)\sigma}^{\text{I}}-\overbrace{(\delta-\tilde{\delta})}^{\text{II}}]}{(1-t^*)(1-T)}+\underbrace{\frac{\phi i(T-t^*)}{(1-t^*)(1-T)}}_{\text{III}},\tag{8}$$

which allows us to examine the likely effects of the Substance-based Income Exclusion in some more detail. Notice that the increase in the effective rental rate due to the larger opportunity cost of equity is smaller than $\phi iT/(1-T)$, see III. A reasonable assumption is that the equity share of capital is 50% (or less) in a multinational corporation and that the opportunity cost of equity is equal to 5%.[10] Given these assumptions and since the minimum tax is equal to $T=0.15$, we have $\phi iT/(1-T)=0.44\%$.

Turning to the effects of the Substance-based Income Exclusion (see I), note that $t^*<0.15$ triggers the minimum tax and $\sigma\geq 0.05$, implying that $(1-t^*)\sigma>3.61\%$. Thus, the Substance-based Income Exclusion implies an investment subsidy as along as the difference between the economic and the tax-deductible depreciation does not exceed 3.61% (see II), which we can rule out as a relevant case. If we go with the economic and the average tax-deductible depreciation rates under the Straight Line Method from section 4, keep the other assumptions and set $t^*=5\%$, we find that $r^{**}-r^*$ is respectively equal to -0.96% for machinery and equal to -0.5% for buildings. These changes are large in terms of rentals, and thus, we may expect that the Substance-based Income Exclusion

[10] Møen et al. (2019) report an average debt ratio of 62% for German multinationals between 1996 and 2006 which implies an equity share of 38%, and Goldbach et al. (2021) report that this debt share has declined to around 50% between the years 1999–2017 which implies an equity share of 50%. The assumption of a 5% opportunity cost of equity is very conservative. Usually, the long-term interest rate of government bonds with a maturity of 10 years is considered to reflect the opportunity cost of capital. This rate has never exceeded 5% since 2010 in Canada, France, Germany, Japan, the UK or in the US; see OECD (2023b).

works like a strong investment subsidy.[11] Consequently, we conclude that the effective rental will decline in response to the introduction of Pillar Two.

The subsidiary profit is now given by $\pi^{**} = (1 - T)\big[R(x) - C(w^{**}, r^{**}, q^{**}, x)\big]$. If Pillar Two reduces (increases) the marginal cost for a given output level x, the subsidiary will increase (decrease) output. We find:

Proposition 1 *For a sufficiently large cost share of labor and/or capital, Pillar Two is equivalent to a production subsidy in low-tax countries.*

Proof See Appendix A.1. □

The minimum tax leads to an increase in the transfer price and thus the effective cost of the material input. In contrast, the Substance-based Income Exclusion allows the firm to tax-deduct wages and part of the tangible assets twice from the overall tax base, and this implies an incentive to increase output. Proposition 1 shows that if the cost share of labor and/or capital are sufficiently high, the benefit of the Substance-based Income Exclusion outstrips the negative effect of a higher transfer price.

Let us illustrate the production effect for some variations of the cost shares. In Fig. 1, we present the critical percentage increase in the transfer price ($\hat{q}^*$), for which production stays unchanged for different cost shares. Furthermore, we continue to use our assumptions from above and set $i = \rho = 5\%$.[12] We assume constant returns to scale such that $\lambda + \kappa + \mu = 1$, and each graph assumes a different cost share of labor from $\lambda = 0.2$ to $\lambda = 0.7$.[13] In each graph, both capital and material input have a cost share of at least 0.1. Furthermore, we start with a cost share of capital $\kappa = 0.1$ such that the cost share of material input is given by $\mu = 0.9 - \lambda$ and increase the cost share of capital and decrease the cost share of material input, that is, $d\kappa = -d\mu$, until we reach $\mu = 0.1$ and $\kappa = 0.9 - \lambda$.

The colored area below the $\hat{q}^*$–line is the area in which the global minimum tax is equivalent to a production subsidy. In this area, the percentage increase in the transfer price is not large enough to imply $\hat{x} < 0$. Instead, the implicit subsidization of capital (and labor) implies that production will increase. Not surprisingly, an increase in κ and a decrease in μ make an increase in production more likely. Figure 1 also shows that the increase in the transfer price (toward the true cost of the material input) must be substantial to imply $\hat{x} < 0$ unless κ is small and thus the cost share of material input μ is relatively large.

We now scrutinize how Pillar Two will change factor demands and how these changes depend on factor price and output changes. Let $\hat{w}, \hat{r}, \hat{q}$ and $\hat{x}$ denote the relative changes of all effective factor prices and the relative output change, respectively. We find:

[11] If we set $t^* = 10\%$, $r^{**} - r^*$ is equal to –0.49% and –0.25% for machinery and buildings, respectively, and these numbers are still sizable in the context of rentals.

[12] These assumptions are $\phi = 0.5, \rho = 0.05, \tilde{\delta} = 0.1776, \delta = 0.1225, t^* = 0.05, \sigma = 0.05$ and $T = 0.15$.

[13] This range of labor cost shares is large but the Penn World Tables report already a large degree of heterogeneity of labor cost shares on country level; see Inklaar and Timmer (2013).

Proposition 2 *Assume that the effective rental decreases with the introduction of the global minimum tax, that is,* $\hat{r} < 0$. *Material imports decrease if output decreases. Labor demand increases* (*decreases*) *if the wage change is sufficiently small* (*large*) *such that* $\hat{w} < (>)(\kappa\hat{r} + \mu\hat{q} + \hat{x})/(\kappa + \mu)$. *Capital demand increases* (*decreases*) *if the rental change is sufficiently small* (*large*) *such that* $\hat{r} < (>)(\lambda\hat{w} + \mu\hat{q} + \hat{x})/(\lambda + \mu)$.

Proof See Appendix A.2. □

Proposition 2 shows that a subsidiary with a large cost share of materal inputs (like a wholesaler) who faces an increase in marginal cost will import less from the headquarters. An increase in imports is possible only if the complementary increase in labor and capital and the increase in output is strong enough. An increase in output will also increase factor demands, but we have already found that the wage subsidy is moderate. For example, assume that the cost share of labor is large, that is, $\lambda = 0.7, \kappa = 0.2, \mu = 0.1$ and where we keep the other assumptions from above (see footnote 12). We then find that the global minimum tax works like a production subsidy; if output stayed constant, labor demand would increase by 0.43%, capital demand would increase by 4.04% and material input demand would decrease by 6.29%.[14] With an output increase, these increases will be larger, showing that the global minimum tax works like a large investment subsidy even if the cost share of capital is relatively small. At the same time, material input demand declines unless output increases by more than 6.29%, and, as a consequence, Pillar Two is likely to replace imports by foreign direct investment.

Due to transfer pricing, the size of material imports is inefficiently large to begin with, and thus Pillar Two can reduce, but not eliminate this import distortion.[15] At the same time, it is likely to exacerbate the capital demand distortion as it will increase the subsidy effects that already exists due to generous depreciation allowances. Furthermore, Pillar Two distorts labor demand that has been undistorted before for given capital and material demand.

6 Concluding remarks

This paper shows that the OECD inclusive framework of Pillar Two fails to implement the claimed 15% minimum corporate tax for subsidiaries of multinational corporations in low-tax countries that are not shell companies. The reason is that the Substance-based Income Exclusion of Pillar Two allows to tax-deduct payroll costs and user costs of tangible assets twice from the aggregate tax base. Employing a standard multinational firm model, we show that Pillar Two dampens abusive transfer pricing, but changes the employment, investment and import incentives. For a sufficiently large cost share of labor and/or capital, the Substance-based Income

[14] For details, see Appendix A.1 and Appendix A.2. $\lambda\hat{w} + \kappa\hat{r} + \mu\hat{q} = -0.0067 < 0$ implies that output will increase.

[15] For our example, the amount of transfer pricing $(\gamma - q)M$ will decline by less than 42.7%.

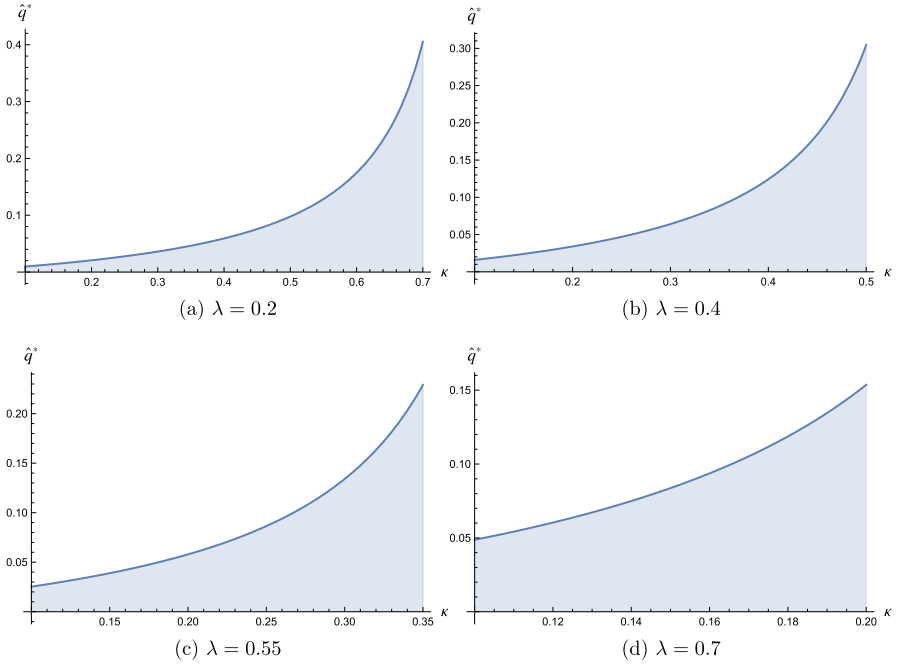

Fig. 1 Critical percentage increase in transfer prices

Exclusion is equivalent to a production subsidy that favors capital-intensive industries over labor-intensive industries since the subsidy to capital is larger than the subsidy to wages.

What is the rationale of the Substance-based Income Exclusion that drives our results? According to the OECD, " [a] substance carve-out based on assets and payroll costs allows a jurisdiction to continue to offer tax incentives that reduce taxes on routine returns from investment in substantive activities, without triggering additional GloBE top-up tax. Given the carve-out covers investment in both tangible assets and payroll, it will have broad application to a wide range of different industries."[16] Our paper has demonstrated that these effects can be indeed very strong and heterogeneous across industries.

At the same time, however, the welfare-relevant implications are by no means clear. First, while Pillar Two will reduce distortions implied by transfer pricing, it will exacerbate the capital demand distortion and introduce a labor market demand distortion in low-tax countries where there is genuine economic activity. Since multinational firms are large and have market power, this may be justified if these effects lead to a larger multinational output. However, it is in no way clear what a carve-out rate of 5% on payroll costs and tangible assets will imply across industries in the long run. It is also not clear that the costs of these distortions will be smaller

[16] See OECD (2021), page 3.

than any benefit, in particular since the Substance-based Income Exclusion will be applied uniformly.

Second, Pillar Two is likely to increase tax revenues from shell companies in tax havens. A common practice among multinationals is to locate intangibles in low-tax countries and sell the use of these assets within the firm network like a material input. The multinational firm has thus an incentive to overinvoice subsidiaries in high-tax countries. Then, by the income inclusion rule (IIR) under which tax revenues are collected by the headquarter country, Pillar Two will have a profound and positive effect. Since there is no genuine economic activity in the low-tax (haven) country, the effective tax rate of the headquarter firm is 15%.[17] In such a case, Pillar Two will also dampen the incentive to manipulate the transfer price for tax reasons. Consequently, how Pillar Two will play out across jurisdictions will crucially depend on the type of multinational activity in the respective country. In any case, it is not true that all multinational activities will be subject to an effective corporate tax rate of 15%. Whatever its underpinnings and wherever the details of the Substance-based Income Exclusion came from, it may be a rude awakening for policymakers when the public realizes that the global minimum tax does not imply the same effective tax rate of 15% for a large number of industries.

Appendix

Proof of Proposition 1

We define $\Gamma = w^{\lambda} r^{\kappa} q^{\mu}$ and express our results in terms of relative changes such that $\hat{y} = d\log(y)$ denotes the relative change of variable y. Taking logs and differentiating marginal costs for unchanged output yields $\widehat{C}' = \widehat{\Gamma}/\alpha$ for $\hat{x} = 0$ where $\widehat{\Gamma} = \lambda\hat{w} + \kappa\hat{r} + \mu\hat{q}$. The cost shares are respectively given by $\lambda/\alpha, \kappa/\alpha$ and μ/α. Since $\hat{w}, \hat{r} < 0$ and $\hat{q} > 0$, $\widehat{\Gamma} < 0$ if $\lambda\hat{w} + \kappa\hat{r} < -\mu\hat{q} = -(\alpha - \lambda - \kappa)\hat{q}$ which is true if λ and/or κ are sufficiently large. $\widehat{\Gamma} < 0$ reduces marginal cost for $\hat{x} = 0$ which implies an increase in output to equalize marginal revenues and marginal costs.

Proof of Proposition 2

Differentiating the logs of (4a), (4b) and (4c) yields

$$\widehat{L} = -(1/\alpha)\left[(\kappa+\mu)\hat{w} - \kappa\hat{r} - \mu\hat{q} - \hat{x}\right], \widehat{K} = -(1/\alpha)\left[(\lambda+\mu)\hat{r} - \lambda\hat{w} - \mu\hat{q} - \hat{x}\right],$$
$$\widehat{M} = -(1/\alpha)\left[(\lambda+\kappa)\hat{q} - \lambda\hat{w} - \kappa\hat{r} - \hat{x}\right].$$

Given that $\hat{q} > 0$ and $\hat{w}, \hat{r} < 0$, $\widehat{M} < 0$ if $\hat{x} \leq 0$. Furthermore,

$$\widehat{L} > (<)0 \text{ if } \hat{w} < (>)\frac{\kappa\hat{r} + \mu\hat{q} + \hat{x}}{\kappa + \mu}, \widehat{K} > (<)0 \text{ if } \hat{r} < (>)\frac{\lambda\hat{w} + \mu\hat{q} + \hat{x}}{\lambda + \mu}.$$

[17] This is the case when the carve-out is zero. See footnote 8.

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