RIETI Discussion Paper Series 25-E-032

Reallocating Taxing Rights and Online Trade: Pillar One as a partial formula apportionment

MUKUNOKI, Hiroshi
Gakushuin University

OKOSHI, Hirofumi
Okayama University

SCHINDLER, Dirk
Erasmus University Rotterdam

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 25-E-032
April 2025

Reallocating Taxing Rights and Online Trade: Pillar One as a partial formula apportionment*

Hiroshi MUKUNOKI
Gakushuin University
Hirofumi OKOSHI
Okayama University
Dirk SCHINDLER
Erasmus University Rotterdam

Abstract

To target the problem of "homeless profits" that digital firms earn in countries without a physical presence, the Pillar One proposal by the OECD aims to reallocate taxing rights to market countries based on the sales revenues of in-scope firms. This study theoretically investigates the implications of Pillar One by considering a global firm that conducts all its real activities in a tax haven and competes via prices in e-commerce with local firms in market countries. Our model identifies two core effects. First, all in-scope firms manipulate their routine profit threshold by increasing their total turnover. This reduces the newly reallocated tax base and crowds out the taxable profits of the local competitors. Second, when corporate tax rates differ across market countries, there is an incentive toward sales shifting, whereby the global firm increases prices in the high-tax country and books larger sales and taxable profits in the low-tax country. Thus, the high-tax country suffers from lower tax revenue and greater market inefficiency, all else being equal.

Keywords: Digital firms, Online trade, OECD Pillar One, Sales-based formula apportionment
JEL classification: F23, H25, L13

*This study is conducted as a part of the project "Economic Policy Issues in the Global Economy" undertaken at the Research Institute of Economy, Trade and Industry (RIETI).
The draft of this paper was presented at the RIETI DP seminar for the paper. We would like to thank Vladimir Karamychev, Yasuyuki Todo, Eiichi Tomiura, and participants of the RIETI DP Seminar for their helpful comments.

1 Introduction

Since 2012, international corporate tax avoidance via base erosion and profit shifting (BEPS) has been very high on the agendas of politics, media, and academic research. The G20 countries mandated the Organisation for Economic Co-operation and Development (OECD) to come up with some solutions that led to the OECD BEPS Action Plan in 2015. The proposed 15 actions addressed most of the BEPS issues, and, by now, they have been implemented by most countries worldwide. One of the biggest concerns, however, remained unaddressed: as the global economy becomes increasingly digital, firms' online economic activities continue to grow substantially, but there is no response to such an issue in the rules of international taxation yet. The result is "homeless profits" that allow firms undergo taxation of convenience. Joseph Stead of the OECD's Centre for Tax Policy and Administration clearly summarizes this point:

> "*MNEs often conduct large-scale business in jurisdictions where they have little or no physical presence. But under existing rules, broadly, the profits of a foreign company can only be taxed in another country where the foreign company has a physical presence. While this made perfect sense a century ago when business revolved around factories, warehouses, and bricks-and-mortar stores, it does not reflect today's digitalised world. (Stead, 2021, p.157)*"

To address this issue, the OECD launched its "Pillar One" proposal as part of the BEPS 2.0 project that the G20 countries and the so-called Inclusive Framework accepted in the summer of 2021 and approved by October 2021.[1] Effectively, OECD Pillar One rests on the introduction of a partial formula apportionment (FA) system that reallocates a portion of residual profits to market countries.[2] Residual profits are defined as profits that exceed a certain threshold on return on (global) sales, and the reallocation formula rests on sales shares only. It targets the largest firms worldwide, and mainly aims for the digital economy. Despite its endorsement in 2021, however, the final proposal of OECD Pillar One (OECD, 2023) fell dead on the floor in 2023. Different from the global minimum tax (GMT) under OECD Pillar Two and its 15% minimum effective tax rate per jurisdiction, no country has approved and ratified Pillar One

[1] See `https://www.oecd.org/tax/beps/statement-on-a-two-pillar-solution-to-address-the-tax-challenges-arising-from-the-digitalisation-of-the-economy-july-2021.pdf`

[2] FA is an international tax rule to split the total pre-tax profit earned by a multinational corporation between the tax jurisdictions where it does business. This rule is adopted in some countries, such as Canada and the U.S., to allocate tax based on provinces and states within these countries.

to date.

Why does OECD Pillar One seemingly die? Should the international community be unhappy about Pillar One not being introduced? What are the incentive effects are crethated by the proposal creates in highly concentrated industries that feature highly imperfect (price) competition? WAnd who exactly wins and loses from Pillar One? Unfortunately, the academic literature on OECD Pillar One still remains very scarce and mainly attempts to estimate revenue effects for different countries.[3] Therefore, the current literature cannot answer these questions.

This paper identifies the different effects of OECD Pillar One on price competition in an oligopolistic setting with digital firms and e-commerce, and it highlights the consequences of each effect on consumers, domestic producers, and tax revenues in different countries. The setting focuses on homeless profits and neglects production in market countries to avoid (double-taxation) problems with the still unclear integration of Pillar One and the existing (and continuing) tax system. We find two main effects: The sales-based FA embedded in OECD Pillar One sets incentives for global firms to increase not only sales (i.e., to be more price aggressive) in low-tax countries but also prices in high-tax countries to decrease sales there. Additionally, under Pillar One, a threshold effect induces all in-scope firms to inflate their turnover to reduce their residual profits. Inflating sales, that is, decreasing prices, in all countries allows global firms to shelter their profits in tax havens. Importantly, this is no bunching effect merely around the threshold, as all firms in the scope of Pillar One face the same incentives. Finally, the implications of both main effects on consumers, producers, and tax revenues significantly depend on how similar the traded varieties are, that is, how fierce price competition in a specific market is.

Under OECD Pillar One, only very large firms with a global turnover of more than EUR 20 billion are "in scope." The expectation is that this applies to approximately 100 firms worldwide, and the main target constitutes large, digital tech companies.[4] For all in-scope firms, 25% of their residual profits, as defined under Pillar One, are reallocated to market countries and taxed where the sales happen. The reallocated tax bases are called "Amount A."[5] OECD Pillar One defines residual profits as the amount of globally consolidated profit

[3]This is another difference relative to OECD Pillar Two. The literature on the GMT is growing fast, and it did not only address revenue issues (Hebous and Keen, 2023) but also identified relevant incentive effects (e.g., Johannesen, 2022; Janeba and Schjelderup, 2023; Schjelderup and Stähler, 2024) early on.

[4]See Devereax and Simmler (2021).

[5]There also is an "Amount B" that shall provide market countries with tax base from the remuneration of

that exceeds a return on global turnover of 10%. If Pillar One comes into effect, estimates suggest a reallocation of annual taxing rights of more than 125 billion U.S. dollars to market countries and an increase in global tax revenues between 17 and 32 billion U.S. dollars, based on 2021 data.[6] Accordingly, the introduction of OECD Pillar One appears desirable for all market countries. The underlying estimations, however, neglect that the in-scope firms operate in highly concentrated markets, have substantial market power, and can game the system by adjusting and shifting their sales country by country.

Our paper, to the best of our knowledge, is the first to capture the effects of Pillar One on market outcomes. To highlight and isolate the issue of homeless profits, we set up a three-country model with one global and two local firms, each supplying differentiated varieties of the same consumption goods. The global firm locates in a tax haven without markets, offers its product to final customers abroad (e.g., via an online sales platform), and exports from the haven directly to customers in segregated non-haven market countries. To take the stylized fact of strong market concentration in digital and tax-aggressive industries (e.g., Johansson et al., 2017) seriously, we assume a duopoly in each market country, where the global firm and one local firm compete on prices for their differentiated goods. A classic example of our setting is the e-commerce business in Europe with digital business-to-customer sales platforms in effectively segregated national markets and one dominant global firm, such as Amazon. By assumption, the global firm is within the scope of OECD Pillar One, such that market countries receive 25% of the global firm's residual profits as an additional tax base under Pillar One, apportioned according to the sales shares of each country.

In more detail, this setting delivers the following results and predictions: As low-taxed routine profits are proportional to global turnover, the global firm can game the system by inflating its global sales. All else being equal, it has an incentive to be more price-aggressive and reduce its sales prices in all markets. This fosters global sales, and the global firm sacrifices some before-tax profits to earn valuable tax savings, stemming from increased routine profits. As prices are strategic complements, the local firms in each market also decrease their prices, but they will lose market shares. In sum, the threshold effect from routine profits allows the global firm for partially bypassing OECD Pillar One, and it benefits consumers as

business functions such as marketing and sales services related to the final goods. This part of OECD Pillar One hardly plays any role in reality, it seems, and thus, we purely focus our analysis on Amount A.

[6] See https://www.meijburg.nl/sites/default/files/2022-04/Beps-what-to-know-flyer-web_.pdf and https://www.oecd.org/en/about/news/press-releases/2023/10/inclusive-framework-releases-new-multilateral-convention-to-address-tax-challenges-of-globalisation-and-digitalisation-.html.

all prices decrease. However, it harms local producers, who suffer from decreased profits. For market countries, the gain in tax revenue, from reallocating the tax base under Pillar One, gets reduced by two effects. First, inflating routine profits reduces the amount of profits of the global firm that gets reallocated to market countries. Second, market countries lose tax revenue from domestic firms as their profits shrink. All these effects matter more or less if products are differentiated, and the easier varieties can be substituted for each other. If the varieties are almost identical, the tax revenue effect can even turn negative.

As soon as there are international tax differentials, the global firm additionally has an incentive to shift sales globally. Increasing sales revenues in low-tax countries and reducing turnover in high-tax countries book more of the reallocated tax base in the lower-taxed country and save taxes relative to a Pillar One scenario without behavioral responses (as often used in revenue simulations). To achieve this sales shifting, the global firm reduces prices in low-tax countries and increases prices in high-tax countries. The local competitors will follow. Hence, consumers in low-tax countries benefit from decreasing prices and larger supply under sales shifting. In contrast, consumers in high-tax countries suffer from even higher prices and more market imperfections, all else being equal. The mirror image results for profits of local firms. In low-tax countries, they suffer further, whereas sales shifting has a positive effect on domestic producers' rents as well. Considering tax revenue, low-tax countries, on a net basis, gain from sales shifting while high-tax countries lose tax revenue on a net basis. Once again, the compensating effects depend on the level of competition and degree of product differentiation.

Despite the two effects to game OECD Pillar One, our simple, first welfare analysis suggests that market countries largely benefit from the tax reform. The substantial gain in tax revenue from the reallocated tax base dominates the two effects from gaming the system that we have identified. Based on this finding, all market countries should embrace OECD Pillar One. Such an interpretation, however, needs to be handled with care. One driving force behind our welfare result is that market countries cannot lose their previous tax base from the global firm in our setting. All negative net revenue effects stem from potential losses in domestic firms' profits. The other important feature is that our quasi-linear utility function effectively measures market efficiency and weighs consumer surplus, producer surplus and tax revenues with the same factor. As our results show, some high-tax countries might lose consumer surplus, that is, suffer more from imperfect competition, and their tax-

revenue effects might be negative, depending on the strength of product differentiation. In a political-economy framework, which groups gain or lose matters. Our analysis provides some first guidance for when such gains or losses occur for consumers, local producers, and tax revenue, depending on the intensity of competition and a country's tax rate. Interestingly, high-tax countries might gain the most thanks to the higher value of the reallocated tax base.

Finally, our results show that the insides of sales-based FA in a monopoly setting (see Altshuler and Grubert, 2010) carry over to an oligopolistic economy with price competition. Global firm (or: multinational) still engages in sales shifting and improves its tax position. Local competitors will, however, follow in the pricing strategy. This strengthens the effects on consumer surplus in both countries. Additionally, there is a new effect. Sales shifting harms the profits of local firms in low-tax countries and rather fosters those of local firms in high-tax countries. Thus, there is a mitigating effect on tax revenues, as low-tax countries gain less tax revenue on a net basis from sales shifting, whereas high-tax countries lose less tax revenues overall, as sales shifting rather allows local firms to earn larger profits.

Studies on OECD Pillar One are scarce, and the few papers mainly provide forecasts on revenue effects based on simulations. Heckemeyer et al. (2024) show a list of in-scope multinational corporations (see Table 16) and find that 65% of them make a major part of their profits from selling finished goods and their components. Although revenues from online intermediation services or the sales of user data are often embedded in the central discussion, none of the in-scope firms in their sample derive major profits from such business. Barake and Le Pouhaër (2024) predict that the introduction of Pillar One delivers additional global tax revenue between 5.7 billion and 10.9 billion euros (see their panel (b) of Figure 3). The positive tax revenue effect is in line with our theoretical model, but importantly, our model also highlights that such estimates may be overestimated; market countries additionally experience a negative tax revenue effect as local firms' profits fall. Hence, our results caution against a literal interpretation of the revenue gains from simulations based on perfect competition and the absence of behavioral responses.

The effects of a pure FA system are well-established, particularly in perfect competition settings. Under FA, the global profits of a (multinational) firm are consolidated across all its affiliates of the firm. Tax authorities then apportion the global profits as a tax base to all involved jurisdictions (countries) based on the economic activity in each jurisdiction. To proxy economic activity, one uses allocation keys based on the share of a jurisdiction in total capital

costs, labor expenses, and sales revenues. The allocation keys effectively turn the corporate tax into a tax on factor inputs (Gordon and Wilson, 1986). A higher corporate tax rate has two effects: (i) it increases the average tax rate which discourages investment and economic activity in all affiliates, and (ii) it incentivizes shifting activity to low-tax countries as this implies that a larger portion of the total tax base gets taxed in the low-tax country. Standard allocation formulas that include capital and labor trigger fiercer tax competition than the current separate accounting (SA) system because the gain in tax base rests on average profits, not on lower marginal profits as under SA (Keen and Konrad, 2013). Countries undercut their tax rates to attract investment and employment. Even when adding profit shifting under SA, Nielsen et al. (2010) show that FA leads to more tax competition (and lower welfare) as long as economic profits are high and costs for profit shifting are intermediary and not too low.

Eichner and Runkel (2008) argue in favor of sales-based FA and claim that shifting sales is much more difficult. The authors focus on a model with perfect competition, two small countries, and multinationals that produce with a fixed factor and decreasing returns to scale. For a sales-only formula, they find a negative fiscal externality and a race to the top in tax competition. One crucial feature is the presence of a fixed factor so that countries try to tax the supernormal profits and sales are not only determined by variable factor inputs. Eichner and Runkel (2008) advocate a sales component as an ideal instrument such that the negative effects of the other formula components can be offset. Altshuler and Grubert (2010) show, however, that this view needs to be handled with care. In a monopoly setting with segregated markets, a multinational has strong incentives to shift its activities (sales and local production) to low-tax countries by reducing prices in low-tax countries (and increasing them in high-tax countries). Consequently, the standard formula externality is back in the game, and the incentives for tax competition are rather in line with the previous findings on FA and a general formula to apportion profits.

Empirically, Giroud and Rauh (2019), using fine-grained affiliate-level data, exploit variations in state corporate tax rates in the U.S., and find evidence of substantial investment and employment shifting to low-tax states. Hence, the second effect dominates the first, average-tax-rate effect.[7] As their data includes many U.S. states with sales-based formulas only, their results suggest that activity shifting also matters significantly for sales formulas, as perfect

[7]Previous empirical evidence for the U.S. rested on aggregate data only and has been contradictive, see Goolsbee and Maydew (2000) vs. Weiner (1994).

competition does not apply in reality. The results regarding activity shifting are in line with earlier findings from the German FA system for its local business income tax that rests on an employment-only formula (Riedel, 2010, Eichfelder et al., 2018). Our results indicate that such activity shifting also matters for OECD Pillar One, and they imply that there are strong incentives for a further race to the bottom as reality rather features strategic price competition between firms than perfect competition as in Eichner and Runkel (2008).

The remainder of this paper is organized as follows: Section 2 outlines the model. Section 3 derives firms' behavior and market equilibria, and establishes the allocation under the current pure SA system as the benchmark case. In Section 4, we analyze the effects of Pillar One on behavior and market structures, and provide some first welfare analysis. Finally, Section 5 summarizes our analysis and offers some conclusions. All formal proofs and derivations are presented in the appendices.

2 Model

In our model, there are three countries: a tax haven h without an economic market and two (market) countries $i = 1, 2$, where customers are located. There are also three firms that host a digital platform each and sell products via the Internet, that is, via business-to-customer online trade. The global firm G is registered and has all its physical presence in the tax haven h. It serves customers via the Internet and exports to the countries $i = 1, 2$. Furthermore, there is one domestic firm in each country i that serves domestic customers only. Hence, the markets in countries 1 and 2 are fully separated. All firms use their digital platform to sell their products to final customers that order online. The products can be intangible online services, l such as cloud storage space or social media accounts, or physical e-commerce goods that customers order online and receive as parcels via standard mail. In each market i, the global firm and the respective local firm supply differentiated products and compete on prices.

We assume that the tax haven has the lowest corporate tax rate of the three countries and that country 2 is potentially high-tax. Thus, for the corporate tax rates, we have $t_h < t_1 \leq t_2$. Furthermore, we assume that the global firm G is liable to tax in the haven country h only because the firm does not have any physical presence in the other countries, and according to standard international tax rules, profits from exports are taxed with corporate income tax

in the country of origin. This assumption simplifies the integration of the tax payment under OECD Pillar One with the national tax codes and ensures that we can eliminate any double-taxation issue without further assumptions and complications.[8] Additionally, the assumption highlights the case of "homeless profits" that are earned in market countries, but booked and taxed (if taxed at all) in haven countries.

The general set-up of our model duly suits the e-commerce business in Europe very well, where Amazon serves all countries either directly through a "domestic" website or by exports ordered via a foreign website. In countries such as Germany, since 2020 Sweden and the Netherlands, and since 2022 Belgium, one can access a local website in the local language and place one's orders there. In other countries such as Switzerland or Norway (and the Netherlands before 2020), one needs to access one of the "foreign" Amazon websites and order there. Amazon then exports the order and serves the customer (usually covering all import fees – but not the tariffs – in the country of the customers). Amazon often denies the cross-border shipping of products listed on its websites in different countries, allowing for the charging of differentiated country-specific prices. For example, a product that Amazon sells on Amazon.nl cannot be ordered on Amazon.de for shipping to the Netherlands. Hence, there is a geographical market separation. Most importantly, Amazon faces substantial price competition in e-commerce with local digital platforms. For example, in the year 2023, Amazon is only number #4 in the net-sales ranking of online stores in the Netherlands; the Dutch (and Belgian) market is still dominated by Bol.com.[9] In contrast, Amazon dominates the online market in Germany, where number #2 in the ranking, Otto.de, makes less than one-third of Amazon's turnover (based on the year 2022).[10] In Switzerland, also based on 2023 values, the online market is dominated by the electronics shop Digitec Galaxus, whereas the Swiss sales by Amazon are mainly split across Amazon.de, Amazon.fr, and Amazon.it.[11] All of these competitors that Amazon faces are truly local competitors, however, as Bol.com only delivers to addresses in the Netherlands and Belgium. Otto.de only serves Germany, and

[8] The OECD (2023) suggests a complex set of rules to avoid double taxation, which is very difficult. To date, it is fully unclear whether and how the suggested rules really avoid double taxation in all cases when aggregate routine profits need to be distributed to various production countries. A way out could be to rely on notional returns on capital, as Beer et al. (2023) use for their analysis. Doing so, however, effectively introduces a component of FA based on capital keys – and with it all the inefficiencies that such an allocation triggers (e.g., Nielsen et al., 2010).

[9] See https://www.statista.com/forecasts/871164/netherlands-top-online-stores-netherlands-ecommercedb.

[10] https://ecommercenews.eu/top-10-online-stores-germany/

[11] https://ecommercedb.com/insights/top-online-stores-of-dach-strange-case-of-amazon-in-switzerland/4449

Digitec.ch and Galaxus.ch do not offer deliveries outside Switzerland.[12]

In each country $i = 1, 2$, there is a representative consumer i that derives utility from the consumption of a numéraire good z_i at price $q_i = 1$ and from consuming orders from digital platforms and their differentiated products available to her. The representative consumer has an exogenous income m_i and additionally fully owns the local digital firm and its after-tax profits $(1 - t_i)\pi_{Li}$. Furthermore, consumer i receives a lump-sum transfer TR_i from her government that is funded by the corporate tax revenue of country i.

By adopting the linear demand model of Dixit (1979) and Singh and Vives (1984),[13] the representative consumer i has a utility function u_i that is quasi-linear in the numéraire good z_i and takes the form

$$u_i = a(x_{Gi} + x_{Li}) - \frac{x_{Gi}^2 + 2\theta x_{Gi}x_{Li} + x_{Li}^2}{2} + z_i. \tag{1}$$

x_{Gi} and x_{Li} represent the quantities of the product varieties consumed at prices p_{Gi} and p_{Li} via the platforms of the global (G) and the local (L) firm, respectively, and $\theta \in [0, 1)$ captures the similarity of these varieties that the digital firms offer. When the consumer maximizes her utility by choosing consumption levels x_{Gi} and x_{Li}, she treats the profits of the local firm and the lump-sum transfer as given. Then, we obtain the following linear demand functions for the products on the digital platforms in country i:[14]

$$x_{Gi} = \frac{(1-\theta)a - p_{Gi} + \theta p_{Li}}{1 - \theta^2} \qquad \text{and} \qquad x_{Li} = \frac{(1-\theta)a - p_{Li} + \theta p_{Gi}}{1 - \theta^2} \tag{2}$$

To provide their products, the digital platforms must incur constant marginal costs c_G and c_L, respectively. If the platform sells a physical product, the marginal costs are surely positive because the product needs to be produced and shipped. If the platforms sell online services, the marginal costs per unit may reach zero. Following the Melitz model, wherein exporting (and multinational) firms are more productive (Melitz and Redding, 2014), a natural assumption seems to be that the global firm is more efficient and has lower marginal costs than its local competitors. However, the global firm has higher shipping costs in the case of

[12] Additionally, the European headquarters that steers all trading in Europe, Amazon EU S.à.r.l, resides in Luxembourg. That is where Amazon Europe reports most of its profits and where it benefits from sweet deals with the government in Luxembourg. `https://ec.europa.eu/commission/presscorner/detail/en/ip_17_3701`. Consequently, this feature fits to our general set-up as well.

[13] This is a standard setup used by other recent studies. See Choné and Linnemer (2020).

[14] See Appendix A.1.

physical products to be sold, as it has to ship the product from the haven country, which is different from the case of the local competitor. In the following, we assume that the shipping costs do not overcompensate the efficiency advantage such that we have $c_L \geq c_G \geq 0$.

Becoming a global firm requires some investment in technology and organization, thus accruing fixed costs. The global firm can afford to pay such fixed costs as its global business sufficiently increases revenues. However, this does not apply to all firms because the competitors remain purely local firms in country i. In the following, we do not endogenize the decision of which firm becomes the global firm. We simply assume that the global firm and the local firm in country i compete on prices for their platform services and ask for prices p_{Gi} and p_{Li} for their products. Hence, they earn before-tax profits

$$\pi_{Gi} = (p_{Gi} - c_G)x_{Gi} \qquad \text{and} \qquad \pi_{Li} = (p_{Li} - c_L)x_{Li}.$$

To derive after-tax profits, we focus on an economic profit tax and assume that all costs are fully tax deductible.[15] Thus, the after-tax profits of the local firm in country i are

$$\Pi^s_{Li} = (1 - t_i)\pi^s_{Li} = (1 - t_i)(p^s_{Li} - c_L)x^s_{Li}, \tag{3}$$

where $s = O, P$ indicates which tax system applies. The tax system does not have a direct effect on the profit equation of the local firm, but it matters for the price set by the global firm, and thus, for the optimal choice of price (and quantity) by the local firm.

Two tax systems are relevant here. The benchmark case is the existing system of pure SA where each entity is taxed upon the profits it earned and exports are taxed at the origin country. We denote this case by $s = O$. The alternative system is the application of OECD Pillar One. We denote this second case by $s = P$.

Under the existing system ($s = O$) then, the after-tax profits of the global firm result are

$$\Pi^O_G = (1 - t_h) \sum_{i=\{1,2\}} \pi^O_{Gi} = (1 - t_h) \sum_{i=\{1,2\}} (p^O_{Gi} - c_G)x^O_{Gi}. \tag{4}$$

In contrast, when OECD Pillar One kicks in ($s = P$), part of the tax base of the global

[15] In reality, the costs of equity, as a part of capital costs, are not tax deductible in the corporate tax systems of most OECD countries. Consequently, not all (capital) costs are tax deductible, which triggers what is known as the corporate tax distortion in investment decisions. In our setting, this aspect would be of second order only, however, and we simplify the analysis by considering economic profit taxes.

firm is reallocated as "Amount A" to the market countries $i = 1,2$. The share $\alpha_R = 25\%$ of the consolidated residual profits π_R of the global firm shall be allocated to where the consumers are located. The Pillar One framework defines consolidated residual profits as the consolidated profits that exceed a threshold of $\alpha_E = 10\%$ return on global turnover. When we define the global firm's sales revenues in country i as $R_{Gi} = p_{Gi}x_{Gi}$, the consolidated residual profits under OECD Pillar One result as

$$\pi^R = \sum_{i=\{1,2\}} \pi_{Gi} - \alpha^E \sum_{i=\{1,2\}} R_{Gi} = \sum_{i=\{1,2\}} \Big((p_{Gi} - c_G)x_{Gi} - \alpha^E p_{Gi}x_{Gi} \Big),$$

where we used $\pi_{Gi} = (p_{Gi} - c_G)x_{Gi}$. For an in-scope global firm, residual profits are always positive, that is, $\pi^R > 0$. If a firm does not reach the turnover threshold, Pillar One does not apply, and it is not an in-scope global firm.

Given the residual profits π^R, the global firm still gets taxed on "routine profits", that is, the return on turnover up to $\alpha^R \cdot \sum_{i=\{1,2\}} R_{Gi}$, and on the share $(1 - \alpha^R)$ of residual profits in its residence country, tax haven h. Following a standard FA rule based on sales revenues, however, the share α^R of residual profits gets allocated to market countries $i = 1,2$, according to their sales shares $\frac{R_{Gi}}{\sum_{i=\{1,2\}} R_{Gi}}$ and taxed with the respective tax rate of country i. Putting everything together, the global tax payment of the global firm under OECD Pillar One becomes

$$T_G^P = t_h \left(\alpha^E \sum_{i=\{1,2\}} R_{Gi} + (1 - \alpha^R)\pi^R \right) + \left(\frac{R_{G1}t_1}{\sum_{i=\{1,2\}} R_{Gi}} + \frac{R_{G2}t_2}{\sum_{i=\{1,2\}} R_{Gi}} \right) \alpha^R \pi^R. \tag{5}$$

Then, we can write the global after-tax profits of the global firm as

$$\begin{aligned} \Pi_G^P &= \sum_{i=\{1,2\}} \pi_{Gi}^P - T_G^P \\ &= (1 - t_h) \sum_{i=\{1,2\}} \pi_{Gi}^P - \alpha^R \left(\sum_{i=\{1,2\}} \pi_{Gi}^P - \alpha^E \sum_{i=\{1,2\}} R_{Gi} \right) \left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}} \right), \end{aligned} \tag{6}$$

where we used $\pi^R = \sum_{i=\{1,2\}} \pi_{Gi} - \alpha^E \sum_{i=\{1,2\}} R_{Gi}$ and collected terms. The total operating profits of the global firm are still fully taxed in the haven country of residence, as shown by the first term in the second line of equation (6). However, the market countries gain a tax base proportional to their sales shares. Now, part of the "homeless profits" (that actually were home to the haven) are taxed where the consumers are situated, and the haven country must grant a tax credit to eliminate double taxation, which is reflected by the second term in

the second line of equation (6).

Turning to the tax revenue TR_i in the market countries $i = 1, 2$, the tax base consists of the profit of the domestic firm only in the benchmark case of pure SA ($s = O$). Consequently,

$$TR_i^O = t_i \pi_{Li}^O. \tag{7}$$

Under OECD Pillar One, country $i = 1, 2$ also collects some revenue from taxing the global firm, based on its local sales, in addition to taxing the profits of the domestic firm that materialize under this regime:

$$TR_i^P = t_i \left(\pi_{Li}^P + \alpha^R \pi^R \frac{R_{Gi}}{\sum_{i=\{1,2\}} R_{Gi}} \right). \tag{8}$$

Finally, we can discuss welfare in our economy. For a representative consumer that owns the domestic firm and receives all tax revenue as a lump-sum transfer, welfare is equivalent to the utility of the representative individual, whose budget constraint implies

$$z_i^s = m_i + (1 - t_i)\pi_{Li}^s + TR_i^s - p_{Gi}^s x_{Gi}^s - p_{Li}^s x_{Li}^s. \tag{9}$$

The individual spends her exogenous income, the after-tax profits of the domestic firm plus the received lump-sum transfer minus the expenditures on the variants of good x, on the numéraire z_i. Accordingly, relying on the utility function from equation (1), the social welfare results are

$$W_i^s = \frac{{x_{Gi}^s}^2 + 2\theta x_{Gi}^s x_{Li}^s + {x_{Li}^s}^2}{2} + m_i + (1 - t_i)\pi_{Li}^s + TR_i^s. \tag{10}$$

The first term of the welfare function shows the consumer surplus, whereas the third and fourth terms are the local firm's post-tax profits and tax revenues, respectively, which we explain next.

3 Firm behavior and a benchmark case

Each domestic firm i maximizes its profits (3) by choosing its price p^s_{Li}, given the price p^s_{Gi} of the competing global firm. Formally, we have

$$\max_{p^s_{Li}} \Pi^s_{Li} = (1-t_i)\pi^s_{Li} = (1-t_i)(p^s_{Li} - c_L)x^s_{Li}, \tag{11}$$

and the corresponding first-order condition reads

$$\frac{\partial \Pi^s_{Li}}{\partial p^s_{Li}} = (1-t_i)\left[x^s_{Li} + (p^s_{Li} - c_L)\frac{\partial x^s_{Li}}{\partial p^s_{Li}}\right] = 0. \tag{12}$$

The first-order condition gives the response function of the local firm i for a given price p^s_{Gi} of the global firm, where the local firm balances the revenue increase from charging a higher price on sold units against the effect of a demand decrease in response to the price increase. The structure of the response function of the local firm is independent of the tax regime $s = O, P$, but the price chosen by the global firm will differ across tax regimes.

Similarly, the global firm maximizes its global after-tax profits (6), where the case $\alpha_R = 0$ nests the benchmark scenario $s = O$ with pure SA. Then, the maximization becomes

$$\max_{p^s_{Gi}} \Pi^s_G = (1-t_h)\sum_{i=\{1,2\}} \pi^s_{Gi} - \alpha^R \left(\sum_{i=\{1,2\}} \pi^s_{Gi} - \alpha^E \sum_{i=\{1,2\}} R_{Gi}\right)\left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}}\right) \tag{13}$$

and the general first-order condition of the global firm follows as

$$\begin{aligned}
\frac{\partial \Pi^P_G}{\partial p^s_{Gi}} &= (1-t_h)\frac{\partial \pi^s_{Gi}}{\partial p^s_{Gi}} - \alpha^R \left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}}\right)\frac{\partial \pi^R}{\partial p^s_{Gi}} \\
&\quad -\alpha^R \pi^R \left(\frac{(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}} - \frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{(\sum_{i=\{1,2\}} R_{Gi})^2}\right)\frac{\partial R_{Gi}}{\partial p^s_{Gi}} \\
&= (1-t_h)\frac{\partial \pi^s_{Gi}}{\partial p^s_{Gi}} - \alpha^R \left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}}\right)\left(\frac{\partial \pi^s_{Gi}}{\partial p^s_{Gi}} - \alpha^E \frac{\partial R_{Gi}}{\partial p^s_{Gi}}\right) \\
&\quad -\alpha^R \pi^R \left(\frac{(t_i - t_j)R_{Gj}}{\left(\sum_{i=\{1,2\}} R_{Gi}\right)^2}\right)\frac{\partial R_{Gi}}{\partial p^s_{Gi}} = 0 \quad \text{where} \quad j \neq i,
\end{aligned} \tag{14}$$

leading to the best response function of the global firm, given the price setting p^s_{Li} of its local competitor in country i. The first term in the second part of equation (14) represents the marginal after-tax profits from selling in country i, but having all profits taxed in the haven

country h. The other two terms only pop up in case that OECD Pillar One applies, that is, for $s = P$ and $\alpha^R > 0$. The last term in the second-to-last line of equation (14) stems from an incentive to inflate global turnover, and with it routine profits. Doing so allows for sheltering profits from being taxed in market countries at a tax rate $t_i > t_h$. Additionally, the term in the last line of equation (14) highlights that there is an incentive for sales shifting as soon as the market countries have different tax rates. Reducing the sales share of the high-tax country reduces the effective tax rate faced by the global firm under OECD Pillar One. We will analyze the latter two effects in detail in the following section.

First, we solve the maximization problem for the benchmark scenario with pure SA, that is, we solve for the case $s = O$ and $\alpha^R = 0$ (see Appendix A.2 for details). For optimal prices, we obtain

$$\widehat{p}_{Gi}^{O} = \frac{(2+\theta)(1-\theta)a + 2c_G + \theta c_L}{4-\theta^2} \equiv \widehat{p}_{G}^{O} \quad \text{and} \quad \widehat{p}_{Li}^{O} = \frac{(2+\theta)(1-\theta)a + 2c_L + \theta c_G}{4-\theta^2} \equiv \widehat{p}_{L}^{O}. \tag{15}$$

Using the demand functions in equation (2), the optimal prices translate into equilibrium quantities

$$\widehat{x}_{Gi}^{O} = \frac{(2+\theta)(1-\theta)a - (2-\theta^2)c_G + \theta c_L}{(1-\theta^2)(4-\theta^2)} \equiv \widehat{x}_{G}^{O} \quad \text{and} \quad \widehat{x}_{Li}^{O} = \frac{(2+\theta)(1-\theta)a - (2-\theta^2)c_L + \theta c_G}{(1-\theta^2)(4-\theta^2)} \equiv \widehat{x}_{L}^{O}. \tag{16}$$

These equilibrium variables also imply profits in country i of $\widehat{\pi}_{Gi}^{O} = (1-\theta^2)\left(\widehat{x}_{G}^{O}\right)^2$ for the global firm and $\widehat{\pi}_{Li}^{O} = (1-\theta^2)\left(\widehat{x}_{L}^{O}\right)^2$ for the local competitor. Global after-tax profits of the global firm result as $\Pi_{G}^{O} = (1-t_h)\sum_{i=\{1,2\}}(1-\theta^2)\left(\widehat{x}_{G}^{O}\right)^2$. These solutions allow for the comparing of the effect of OECD Pillar One to the benchmark case of pure SA.

4 The effects of OECD Pillar One

In the following, we first discuss the effect of OECD Pillar One in a symmetric setting whereby the market countries are identical. Thereafter, we highlight the impact of sales shifting as soon as the market countries differ in their tax rates.

4.1 Symmetric equilibrium

With OECD Pillar One in place ($\alpha^R > 0$), the last line of the first-order condition (14) still drops to zero for the symmetric case where the market countries are identical and charge the same tax rate $t_1 = t_2 \equiv t$. However, the second term in the second-to-last line becomes active now, and it holds that

$$-\alpha^R \left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}} \right) \left(\frac{\partial \pi_{Gi}}{\partial p^s_{Gi}} - \alpha^E \frac{\partial R_{Gi}}{\partial p^s_{Gi}} \right) = -\frac{\alpha^R (t - t_h)}{2} \left(\frac{\partial \pi_{Gi}}{\partial p^s_{Gi}} - \alpha^E \frac{\partial R_{Gi}}{\partial p^s_{Gi}} \right) < 0, \quad (17)$$

as we show in Appendix A.2. Consequently, this new term works in favor of setting a lower price p^P_{Gi} for the good of the global firm.

Intuitively, the term stems from the incentive to manipulate the level of routine profits $\alpha^E \sum_{i=\{1,2\}} R_{Gi}$ that gets taxed in the haven country only. By reducing the price it asks for its product in both markets, the global firm sells more units in both markets, increases its global turnover, and is allowed to book a larger amount of profits in the haven country. Charging a lower price sacrifices some market power and before-tax profits, but the avoidance of tax payments in the market countries and the resulting increase in after-tax profits make this strategic maneuver profitable.

The structure of the first-order conditions for the local firms remains the same. Therefore, given symmetric local firms, the global firm charges a uniform price in both markets, that is, $\widehat{p}^{PS}_{G1} = \widehat{p}^{PS}_{G2} = \widehat{p}^{PS}_{G}$, where the superscript PS indicates the price under the Pillar One regime (P) in the symmetric case (S). Similarly, the local firms will choose identical prices with $\widehat{p}^{PS}_{L1} = \widehat{p}^{PS}_{L2} = \widehat{p}^{PS}_{L}$. Consequently, the resulting quantities will also be symmetric, that is, $\widehat{x}^{P}_{G1} = \widehat{x}^{P}_{G2} \equiv \widehat{x}^{PS}_{G}$ and $\widehat{x}^{P}_{L1} = \widehat{x}^{P}_{L2} \equiv \widehat{x}^{PS}_{L}$ hold in the equilibrium.

When we solve the response functions for the symmetric equilibrium (see Appendix A.2), we obtain the equilibrium prices and supplies

$$\widehat{p}^{PS}_{G} = \widehat{p}^{O}_{G} - \frac{2c_G\chi}{4-\theta^2} \qquad \text{and} \qquad \widehat{p}^{PS}_{L} = \widehat{p}^{O}_{L} - \frac{\theta c_G\chi}{4-\theta^2}, \quad (18)$$

$$\widehat{x}^{PS}_{G} = \widehat{x}^{O}_{G} + \frac{(2-\theta^2)c_G\chi}{(1-\theta^2)(4-\theta^2)} \qquad \text{and} \qquad \widehat{x}^{PS}_{L} = \widehat{x}^{O}_{L} - \frac{\theta c_G\chi}{(1-\theta^2)(4-\theta^2)}, \quad (19)$$

where $\chi \equiv \frac{\alpha^R\alpha^E(t-t_h)}{1-t_h-\alpha^R(1-\alpha^E)(t-t_h)} > 0$ denotes a Pillar-One adjustment term. This change in the equilibrium supplies is summarized as

Proposition 1. *For symmetric non-haven market countries and price competition, the introduction*

of OECD Pillar One reduces the equilibrium prices of all firms. Pillar One increases the sales of the global firm but decreases the sales of the local firms.

Under OECD Pillar One, all else being equal, the global firm aims for higher sales to inflate global turnover and, by this, lower-taxed routine profits. It achieves this aim by aggressively reducing the price of its product in both markets. As prices are strategic complements,[16] the local competitors respond by lowering their prices as well. They reduce their prices to less than that of the global firm, however, and therefore, they lose sales.

The identified mechanism differs from the standard manipulation of thresholds. Usually, there are local incentives for firms around a threshold to stay below (or above) that threshold just to avoid a situation whereby a (tax) rule becomes binding. Hence, there is some bunching at the threshold. For example, Haufler and Kato (2024) analyze the dynamics of setting the GMT under OECD Pillar Two when firms around the GMT threshold hold back investment to notmerely fall within the scope of the GMT. In contrast, the manipulation of the routine profit threshold of Pillar One happens across the entire range of firms around and above the threshold. All firms that would end up in the scope of Pillar One benefit from inflating their routine profits, regardless of whether this allows them to avoid the application of Pillar One or whether they still fall under the new regime. There is no real bunching around the threshold in Pillar One.

The effects identified in Proposition 1 have important implications that will be relevant for the welfare analysis in Subsection 4.3. In Appendix A.3, we provide the proof.

Proposition 2. *In the symmetric equilibrium, OECD Pillar One decreases the profits of the local firms, increases consumer surplus, and has an ambiguous effect on tax revenues in market countries.*

The fact that the global firm is more price aggressive harms the local competitors: all prices decrease and the demand for the local firms' products decreases as well because the price of the global firm decreases the most. Hence, profits of the local firms decrease.

However, the drop in prices triggered by the introduction of Pillar One implies that consumers benefits. The increase in the consumption of the global firm's product overcompensates for the reduction in demand for that of the local firms, that is, $\left|\widehat{x}_G^S - \widehat{x}_G^O\right| > \left|\widehat{x}_L^S - \widehat{x}_L^O\right|$. Therefore, prices decrease and total sales increase.

[16] Under price competition, the marginal decrease in the global firm's price discourages consumers from purchasing from the local firms, and $-\frac{\partial^2 \pi_{Li}}{\partial p_{Gi} \partial p_{Li}} = -\frac{\partial x_{Li}}{\partial p_{Gi}} < 0$ holds.

Finally, and surprisingly, in our setting, the effects of OECD Pillar One on tax revenues in non-haven market countries are ambiguous and potentially turn negative in some situations. Pillar One affects tax revenue in market countries in two ways: the change in tax revenue ΔTR_i follows from

$$\Delta TR_i \equiv TR_i^{PS} - TR_i^O = t\left[\frac{\alpha^R \pi^R}{2} - (\pi_{Li}^O - \pi_{Li}^{PS})\right].$$

The first term in the bracket represents the tax base that market country i newly obtains from the global firm, whereas the second term shows the change in the (taxable) profits of the local firm. On the one hand, the introduction of Pillar One allows market countries to tax the (digital) global firm (under symmetry, based on half of the residual profits π^R) and collect new tax revenue. On the other hand, however, the fiercer price competition, triggered by Pillar One, decreases the local firm's profits and results in less tax bases of local firms. If the latter effect dominates, OECD Pillar One reduces tax revenues in market countries that do not tax the global firm under SA. Because the local firm loses a lot when the products are similar and the local firm is similarly productive to the global firm, the total change in tax revenue might well be negative for high values of θ (and similar marginal costs across firms, i.e., $c_G \approx c_L$).

In our setting, this ambiguous effect on tax revenue is surprising. In many cases in reality, the global firm is a multinational with several affiliates. For example, Amazon.de and Amazon.nl serve as permanent establishments (or affiliates) in market countries in addition to the sales hub Amazon EU S.à.r.l in Luxembourg. Moreover, large automotive companies will fall under OECD Pillar One. These companies host production facilities in some market countries. In all these cases, the net effect of reshuffling the tax base from production countries to market countries is essentially ambiguous, especially for those that are both production places and market countries. Our focus on "homeless profits" and all the activities of the global firm in the haven country only, eliminates such an ambiguous reallocation of the in-scope firm's tax base (besides avoiding the unsolved issue of double taxation). Yet, the tax revenue effect under OECD Pillar One remains ambiguous for market countries because the global firm's strategic manipulation of routine profits crowds out the domestic tax base.

4.2 Asymmetric equilibrium

Next, we introduce asymmetry between non-haven countries and assume that country 2 imposes a higher tax rate than country 1, that is, $t_2 > t_1$. Formally, the last term in equation (14) comes into play. It punishes sales in the high-tax country, as these sales apportion a larger share of the tax base to the high-tax country. More precisely, the effect calls for a higher price in the high-tax country, all else being equal, because a higher price reduces sales, and with it sales revenues, in that country. By doing so, the weight of the high-tax country in the apportionment formula drops and a lower share of the residual profits under Pillar One is taxed in that country. Analogously, the global firm has an incentive to decrease the price charged in the low-tax market country to boost sales and sales revenue in the latter country. This increases the weight of the low-tax country in the apportionment formula and reduces the total tax burden on residual profits.

Indeed, when we evaluate the first-order condition (14) for optimal prices in the symmetric equilibrium, the new, additional effect turns out as

$$\left.\frac{\partial \Pi_G^P}{\partial p_{G1}^s}\right|_{p_{Gi}=\widehat{p}_G^{PS}, p_{Li}=\widehat{p}_L^{PS}} = \alpha^R \pi^R \left(\frac{(t_2 - t_1) R_{G2}}{\left\{ \sum_{i=\{1,2\}} R_{Gi} \right\}^2} \right) \frac{\partial R_{G1}}{\partial p_{G1}} < 0,$$

$$\left.\frac{\partial \Pi_G^P}{\partial p_{G2}^s}\right|_{p_{Gi}=\widehat{p}_G^{PS}, p_{Li}=\widehat{p}_L^{GS}} = -\alpha^R \pi^R \left(\frac{(t_2 - t_1) R_{G1}}{\left\{ \sum_{i=\{1,2\}} R_{Gi} \right\}^2} \right) \frac{\partial R_{G2}}{\partial p_{G2}} > 0,$$

and the global firm increases its price and decreases its sales to consumers in the high-tax country, compared to the symmetric equilibrium under OECD Pillar One. The opposite holds for price and sales in the low-tax country.

As before in the symmetric equilibrium, the local firms respond with a complementary adjustment: The local firm in the high-tax (low-tax) country also increases (decreases) its price because prices are strategic complements. Formally, by differentiating the best response functions, we obtain the local firms' responses as $\frac{dp_{Li}}{dp_{Gi}} = \frac{\theta}{2} > 0$.

From the demand function in eq.(2) and the local firm's response $dp_{Li} = \frac{\theta}{2} dp_{Gi}$, resulting

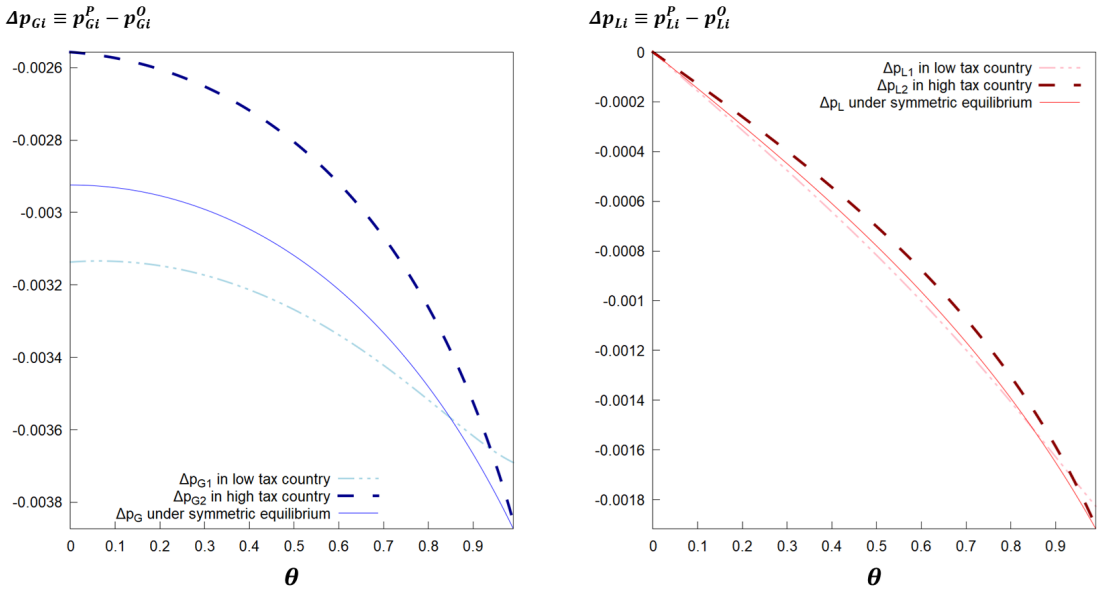

Figure 1: Change in prices by introducing the Pillar One rule

changes in quantities in country i can be summarized as

$$dx^P_{Gi} = \frac{-dp_{Gi} + \theta dp_{Li}}{1-\theta^2} = \frac{-dp_{Gi} + \theta\left(\frac{\theta}{2}dp_{Gi}\right)}{1-\theta^2} = \frac{-(2-\theta^2)dp^P_{Gi}}{2(1-\theta^2)} \tag{20}$$

$$dx^P_{Li} = \frac{-dp_{Li} + \theta dp_{Gi}}{1-\theta^2} = \frac{-\left(\frac{\theta}{2}dp_{Gi}\right) + \theta dp_{Gi}}{1-\theta^2} = \frac{\theta dp^P_{Gi}}{2(1-\theta^2)}. \tag{21}$$

Effectively, OECD Pillar One reallocates the global firm's sales from the high-tax market country 2 to the low-tax market country 1. Subsequently, the local firm in country 1 reduces its sales whereas that in country 2 increases its equilibrium supply. However, the changes by the global firm always dominate. Thus, we summarize as follows:

Proposition 3. *Under price competition and relative to the symmetric equilibrium, a marginal difference in tax rates in non-haven market countries triggers an increase in the prices on digital platforms in the high-tax country and a decrease in those in the low-tax non-haven country. The global firm shifts sales from the high-tax to the low-tax country, and the high-tax country (low-tax country) experiences a larger (less) market inefficiency from imperfect competition and lower (higher) tax revenues, compared to the symmetric equilibrium.*

Fig.1 depicts a numerical example of the effects of a marginal tax difference under Pillar One on the prices of the firms. We set tax rates $t_1 = \{0.29, 0.3\} \leq t_2 = 0.3$. The left-hand panel shows the global firm's response whereas the right-hand one illustrates the responses

of the local firm.[17] In each panel, the thin solid curve shows the change in prices relative to competition intensity θ if each market country imposes the same tax rate $t_1 = t_2 = 0.3$. If country 1 decreases its corporate tax rate by one percentage point and turns into a low-tax market country, the dash-dot curves show the effects of Pillar One on firms' pricing in a low-tax market country, whereas the dashed curves are those in a high-tax market country. In line with Proposition 3, we confirm the predicted changes in prices for the entire range of θ. Only if $\theta = 0$ and all firms are monopolists for their varieties, the local firms will not respond on the price changes by the global firm.

Our results contradict the popular view that sales-based FA is the preferred tax system, as customers are immobile and the sales formula does not trigger any shift in economic activity (see, e.g., Zucman, 2018). This popular view is often applied to OECD Pillar One and its Amount A as well. Our analysis shows that while customers may be immobile, but sales are not as soon as the global (or multinational) firm has market power and can set prices. The resulting shifting of sales is analogous to that of investment in standard FA models (e.g., Nielsen et al., 2010). Actually, our insights on this matter are not brand-new. We generalize the effects of the monopoly setting in Altshuler and Grubert (2010), a clearly undervalued paper in the discussion of (sales-based) FA, to an oligopoly with price competition, and show that the argument also applies to OECD Pillar One. Our findings suggest a positive fiscal externality and challenge the plea for sales-based FA (as a compensation for other apportionment factors) in Eichner and Runkel (2008).

4.3 Welfare

To analyze welfare effects, equation (10) introduces the welfare function as

$$W_i^s = \frac{{x_{Gi}^s}^2 + 2\theta x_{Gi}^s x_{Li}^s + {x_{Li}^s}^2}{2} + m_i + (1 - t_i)\pi_{Li}^s + TR_i^s,$$

consisting of consumer surplus, the profits of the local firm, and tax revenue in a country i. A clear-cut welfare analysis of the introduction of OECD Pillar One is difficult, even in the symmetric case as consumer surplus increases whereas the local firm's profits decrease, and the effect on tax revenues is ambiguous (see Proposition 2). Furthermore, the strength of all the effects in isolation depends on the level of competition θ, that is, how similar the varieties

[17] The following parameters are used: $a = 3$, $c_G = c_L = 1$, $\alpha^E = 0.1$, and $\alpha^R = 0.25$.

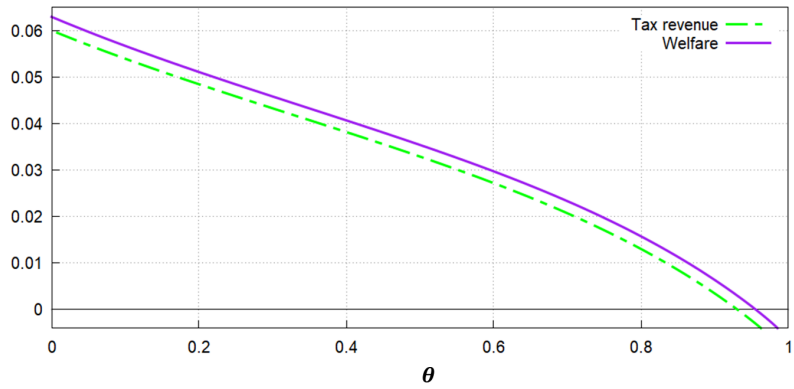

Figure 2: The welfare effects of Pillar One under symmetric equilibrium

offered by the digital platforms are.

Therefore, first, we rely on simulations and return to the symmetric equilibrium first. As a numerical example, the green dash-dot curve in Fig.2 illustrates the effects of Pillar One on tax revenues in symmetric market countries if marginal costs are homogenous, that is, $c_G = c_L = 1$.[18] If the firms are more or less monopolists, there is a substantial increase in tax revenue, but positive tax revenue effect decreases continuously with competition and parameter θ. As shown on the right-hand edge of the horizon, Pillar One reduces tax revenues in market countries when the firms' products are sufficiently similar. This result of a tax revenue loss is notable, particularly because Pillar One was expected to increase tax revenues in market countries. Our numerical analysis, together with Proposition 2, shows that the expected increase requires that the digital firms' products are sufficiently unique and that firms do not intensely compete with each other.

Fig.2 also highlights that the development of welfare runs parallel to that of tax revenue. Per se, it displays an ambiguous total welfare effect. Because Pillar One leads to fiercer price competition and generates large consumers' gains by deviating from the duopoly equilibrium under SA, it is likely that an increase in consumer surplus outweighs the post-tax profits of the local firm. Therefore, the purple curve locates above the green one by the net gains via the consumer and local firm. Although a negative welfare effect is less likely, compared to a negative tax revenue effect, OECD Pillar One can deteriorate welfare in a market country if there is a sufficiently high degree of similarity between online services.

Turning to the asymmetric case, Proposition 3 points out the marginal effects (and mechanisms) that add to the welfare effects under the symmetric case. Analyzing the effects of

[18]The following other parameters are used for the figure: $a = 3$, $t_h = 0.1$ $t_1 = t_2 = 0.3$, $\alpha^E = 0.1$ and $\alpha^R = 0.25$.

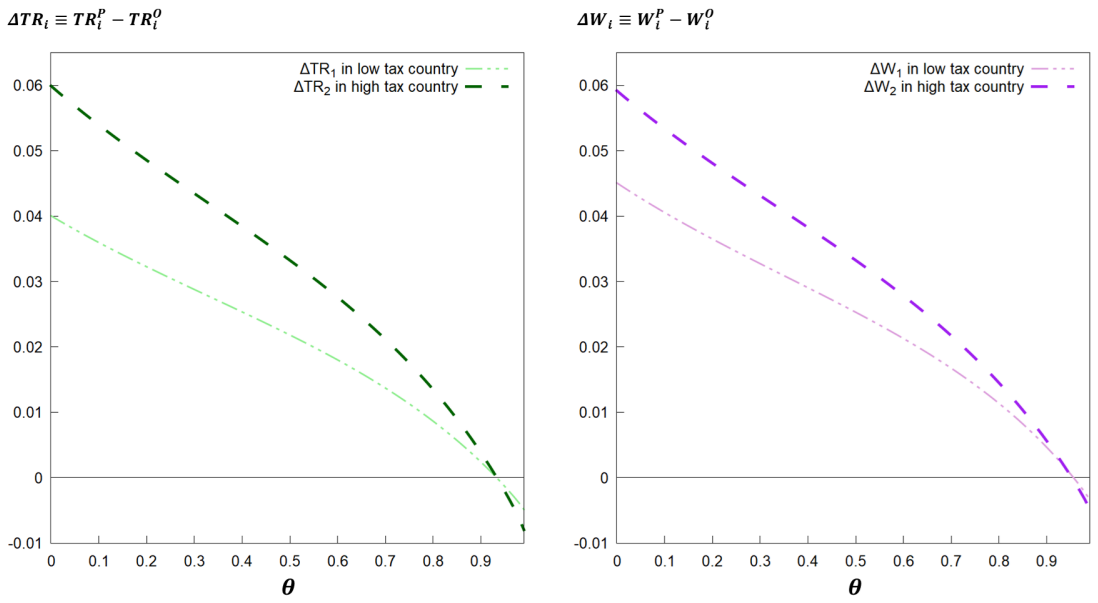

Figure 3: Effects of Pillar One on tax revenues and welfare with $t_1 = 0.2 < 0.3 = t_2$

Pillar One under an inframarginal, substantial tax gap between market countries is complicated, however, and we rely on numerical examples once again. We use the same parameter values, except for the tax rate in country 1, which is set to $t_1 = 0.2$ hereafter.[19]

Fig.3 illustrates the effects of Pillar One on tax revenue and welfare in the asymmetric equilibrium. Analogous to Fig.2, Pillar One has a positive tax revenue and welfare effect when firms are almost monopolists, but these positive effects continuously decrease with an increasing similarity θ of the firms' products. Moreover, unless θ becomes very large, the light-colored curves are below the dark-colored ones, which means that Pillar One tends to benefit the high-tax market country more than the low-tax market country. This surprising result is explained by the still substantial inflow of the tax base to the high-tax country that gets taxed at a significantly higher tax rate than the tax base gains in the low-tax country. In our simple model, this specific revenue effect dominates the distortive effects identified in Proposition 3, unless competition becomes very strong (i.e., θ gets very large).

As Proposition 3 indicates different effects on prices in market countries, it is helpful to examine the effects on consumers and local firms in more detail. Fig.4 depicts the effects of Pillar One on consumer surplus and local firms. Because Pillar One fosters price competition in the low-tax market country and mutes it in the high-tax market country, it is possible that Pillar One benefits the local firm in a high-tax market country but hurts consumers in a high-tax market country, as shown in the right- and left-hand panels. As the figure shows,

[19]The following parameters are used: $a = 3$, $c_G = c_L = 1$, $\alpha^E = 0.1$, and $\alpha^R = 0.25$.

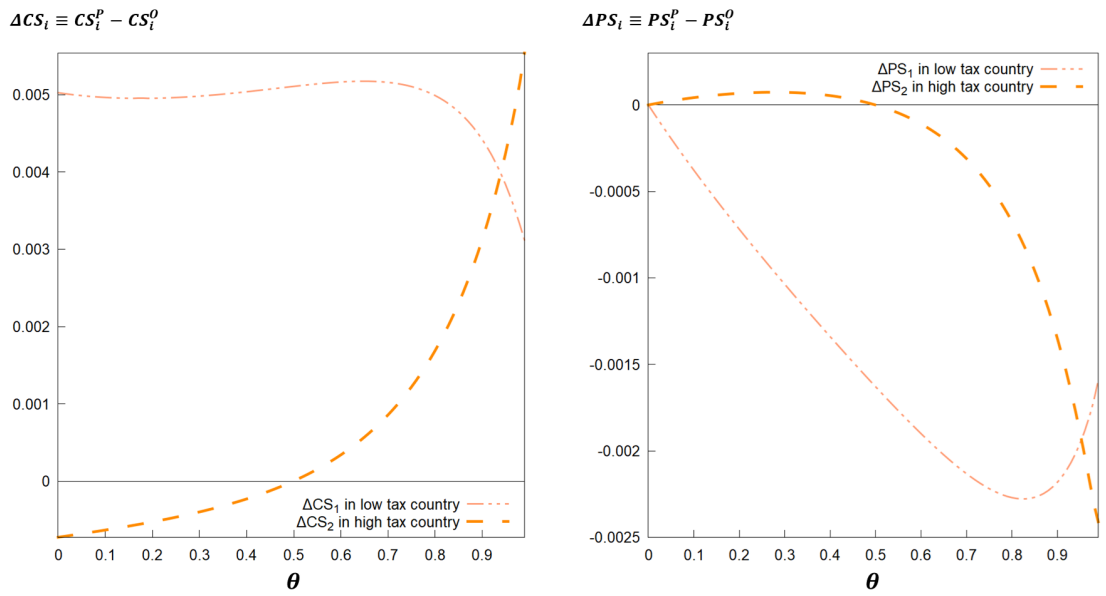

Figure 4: Effects of Pillar One on CS (left panel) and PS (right panel) with $t_1 = 0.2 < 0.3 = t_2$

such new effects occur when firms supply differentiated services. If firms supply really differentiated services, then the global firm's response under symmetric equilibrium does not significantly affect the local firm. Moreover, a tax gap between market countries mitigates price competition in a high-tax market country, and this price adjustments across countries can be the main effect. Similarly, such high prices in a high-tax market country 2 can hurt consumers. These results provide different policy implications for countries: a government in a low-tax market country should design some policy to protect its local online firm whereas that in a high-tax market country should propose a policy to foster online market competition to secure consumers' benefits.

What follows from our welfare analysis and why does OECD Pillar One not get ratified by the countries that have originally endorsed the initiative? In our model, the production country loses substantially in the tax revenue and profits of the global firm. However, our production country is a pure tax haven, and tax havens do not matter much in the public discourse, while seemingly lacking much decision power in multilateral agreements any longer. In contrast, all our market countries experience a sizable welfare increase as long as there is some relevant differentiation in the varieties offered by our platform firms. Based on these findings, all non-haven countries should be happy to embrace OECD Pillar One.

Such a conclusion would, however, be premature, as our model simplifies the relevant aspects of reality. First, the dominating part of the welfare effect is the sizable, infra-marginal

gain in tax revenue for market countries that could not claim any tax base on the global firm before. This model assumption helps highlight the case of pure "homeless profits"; however in reality, many firms that would be in the scope of OECD Pillar One host production facilities also in market countries. For these countries, there is a redistribution between taxing rights under pure SA and the reallocation of tax bases under Pillar One. Any production country for which the in-scope firms are net exporters will lose their tax base under Pillar One. This makes the new tax regime much less attractive for these countries, all else being equal.

Second, our welfare function rests on the quasi-linear utility function of a representative consumer and weighs all components equally, effectively measuring pure economic efficiency. Our results, however, show that various offsetting effects are triggered by OECD Pillar One. Manipulating routine profits by inflating sales revenues benefits consumers in all countries. In contrast, sales shifting from high- to low-tax countries fosters consumers' benefits in low-tax countries, whereas it causes utility losses for consumers in high-tax countries. The development of producer rents for local firms is the mirror image of these effects. The change in the profits of local firms also mitigates the revenue effects from the reshuffling of the tax bases of in-scope firms. Allowing for heterogeneous individuals, where only a part of society owns the local firms, and putting different social welfare weights on different components of the welfare function will affect the net result of OECD Pillar One. Third, our model fully neglects the highly likely sizable compliance costs that Pillar One causes and the still largely unsolved problem of avoiding double taxation when integrating Pillar One with the existing corporate tax system. Fourth, we treat tax rates as exogenous. For a total welfare analysis, taking the optimal adjustment of tax rates into account will be necessary. For example, sales shifting creates an incentive for tax competition to attract sales and tax bases. In sum, our welfare results should be seen as a first starting point for a rigorous welfare analysis in future research.

5 Conclusion

The OECD has proposed a Pillar One tax system for very large (global or multinational) companies to reallocate tax base to where markets and customers are. One main aim is to tackle "homeless profits" that are often earned without physical presence in market countries. To achieve this aim, Pillar One rests on a partial FA system where the only allocation key will be a country's share of sales in the total turnover of an in-scope firm. Surprisingly, different

from the GMT (Pillar Two), Pillar One has not yet been ratified by any sizable country yet, and the incentives, mechanisms, and effects coming from the reallocation of tax bases have not been carefully analyzed to date.

Our paper sets up a simple model of digital platform firms that conduct business-to-customer trade in which a global firm hosts all economic activities in a tax haven. The global firm sells, however, in market countries where it faces price competition from local firms. Our results identify two main effects. First, firms under Pillar One have an incentive to manipulate what is taxed as routine profits in production countries. They can do so by inflating their turnover, that is, by being more price aggressive in market countries and fostering their sales. This effect mitigates the market inefficiencies deriving from imperfect competition, but it costs market countries sizable tax revenue. Second, in-scope firms have an incentive to increase prices in the high-tax countries and lower prices in low-tax countries. With this strategy, they can shift sales to low-tax countries and manipulate the sales-based FA component to their benefit. All else being equal, high-tax countries face lower tax revenues and larger market inefficiencies, whereas low-tax countries gain on these aspects. This result generalizes insights in Altshuler and Grubert (2010) to oligopolistic competition and the Pillar One setting.

As a first welfare result, our simulations show that all market countries still benefit as long as the traded varieties are somewhat differentiated. The high-tax countries gain even the most, as the infra-marginal reallocation of tax base trumps all the other effects in our simple model. However, our analysis shows that there are several offsetting effects compete with each other. As our welfare function uses equal weights for all of them, relies on a representative consumer, and effectively measures market efficiency only, our welfare findings need to be interpreted with caution as they neglect important aspects. We also overlook the fact that some market countries are still production countries and will experience a directly negative effect from reallocating residual profits. Therefore, a more elaborated analysis of the welfare effects in future research will be important to understand why the Pillar One proposal has not yet received much support.

Appendix

A.1. Derivation of the demand function and social welfare function

With the utility function defined in eq.(1), solving the utility maximization problem of the representative consumers yields the following inverse demand function for a good supplied by each firm:

$$p_{Gi} = a - x_{Gi} - \theta x_{Li}, \quad \text{and} \quad p_{Li} = a - x_{Li} - \theta x_{Gi} \tag{A-01}$$

The two equations of the inverse demand function can be transformed into the following demand function for each product;

$$x_{Gi} = \frac{(1-\theta)a - p_{Gi} + \theta p_{Li}}{1-\theta^2} \qquad \text{and} \qquad x_{Li} = \frac{(1-\theta)a - p_{Li} + \theta p_{Gi}}{1-\theta^2}. \tag{A-02}$$

Furthermore, we can rewrite the expression for firm G (and, analogously, firm L) as follows:

$$\begin{aligned} x_{Gi} &= \frac{(1-\theta)a - p_{Gi} + \theta p_{Li}}{1-\theta^2} = \frac{(1-\theta)a - (1-\theta)p_{Gi} + \theta(p_{Li} - p_{Gi})}{1-\theta^2} \\ &= \frac{a}{1+\theta} - \frac{p_{Gi}}{1+\theta} + \frac{\theta(p_{Li} - p_{Gi})}{1-\theta^2}. \end{aligned} \tag{A-03}$$

We can confirm that the demand function is independent of the local firm's good when $\theta = 0$, which leading to a monopoly case. On the contrary, it approaches perfect competition as θ gets close to unity, because the coefficient of the last term becomes infinity and the differences in prices shape the size of demands.

Here, we derive the social welfare function from eq.(1). Note that the utility maximization problem results in the optimal consumption on the numéraire good as $z_i^{*s} = m_i + (1-t_i)\pi_{Li}^s + TR_i^s - p_{Gi}^s x_{Gi}^s - p_{Li}^s x_{Li}^s$. Therefore, plugging z_i^* and eq.(A-01) into eq.(1) yields the social welfare

function $W_i^s \equiv u_i^s(z_i^{*s})$ as follows:

$$
\begin{aligned}
W_i^s &= a(x_{Gi}^s + x_{Li}^s) - \frac{{x_{Gi}^s}^2 + 2\theta x_{Gi}^s x_{Li}^s + {x_{Li}^s}^2}{2} + \{m_i + (1-t_i)\pi_{Li}^s + TR_i^s - p_{Gi}^s x_{Gi}^s - p_{Li}^s x_{Li}^s\} \\
&= a(x_{Gi}^s + x_{Li}^s) - \frac{{x_{Gi}^s}^2 + \theta x_{Gi}^s x_{Li}^s + \theta x_{Gi}^s x_{Li}^s + {x_{Li}^s}^2}{2} - p_{Gi}^s x_{Gi}^s - p_{Li}^s x_{Li}^s + m_i + (1-t_i)\pi_{Li}^s + TR_i^s \\
&= x_{Gi}^s \left(a - \frac{x_{Gi}^s + \theta x_{Li}^s}{2} - p_{Gi}^s \right) + x_{Li}^s \left(a - \frac{\theta x_{Gi}^s + x_{Li}^s}{2} - p_{Li}^s \right) + m_i + (1-t_i)\pi_{Li}^s + TR_i^s \\
&= x_{Gi}^s \left(a - \frac{x_{Gi}^s + \theta x_{Li}^s}{2} - (a - x_{Gi}^s - \theta x_{Li}^s) \right) + x_{Li}^s \left(a - \frac{\theta x_{Gi}^s + x_{Li}^s}{2} - (a - x_{Li}^s - \theta x_{Fi}^s) \right) \\
&\qquad + m_i + (1-t_i)\pi_{Li}^s + TR_i^s \\
&= x_{Gi}^s \left(\frac{x_{Gi}^s + \theta x_{Li}^s}{2} \right) + x_{Li}^s \left(\frac{\theta x_{Gi}^s + x_{Li}^s}{2} \right) + m_i + (1-t_i)\pi_{Li}^s + TR_i^s \\
&= \frac{{x_{Gi}^s}^2 + 2\theta x_{Gi}^s x_{Li}^s + {x_{Li}^s}^2}{2} + m_i + (1-t_i)\pi_{Li}^s + TR_i^s. \qquad \text{(A-05)}
\end{aligned}
$$

A.2. Derivation of the equilibrium price and quantities under the benchmark model and symmetric case

The first-order condition for the local firm's price, as shown in eq.(12), yields the following best response function:

$$
\begin{aligned}
\frac{\partial \Pi_{Li}^s}{\partial p_{Li}^s} = (1-t_i)\left[x_{Li}^s + (p_{Li}^s - c_L)\frac{\partial x_{Li}^s}{\partial p_{Li}^s} \right] &\propto \frac{(1-\theta)a - p_{Li} + \theta p_{Gi}}{1-\theta^2} - \left(\frac{p_{Li} - c_L}{1-\theta^2} \right) = 0 \\
\iff p_{Li} &= \frac{(1-\theta)a + \theta p_{Gi} + c_L}{2}. \qquad \text{(A-06)}
\end{aligned}
$$

Additionally, that for the global firm is presented in eq.(14)

$$
\begin{aligned}
\frac{\partial \Pi_G^P}{\partial p_{Gi}^s} = (1-t_h)\frac{\partial \pi_{Gi}^s}{\partial p_{Gi}^s} - \alpha^R \left(\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}} \right) \left(\frac{\partial \pi_{Gi}^s}{\partial p_{Gi}^s} - \alpha^E \frac{\partial R_{Gi}}{\partial p_{Gi}^s} \right) \\
- \alpha^R \pi^R \left(\frac{(t_i - t_j)R_{Gj}}{\left(\sum_{i=\{1,2\}} R_{Gi} \right)^2} \right) \frac{\partial R_{Gi}}{\partial p_{Gi}^s} = 0 \quad \text{where} \quad j \neq i.
\end{aligned}
$$

If the tax rate in the market countries are the same, that is, $t_1 = t_2 \equiv t$, the second line vanishes. Note also that the assumption of symmetric countries makes the revenues from each country the same, that is, $R_{G1} = R_{G2}$. This means $\frac{\sum_{i=\{1,2\}} R_{Gi}(t_i - t_h)}{\sum_{i=\{1,2\}} R_{Gi}} = \frac{t - t_h}{2}$. Therefore, the

first-order condition is reexpressed as,

$$\begin{aligned}
\frac{\partial \Pi_G}{\partial p_{Gi}} &= \left(1 - t_h - \frac{\alpha^R(t-t_h)}{2}\right)\frac{\partial \pi_{Gi}}{\partial p_{Gi}} + \left(\frac{\alpha^R\alpha^E(t-t_h)}{2}\right)\left(\frac{\partial R_{Gi}}{\partial p_{Gi}}\right) \\
&= \left(1 - t_h - \frac{\alpha^R(t-t_h)}{2}\right)\left(\frac{(1-\theta)a - p_{Gi} + \theta p_{Li}}{1-\theta^2} - \left(\frac{p_{Gi} - c_G}{1-\theta^2}\right)\right) \\
&\qquad + \left(\frac{\alpha^R\alpha^E(t-t_h)}{2}\right)\left(\frac{(1-\theta)a - p_{Gi} + \theta p_{Li}}{1-\theta^2} - \left(\frac{p_{Gi}}{1-\theta^2}\right)\right) \\
&= \left\{2(1-t_h) - \alpha^R(t-t_h)\right\}\left\{(1-\theta)a - 2p_{Gi} + \theta p_{Li} + c_G\right\} \\
&\qquad + \alpha^R\alpha^E(t-t_h)\left\{(1-\theta)a - 2p_{Gi} + \theta p_{Li}\right\} \\
&= \left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}\left\{(1-\theta)a - 2p_{Gi} + \theta p_{Li}\right\} \\
&\qquad + \left\{2(1-t_h) - \alpha^R(t-t_h)\right\}c_G = 0
\end{aligned} \tag{A-07}$$

By substituting eq.(A-06) into eq.(A-07), we have

$$\begin{aligned}
&\frac{\partial \Pi_G}{\partial p_{Gi}} = \left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}\left\{(1-\theta)a - 2p_{Gi} + \theta\left(\frac{(1-\theta)a + \theta p_{Gi} + c_L}{2}\right)\right\} \\
&\qquad + \left\{2(1-t_h) - \alpha^R(t-t_h)\right\}c_G = 0 \\
&\rightarrow \left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}\left\{(2+\theta)(1-\theta)a - (4-\theta^2)p_{Gi} + \theta c_L\right\} \\
&\qquad + 2\left\{2(1-t_h) - \alpha^R(t-t_h)\right\}c_G = 0 \\
&\rightarrow p_{Gi} = \frac{\left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}\left\{(2+\theta)(1-\theta)a + \theta c_L\right\} + 2\left\{2(1-t_h) - \alpha^R(t-t_h)\right\}c_G}{\left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}(4-\theta^2)}.
\end{aligned} \tag{A-08}$$

Note that, if $\alpha^R = 0$ holds, that is, the case without the Pillar One rule, we have the equilibrium price of the global firm in the absence of the Pillar One rule:

$$\widehat{p}^O_{Gi} = \frac{(2+\theta)(1-\theta)a + \theta c_L + 2c_G}{(4-\theta^2)}. \tag{A-09}$$

Moreover, if $\alpha^R > 0$ holds, eq.(A-08) shows the equilibrium price of the global firm in the presence of Pillar One. By using eq.(A-09), we obtain

$$\begin{aligned}
\widehat{p}^s_G &= \widehat{p}^O_{Gi} - \widehat{p}^O_{Gi} + \frac{\left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}\left\{(2+\theta)(1-\theta)a + \theta c_L\right\} + 2\left\{2(1-t_h) - \alpha^R(t-t_h)\right\}c_G}{\left\{2(1-t_h) - \alpha^R(1-\alpha^E)(t-t_h)\right\}(4-\theta^2)} \\
&= \widehat{p}^O_{Gi} - \frac{2c_G\chi}{4-\theta^2} \qquad \text{where} \qquad \chi \equiv \frac{(t-t_h)\alpha^E\alpha^R}{1-t_h+(t-t_h)(1-\alpha^E)\alpha^R} > 0
\end{aligned} \tag{A-10}$$

From eqs.(A-06) and (A-10), we can derive the equilibrium price of the local firms as

$$\begin{aligned}
\widehat{p}^{s}_{Li} &= \frac{(1-\theta)a + \theta\widehat{p}^{S}_{Gi} + c_L}{2} = \frac{(1-\theta)a + \theta\widehat{p}^{O}_{Gi} + c_L}{2} - \frac{\theta c_G \chi}{4-\theta^2} \\
&= \frac{(1-\theta)a + \theta\frac{(2+\theta)(1-\theta)a+\theta c_L+2c_G}{(4-\theta^2)} + c_L}{2} - \frac{\theta c_G \chi}{4-\theta^2} \\
&= \frac{(1-\theta)(4-\theta^2)a + \theta\{(2+\theta)(1-\theta)a + \theta c_L + 2c_G\} + c_L(4-\theta^2)}{2(4-\theta^2)} - \frac{\theta c_G \chi}{4-\theta^2} \\
&= \frac{2(1-\theta)(2+\theta)a + 2\theta c_G + 4c_L}{2(4-\theta^2)} - \frac{\theta c_G \chi}{4-\theta^2} \\
&= \frac{(1-\theta)(2+\theta)a + \theta c_G + 2c_L}{4-\theta^2} - \frac{\theta c_G \chi}{4-\theta^2}. \qquad \text{(A-11)}
\end{aligned}$$

Recall again, that the absence of Pillar One holds under $\alpha^R = 0$, that is, $\chi = 0$. Thus, the first term is equal to $\widehat{p}^{O}_{Li}$ and the eq.(A-11) is $\widehat{p}^{P}_{Li}$.

Note that, because $\frac{\partial \pi^{O}_{Gi}}{\partial p^{O}_{Gi}} = x^{O}_{Gi} + \left(p^{O}_{Gi} - c_G\right)\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}} = 0$ and $\frac{\partial R^{O}_{Gi}}{\partial p^{O}_{Gi}} = x^{O}_{Gi} + p^{O}_{Gi}\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}}$ hold,

$$\frac{\partial \pi^{O}_{Gi}}{\partial p^{O}_{Gi}} = \frac{\partial R^{O}_{Gi}}{\partial p^{O}_{Gi}} - c_G\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}} = 0 \rightarrow \frac{\partial R^{O}_{Gi}}{\partial p^{O}_{Gi}} = c_G\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}} < 0 \qquad \text{(A-12)}$$

also holds because of $\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}} < 0$. In addition, as $\frac{\partial \pi^{P}_{Gi}}{\partial p^{P}_{Gi}} = \frac{\alpha^R\alpha^E(t-t_h)}{2}\frac{\partial R^{P}_{Gi}}{\partial p^{P}_{Gi}} = \frac{\alpha^R\alpha^E(t-t_h)c_G}{2}\frac{\partial x^{O}_{Gi}}{\partial p^{O}_{Gi}} < 0$ at p^{O}_{G} and $\frac{\partial^2 \pi_{Gi}}{\partial p^2_{Gi}} = -2\frac{\partial x^{s}_{Gi}}{\partial p_{Gi}} < 0$ hold, we can conclude that

$$-\left(\frac{\alpha^R(t-t_h)}{2}\right)\left(\frac{\partial \pi^{P}_{Gi}}{\partial p^{P}_{Gi}} - \alpha^E\frac{\partial R_{Gi}}{\partial p^{P}_{Gi}}\right) < 0, \qquad \text{(A-13)}$$

and the downward pressure on the price for the global firm is confirmed.

Additionally, by substituting the equilibrium prices into the demand function, we derive the following equilibrium consumption of the local firm's good:

$$\begin{aligned}
\widehat{x}^{s}_{Li} &= \frac{(1-\theta)a - \widehat{p}^{s}_{Li} + \theta\widehat{p}^{s}_{Gi}}{1-\theta^2} = \frac{(1-\theta)a - \widehat{p}^{O}_{Li} + \theta\widehat{p}^{O}_{Gi}}{1-\theta^2} + \frac{1}{1-\theta^2}\left(\frac{\theta c_G \chi}{4-\theta^2} - \frac{2\theta c_G \chi}{4-\theta^2}\right) \\
&= \frac{(1-\theta)a - \left(\frac{(1-\theta)(2+\theta)a+\theta c_G+2c_L}{4-\theta^2}\right) + \theta\left(\frac{(2+\theta)(1-\theta)a+\theta c_L+2c_G}{(4-\theta^2)}\right)}{1-\theta^2} - \frac{\theta c_G \chi}{(1-\theta^2)(4-\theta^2)} \\
&= \frac{(1-\theta)(2+\theta)a + \theta c_G - (2-\theta^2)c_L}{(1-\theta^2)(4-\theta^2)} - \frac{\theta c_G \chi}{(1-\theta^2)(4-\theta^2)}. \qquad \text{(A-12)}
\end{aligned}$$

Analogously, we have,

$$\begin{aligned}\widehat{x}^s_{Gi} &= \frac{(1-\theta)a - \widehat{p}^s_{Gi} + \theta\widehat{p}^s_{Li}}{1-\theta^2} = \frac{(1-\theta)a - \widehat{p}^O_{Gi} + \theta\widehat{p}^O_{Li}}{1-\theta^2} + \frac{1}{1-\theta^2}\left(\frac{2c_G\chi}{4-\theta^2} - \frac{\theta^2 c_G\chi}{4-\theta^2}\right) \\ &= \frac{(1-\theta)a - \left(\frac{(1-\theta)(2+\theta)a+\theta c_L+2c_G}{4-\theta^2}\right) + \theta\left(\frac{(2+\theta)(1-\theta)a+\theta c_G+2c_L}{(4-\theta^2)}\right)}{1-\theta^2} + \frac{(2-\theta^2)c_G\chi}{(1-\theta^2)(4-\theta^2)} \\ &= \frac{(1-\theta)(2+\theta)a + \theta c_L - (2-\theta^2)c_G}{(1-\theta^2)(4-\theta^2)} + \frac{(2-\theta^2)c_G\chi}{(1-\theta^2)(4-\theta^2)}. \end{aligned} \tag{A-13}$$

A.3 Proof of Proposition 2

Let CS^s_i be the consumer surplus in country i under scheme s. Then, the effect of Pillar One on consumer surplus $\Delta CS_i \equiv CS^{PS}_i - CS^O_i$ is computed as

$$\begin{aligned}\Delta CS_i &= \frac{x^{PS}_{Gi}{}^2 + 2\theta x^{PS}_{Gi}x^{PS}_{Li} + x^{PS}_{Li}{}^2}{2} - \frac{x^{O}_{Gi}{}^2 + 2\theta x^{O}_{Gi}x^{O}_{Li} + x^{O}_{Li}{}^2}{2} \\ &= \frac{c_G\chi}{2(1-\theta^2)(4-\theta^2)}\left(2(1-\theta^2)(2x^O_{Gi} + \theta x^O_{Li}) + \frac{c_G\chi(4-3\theta^2+\theta^4)}{(1-\theta^2)(4-\theta^2)}\right) > 0 \end{aligned} \tag{A-14}$$

which shows that consumers gain from the introduction of OECD Pillar One.

Next, we can derive the effects of OECD Pillar One on local firms as follows:

$$\begin{aligned}\Delta\Pi_{Li} \equiv \Pi^{PS}_{Li} - \Pi^O_{Li} &= (1-t_i)(1-\theta^2)\{(\widehat{x}^{PS}_L)^2 - (\widehat{x}^O_L)^2\} \\ &= (1-t_i)(1-\theta^2)(\widehat{x}^{PS}_L + \widehat{x}^O_L)(\widehat{x}^{PS}_L - \widehat{x}^O_L) < 0. \end{aligned} \tag{A-15}$$

The last inequality holds because $\widehat{x}^{PS}_L < \widehat{x}^O_L$ holds.

Finally, the tax effects of OECD Pillar One are formulated as

$$\Delta TR_i \equiv TR^{PS}_i - TR^O_i = t\left[\frac{\alpha^R\pi^R}{2} - (\pi^O_{Li} - \pi^{PS}_{Li})\right] = t\left[\frac{\alpha^R\pi^R}{2} - (\widehat{x}^O_L + \widehat{x}^{PS}_L)(\widehat{x}^O_L - \widehat{x}^{PS}_L)\right].$$

Although the first term in the parentheses is positive, but the second term is negative, and the sign is ambiguous. Our numerical analysis, depicted by Fig.2, shows that the tax effects can be either positive or negative. This proves Proposition 2. □

References

Altshuler, R., and H. Grubert, 2010. Formula Apportionment: Is It Better than the Current System and Are There Better Alternatives? National Tax Journal 63, 1145 – 1148.

Barake, M., and E. Le Pouhaër, 2024. Tax revenue from Pillar One Amount A: Country-by-country estimates. International Tax and Public Finance, 1-61.

Beer, S., R. de Mooij, S. Hebous, M. Keen, and L. Liu, 2023. Exploring Residual Profit Allocation. American Economic Journal: Economic Policy 15, 70 – 109.

Choné, P., and L. Linnemer 2020. Linear demand systems for differentiated goods: Overview and user's guide. International Journal of Industrial Organization 73, 102663.

Dixit, A, 1979. "A model of duopoly suggesting a theory of entry barriers." The Bell Journal of Economics, 20-32.

Devereux, M. P., and M. Simmler, 2021. Who will pay Amount A?. No. 36. EconPol Policy Brief 36, vol.5, European Network of Economic and Fiscal Policy Research.

Eichfelder, S., F. Hechtner, and J. Hundsdoerfer, 2018. Formula Apportionment: Factor Allocation and Tax Avoidance. European Accounting Review 27, 649 – 681.

Eichner, T., and M. Runkel, 2008. Why the European Union Should Adopt Formula Apportionment with a Sales Factor. Scandinavian Journal of Economics 110, 567 – 589.

Giroud, X., and J. Rauh, 2019. State Taxation and the Reallocation of Business Activity: Evidence from Establishment-level Data. Journal of Political Economy 127, 1262 – 1316.

Goolsbee, A., and E.L. Maydew, 2000. Coveting Thy Neighbor's Manufacturing: The Dilemma of State Income Apportionment. Journal of Public Economics 75, 125 – 143.

Gordon, R., and J.D. Wilson, 1986. An Examination of Multijurisdictional Corporate Income Taxation under Formula Apportionment. Econometrica 54, 1357 – 1373.

Haufler, A., and H. Kato, 2024. A Global Minimum Tax for Large Firms Only: Implications for Tax Competition. CESifo Working Paper No. 11087.

Hebous, S., and M. Keen, 2023. Pareto-Improving Minimum Corporate Taxation. Journal of Public Economics 225, 104952.

Heckemeyer, J., I. Schulz, C. Spengel, and S. Winter, 2024. The Digital Economy, Global Tax Reforms and Developing Countries–An Evaluation of Pillar I and Art. 12B UN Model. ZEW-Centre for European Economic Research Discussion Paper, (24-022).

Janeba, E., and G. Schjelderup, 2023. The Global Minimum Tax Raises More Revenues than You Think, or Much Less. Journal of International Economics 145, 103837.

Johannesen, N., 2022. The Global Minimum Tax. Journal of Public Economics 212, 104709.

Johansson, Å., Ø.B. Skeie, S. Sorbe, and C. Menon. 2017. Tax Planning by Multinational Firms: Firm-level Evidence from a Cross-country Database. OECD Economics Departments Working Papers No. 1358.

Keen, M., and K.A. Konrad, 2013. The Theory of International Tax Competition and Coordination. In: A.J. Auerbach, R. Chetty, M. Feldstein, and E. Saez (eds.), Handbook of Public Economics, Volume 5. Elsevier, Amsterdam, 257 – 328.

Melitz, M.J., and S.J. Redding, 2014. Heterogeneous firms and trade. In: Gopinath, G., Helpman, E., Rogoff, K. (Ed.), Handbook of international economics, vol. 4. Elsevier, Amsterdam. Chapter 1.

Nielsen, S.B., P. Raimondos-Møller, and G. Schjelderup, 2010. Company Taxation and Tax Spillovers: Separate Accounting versus Formula Apportionment. European Economic Review 54, 121 – 132.

OECD, 2023. Multilateral Convention to Implement Amount A of Pillar One. Paris: OECD Publishing.

Riedel, N., 2010. The Downside of Formula Apportionment: Evidence on Factor Demand Distortions. International Tax and Public Finance 17, 236 – 258.

Schjelderup, G., and F. Stähler, 2023. The Economics of the Global Minimum Tax. International Tax and Public Finance 31, 935 – 952.

Singh, N., and X. Vives, 1984. "Price and quantity competition in a differentiated duopoly." The Rand journal of economics, 546-554.

Stead, J., 2021. Taxing Digital Economies. In: OECD (ed.), OECD Development Co-operation Report 2021: Shaping a Just Digital Transformation. Paris: OECD Publishing.

Weiner, J., 1994. Company Taxation for the European Community. How Sub-national Tax Variation Affects Business Investment in the United States and Canada. Ph.D. Dissertation. Harvard University.

Zucman, G., 2018. Taxing Multinational Corporations in the 21st Century. Econfip Research Brief September 2018.