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TAXATION AND MULTI-SIDED PLATFORMS: A REVIEW

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Abstract

Many of the largest and most influential industries in the global economy operate digitally as multi-sided platforms, catering to different groups who are connected through intergroup network effects. This paper provides a survey of the literature on the effects of taxing these firms via indirect and corporate taxes. It seeks to establish an understanding of why traditional insights from taxation in one-sided markets may not apply to firms in multi-sided markets. Indeed, governments risk implementing counterproductive tax policies in multi-sided markets if they base their strategies on what constitutes efficient taxation in traditional markets.

Key Words: Keywords: multisided platforms, taxation, imperfect competition

JEL Classification: D4, D43, H21, H22, L13

1 Introduction

The digital economy refers to an economic system that is based on digital computing technologies. It encompasses a wide range of economic activities that use digitized information and knowledge as essential factors of production. Key aspects of the digital economy include E-Commerce, digital marketing, and online services delivered over the internet (streaming media, online banking, cloud computing services, and more). In addition, mobile technologies (smartphones, for example), digital content creation (videos, music, e-books, and online articles) and data analytics are key elements of the digital economy.²

Many of the largest and most influential industries in the global economy operate digitally, with transactions conducted over the internet. Understanding the behavior of such companies and their responses to public policy is crucial, especially given their rapid expansion and growing importance. However, it is important to distinguish between traditional e-commerce firms, which primarily use the internet to sell goods, and multi-sided platforms. The latter are unique in that they serve different groups, whose interactions are mutually reinforced by intergroup network effects. These platforms maximize profits by strategically nurturing and facilitating value-

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² See, e.g., TechTarget ([What is the Digital Economy? | Definition from TechTarget](#)).

generating interactions between customer groups, often responding to policy changes in ways that diverge significantly from firms in traditional, one-sided markets.³

The media industry (TV, Radio, newspapers, magazines, and news web portals) is an example of a multi-sided industry. A newspaper serves at least two distinct groups of customers; readers and advertisers. Readers derive a direct benefit from consuming the media content, whilst advertisers derive an indirect benefit by reaching potential customers from the group of readers. Other examples of multi-sided industries and products are payment cards (merchants and cardholders), social media platforms (e.g., GOOGLE, Facebook, Instagram and X; users and advertisers), search engines (e.g., Chrome; users and advertisers) and hardware and software systems (Mac OS, Windows; developers and end users).⁴

There are important similarities and differences between digital platforms and traditional multi-sided platforms. Both act as intermediaries between distinct customer groups, with profitability often depending on how effectively they internalize the externalities between these groups. However, they may differ significantly in scale adjustment, interactivity, data use, and the nature and size of network effects. Digital platforms generally exhibit stronger, more scalable network effects, often including direct network effects within each user group. For example, the value of joining platforms like Facebook and X increases as more consumers use them, whereas reading the paper edition of The New York Times does not depend on how many others are reading it.⁵ Additionally, network effects for digital platforms are typically global, allowing for rapid scaling in response to market shifts. Traditional platforms, in contrast, tend to be more local or regional and are often less scalable, particularly in the short term.

Because digital platforms often have a global reach and can operate across countries without requiring physical infrastructure, they can largely base their activities in low-tax jurisdictions while exporting services online. They also enjoy a cost advantage over traditional platforms, as content can be deployed across regions at minimal additional cost, as with Google's Chrome browser. Another key difference is the ability of digital platforms to leverage user data to track behavior, interactions, and preferences. This data enables them to personalize experiences, target ads more effectively, and optimize algorithms. Traditional platforms have much more limited capacity to collect data for content or ad personalization.

³ The definition of multi-sided markets is discussed in research contributions by Rochet and Tirole (2003, 2004, 2006), Caillaud and Jullien (2003), Armstrong (2006) and Weyl (2010).

⁴ In an early contribution Evans (2003) provided a range of examples and classifications of multi-sided markets.

⁵ This might differ slightly for the digital edition of The New York Times; many find it valuable to view and engage with comments from others. All else equal, this value increases with the newspaper's readership size.

In this paper, we explore existing research on the implications of taxing products offered by multi-sided platforms. A notable insight from the literature is that traditional public finance principles suggesting that the tax burden depends on the relative elasticity of supply and demand on each product may not apply. In fact, higher taxation on goods in multi-sided markets does not always negatively impact consumer purchasing behavior. This insight has implications for how we should expect tax changes to affect welfare and it challenges the arguments put forward in favor of uniform taxation. It also has profound policy implication for some tax-sheltered industries such as media firms (say, newspapers). Many countries have given some industries preferential tax treatment in the form of lower value added tax rates or even exemption from commodity taxation to stimulate their sales.⁶ The literature, however, demonstrates that preferential tax treatment towards certain customer groups served by multi-sided platforms may have counter-productive effects. Lowering the VAT rate on newspapers, for instance, might increase the price and reduce the circulation.

The complexity of taxing multi-sided platforms is further compounded by the fact that they frequently operate on an international scale with subsidiaries worldwide. Variations in corporate tax rates across different nations may influence their pricing strategies. Moreover, multi-sided platform corporations often employ transfer pricing as a mechanism to shift profits to jurisdictions with lower tax rates. The interplay of disparate corporate tax environments, profit shifting strategies, and the inherent multi-sided nature of these businesses adds a layer of complexity to the formulation and implementation of effective public policy.

2 Variety of business models for digital firms

It is important to distinguish between the fundamental economic forces governing digital firms like Facebook on the one hand, and eBay on the other hand, and understand why the forces translate into different business models and regulatory challenges. Facebook operates as a multi-sided platform within the digital economy, leveraging user data to provide targeted advertising opportunities. Advertisers seeking access to Facebook's extensive user base must adhere to pricing structures set by the platform. This pricing framework is contingent upon factors such as the number of active Facebook users and the granularity of data accessible for targeting purposes. By monetizing user data, Facebook serves as both a facilitator of user engagement and a gateway for businesses to reach specific audiences.

In contrast, eBay functions primarily as an e-commerce firm within the digital economy, facilitating transactions between buyers and sellers without dictating prices. Unlike multi-sided

⁶ Digital and printed newspapers serve as a case in point. Governments consider newspapers essential for the dissemination of vital information, including topics such as culture, politics, and international affairs, and therefore aim for high circulation.

platforms, eBay serves as an intermediary, enabling direct negotiation between customers and suppliers. While it plays a pivotal role in connecting parties, eBay does not enforce pricing mechanisms or mediate transactions beyond facilitating the exchange. The same is true for digital giants like Alibaba's Taobao and the Japanese C2C firm Mercari.

Summing up, while both Facebook and eBay contribute to the digital economy, their operational dynamics differ significantly. Facebook operates more as a multi-sided platform leveraging user data for targeted advertising, while eBay operates primarily as an intermediary that facilitates transactions, illustrating the nuanced landscape of digital business models within the broader digital economy. It is more difficult to categorize a firm like Amazon; even though it facilitates transactions between buyers and sellers somewhat like eBay, it also sells products directly. In the latter role it often competes with third-party sellers and might strategically influence independent sellers' pricing strategies.

In determining their pricing strategies, multi-sided platforms must take into account the externalities that exist between their customer groups. In the media industry, for instance, advertising may be perceived as either a nuisance or a benefit by readers. A media firm can address this externality by appropriately charging advertisers to affect the advertising volume. If consumers dislike ads, the media firm will typically choose to sell less advertising space than the quantity that would maximize profits from the advertising side of the market, and vice versa if consumers perceive ads as a good (which might be the case in, e.g., fashion magazines). The externality arising between customer groups enables a platform to facilitate coordination more efficiently than bilateral relationships between distinct customer groups, and the substantial number of readers makes it more efficient for advertisers to place ads on social media platforms (such as Facebook or Instagram) than to contact readers directly.⁷

Multi-sided platforms often treat one side as a profit center and the other as a loss leader or, at best, as financially neutral. Facebook, for instance, allows its members to use its service for free in exchange for harvesting their data, and make money on the advertising side. Another example is the web-browser Chrome offered by Google, which can be used for free, but in return users give away their browsing history. By harvesting its users' browsing history, Chrome offers tailored advertising to customers in different countries.

In some cases, platforms operate with multiple business models tailored to consumer preferences. Take X, formerly known as Twitter, for example. It offers free access to its basic

⁷ Multi-sided platforms must not be confused with standard microeconomic theory of complements. Complementary goods are products or services that are consumed together (and not by different customer groups), with demand for one good being positively influenced by the consumption of another good. When the price of one good increases, the demand for both goods decrease, and vice versa (see, e.g., Kreps, 1990, p. 61).

features, allowing users to create accounts, post tweets, follow others, and engage with content at no cost. X generates revenue through advertising and data monetization from this user group. Additionally, X provides a premium subscription option for users who strongly dislike ads. These subscribers pay a monthly fee to enjoy an ad-free experience.

3 Taxation and Multisided platforms

Digital multisided platforms face both corporate and indirect taxes and fees. Since they typically operate across jurisdictions, it is important to understand international tax rules.

Corporate taxes on a firm are levied based on where the firm is tax domiciled. In most countries, a company is for tax purposes generally treated as a resident based on where its central management and control are exercised. The term “central management and control” refers to the highest level of oversight, usually as exercised by the board, rather than day-to-day management. For example, if the board of a company is located in another country than where the firm has a permanent establishment (such as a factory or sales outlet), the firm may be subject to tax in both countries depending on the tax treaty between the two countries.

In the context of international tax law, a "permanent establishment" refers to a fixed place of business through which the business activities of a company are wholly or partly carried out. This concept is crucial for determining tax domicile and obligations because it establishes a physical presence in a jurisdiction that typically triggers the right of that jurisdiction to tax the profits attributable to the activities conducted through the permanent establishment.

The definition of what constitutes a permanent establishment can vary between different tax jurisdictions and is often detailed in tax treaties between countries. Common examples of a permanent establishment include a place of management, an office, a sales outlet, or a factory. The significance of a permanent establishment lies in its role in allocating taxation rights between jurisdictions. Profits attributed to the permanent establishment may be taxed in the country where it is located, regardless of where the company's global headquarters or domicile for tax purposes is located. This concept helps prevent tax evasion and ensures that companies contribute taxes where they are economically active and generate profits. Tax domicile of firms is an important topic in the digital economy since most digital firms do not have a permanent establishment in many countries but export their services (data used by advertisers).

The other set of taxes that face firms in the digital economy are indirect taxes. Typical examples of indirect taxes are the value added tax (VAT) and the sales tax. A significant and enduring policy debate centers on whether traded commodities should be taxed in the

consumer's country (destination principle) or in the producer's country (origin principle). Historically, global trade has predominantly adhered to the destination principle. In scenarios featuring perfectly competitive commodity markets, there is theoretical backing for this approach, as the destination principle helps prevent countries from competing over tax bases amid cross-border shopping.⁸

An important aspect of the new digital economy is the sale of digital products online. Such sales are subject to VAT in the country where the buyer is located. Prior to 2015, VAT was collected in the country where the seller resided. This led to tax competition among low-tax jurisdictions. Luxembourg, for example, reduced its standard VAT rate of 17 % to 3 % on digital products. In response, online platforms like Amazon, Google, and Apple decided to set headquarters in Luxembourg.⁹ At the time, the move was also facilitated by a relatively low corporate tax rate. The application of the destination principle on digital sales has eliminated the incentives to locate in a low VAT country, but low-tax jurisdictions will continue to be appealing for online sellers who consider corporate tax rates as a factor in their location decisions. The literature on tax and multi-sided platform firms is small and most of the literature concentrates on indirect taxes like a sales tax (unit tax) and VAT.¹⁰

4 Multi-sided platforms and indirect taxes.

While most countries employ value-added taxes on goods and services, there are a few exceptions. Notably, in the United States, sales taxes are not federal but are imposed and administered by the states and local governments. In multi-sided markets, imposing indirect taxes on one side can prompt the platform to change business model. For instance, taxing advertising revenue might compel the platform to introduce subscription fees for users, potentially excluding those who place the lowest value on the service. Similarly, a tax on data flows could lead the platform to impose subscription fees to moderate the volume of data users willingly upload. Additionally, implementing taxes per user, whether levied on the platform or directly on users, could result in the exclusion of users who value the service the least.

The literature on multi-sided platforms and tax has largely been concerned with how ad valorem and specific taxes affect the platform and its customer groups through network effects. Main insights from the literature are that it matters whether taxes are specific or ad valorem and if they are levied only on one side of the market or on both. It also matters if there are several

⁸ Lockwood (2001) surveys the literature.

⁹ The case of Luxembourg is discussed in Kind and Köthenbürger (2018).

¹⁰ Myles (1966) studies the optimal combination of ad valorem and specific taxation in traditional markets.

network effects between the two customer groups. For example, the willingness to pay for an ad is increasing in the number of readers. But readers may be ad averse. In this case we have two network externalities that the platform must balance. An important insight from the literature is that taxing one side of a market can lead to the counterintuitive outcome of the platform lowering the price of the taxed good. This seemingly paradoxical result occurs when the value attributed to capturing an additional customer on the taxed side exceeds the marginal costs associated with providing the good to this customer. Reducing the price negatively impacts the platform, but the network externality mitigates the tax's effect, helping to offset potential revenue losses the platform might experience if one side were to bear the entire tax burden.

In what follows we shall use a simple model to bring forward some key results from the literature on the idiosyncratic effects of indirect taxation in multi-sided markets, holding the business model fixed. Specific taxes essentially function as an increase in the platform's marginal cost, leading to conventional effects. In contrast, ad valorem taxes influence the relative profitability of serving the two customer groups, resulting in unconventional outcomes. Consequently, we concentrate on the impact of ad valorem

To highlight the mechanisms at work, consider a media monopoly which sells n copies of a newspaper at price p^N . The inverse demand curve for the newspaper is downward-sloping, such that we have $p_n^N(n) \equiv \partial p^N / \partial n < 0$ (subscripts henceforth denote partial derivatives). Labelling the ad valorem tax rate by t , this implies that the media firm receives the price $p^N / (1 + t)$ per copy it sells of the newspaper. The newspaper further sells eyeballs to advertisers at a price p^A per ad. The inverse demand curve for ads is downward-sloping ($p_a^A < 0$), but the willingness to pay for ads is increasing in newspaper circulation ($p_n^A > 0$). We thus have a positive network externality from the reader side of the market to the advertising side.

From the above, we specify the newspaper's profit function as

$$\pi = \frac{np^N(n)}{1+t} + p^A(a, n)a - C(a, n) \quad (1)$$

where $C(a, n) \geq 0$ is the cost function, with $C_a \geq 0$ and $C_n \geq 0$. We assume that the cost and demand functions are well behaved, and that the second order conditions for profit-maximization hold. Note that the willingness to pay for newspapers, p^N , is solely a function of n , and not of a . This means that readers are indifferent to the ad level (no network externality from advertisers to readers). However, this is not a critical assumption in our setting (see, e.g., Kind et al, 2010).

The media firm maximizes profits with respect to the advertising volume (a) and newspaper circulation (n). Setting $\pi_a = 0$, we find

$$\pi_a = p^A + ap_n^A - C_a = 0. \quad (2)$$

Equation (2) has the standard interpretation that the marginal revenue of selling ads is equal to marginal costs in optimum.

Solving $\pi_n = 0$ yields

$$\pi_n = \frac{p^N + np_n^N}{1+t} - (C_n - ap_n^A) = 0. \quad (3)$$

The second-order conditions for profit maximization require that $\pi_{nn} < 0$, $\pi_{aa} < 0$ and $H = \pi_{nn}\pi_{aa} - \pi_{an}^2 > 0$. We assume that these conditions hold.

The term $\frac{p^N + np_n^N}{1+t}$ in equation (3) measures the marginal revenue on the reader side of selling an extra copy of the newspaper. In optimum, this is equal to the marginal costs of selling the newspaper, C_n , minus the marginal gain on the advertising side of selling more newspapers. The latter is equal to the advertising volume, a , times the increased willingness to pay for each ad, p_n^A , if the newspaper offers one extra pair of eyeballs. Since ap_n^A is positive, it follows that the media firm will sell more newspapers (and charge a lower price) the greater the advertisers' willingness to pay for reaching a large audience.

To find the consequences of increasing the VAT rate on newspaper sales and advertising volume, we totally differentiate equations (2) and (3) with respect to t . This yields

$$\frac{dn}{dt} = \frac{-\pi_{nn}(ap_n^A - C_n)}{H(1+t)} \quad \text{and} \quad \frac{da}{dt} = \frac{-\pi_{an}(ap_n^A - C_n)}{H(1+t)}. \quad (4)$$

Since $p^N = p^N(n)$ and $p^A = p^A(a, n)$, it follows that the price effects of increasing the VAT rate are given by

$$\frac{dp^N}{dt} = p_n^N \frac{dn}{dt} \quad \text{and} \quad \frac{dp^A}{dt} = p_a^A \frac{da}{dt} + p_n^A \frac{dn}{dt} \quad (5)$$

Let us first focus on the consumer (reader) side of the market. The implications of equations (4) and (5) are stark; they show that $dn/dt > 0$ and $dp^N/dt < 0$ if $ap_n^A - C_n > 0$. Consequently, we encounter the seemingly paradoxical scenario that an elevated VAT on newspapers results in greater newspaper circulation (and a lower newspaper price for consumers). This phenomenon

can be understood by considering the underlying rationale: when the value attributed to capturing an additional reader, ap_n^A , surpasses the marginal costs associated with serving that reader, C_n , it becomes profitable to marginally reduce the newspaper price. As a consequence, readership expands, enabling the media firm to augment advertising sales and accrue greater profits compared to scenarios where the newspaper price is increased and newspaper output reduced. This result stands in sharp contrast to what we typically would observe in one-sided markets. The point is that a firm, which operates in a multi-sided market can reduce its tax burden by shifting revenue to the side of the market where the tax rate is unchanged.¹¹

Now, let us look at the advertising side of the market. Assume that $ap_n^A - C_n > 0$. From equation (4) we then see that a higher VAT on newspapers will induce the newspaper to sell more advertising space if the newspaper's marginal profit of selling ads increases with newspaper sales. In this case, higher value-added taxes thus increase output on both sides of the market.¹² Interestingly, equation (5) tells us that this has an ambiguous effect on the advertising price. Other things equal, the newspaper must reduce the price of advertising to sell more ads ($p_a^A < 0$). However, the fact that newspaper circulation increases, allows the newspaper to charge a higher price ($p_n^A > 0$). Whether the equilibrium advertising price goes up or down subsequent to a higher VAT on newspaper sales, depends on which of these two effects dominate.

From a policy point of view, it might be important to assess whether the condition $ap_n^A - C_n > 0$ holds, and thus whether a higher VAT will reduce prices. Presumably, this varies between different segments of the media sector. In the newspaper market, there is little doubt that the marginal cost per reader is relatively low. Indeed, for all practical purposes, it is equal to zero for digital newspapers. Consequently, according to this analysis, digital newspapers would unequivocally find it advantageous to lower reader prices in response to a VAT increase. Additionally, it is noteworthy that advertising stands as the primary or sole revenue source for certain media outlets, suggesting a relatively high value for ap_n^A . Therefore, it's plausible that $ap_n^A - C_n > 0$ even for media firms with significantly positive marginal costs. In either case, the key insight from this analysis is that a policy intervention of reducing VAT is unlikely to be an effective tool to reduce newspaper prices and increase newspaper circulation. Media firms certainly gain from a lower value-added tax, but the consumers might be harmed.¹³

¹¹ See Fullerton and Metcalf (2002) for an overview over the tax incidence literature in one-sided markets.

¹² Kind et al. (2008) show that platforms may have too high output on both sides of the market and demonstrate that this might be corrected by reducing value-added taxes or increasing specific taxes.

¹³ See also Kind and Köthenbürger (2018), who analyze how changing the VAT rate may affect competition between, for example, printed and digital books, and influence the relative prices charged by media conglomerates.

The fact that the size of the VAT rate on newspapers affects the relative importance of raising revenue from advertisers versus directly from the readers might have implications for media diversity. The more a newspaper relies on advertising revenue, the more it will aim for the mass market, other things equal, to reach a large audience (see, e.g., Anderson and Jullien, 2015, and Anderson and Gabszewicz, 2005). If VAT is reduced, it becomes more profitable to raise revenue from the reader market. The media firm will consequently try to enhance the readers' willingness to pay for the newspaper. One way of doing this is to further differentiate its content from what the rivals offer. This move away from the mass market could lead to increased media diversity. Thus, while reducing the VAT rate on newspapers might increase newspaper prices, as shown above, it could also lead to more media differentiation. The former is typically considered as negative by policy makers, and the latter as positive. Policy makers thus face a trade off when they consider the VAT rate on newspapers.¹⁴

The literature on indirect taxation primarily examines the effects of ad valorem and specific taxes on tax incidence, competition, data collection, welfare, and tax revenue. A pivotal distinction across studies lies in the type of network externalities considered and how they are modeled. On digital platforms like Facebook, the utility a user derives from accessing the platform increases with the number of other users (strong within-group externalities). Additionally, a larger user base enhances the value of advertising on the platform (strong across-group externalities). Similar dynamics apply to X. In contrast, for online readers of the New York Times, the number of other readers or subscribers has a much weaker influence on individual utility (weak within-group externalities). However, across-group externalities remain significant: a larger reader base is essential for attracting advertisers.

In one-sided (traditional) markets, Suits and Musgrave (1953) show that ad valorem taxes revenue-dominate unit taxes under monopoly, i.e. for any unit tax it is possible to find an ad valorem tax which generates higher tax revenues while leaving quantity choices unaffected. Subsequent literature shows that ad valorem taxes welfare-dominate, and even Pareto-dominate, unit taxes under imperfect competition.¹⁵ The effect of ad valorem taxes and unit taxes in multi-sided monopoly markets stands in sharp contrast to the traditional findings. Kind et al. (2009) demonstrate that in a monopolistic multi-sided platform with constant production costs, switching from a value-added tax (VAT) to a unit tax can increase tax revenues. Furthermore, even if tax revenues remain constant, this shift to a unit tax can enhance overall welfare. Specifically, if there is a strong positive indirect externality between the two groups on the platform, the switch

¹⁴ See Kind et al. (2013)

¹⁵ See; e.g. Delipalla and Keen (1992), Skeath and Trandel (1994) and Keen and Lahiri (1998).

to a unit tax, while maintaining the same output level, can lead to both higher tax revenues and improved welfare outcomes.

Belleflamme and Toulemonde (2018) set up a model of Hotelling competition between two identical multi-sided platforms. Each platform serves the same two groups of customers. In each group, customers' utility increases with the number of customers in the other group. Platforms simultaneously set an access price for each group, and the customers observe these prices and choose only one platform to visit (single homing). Given this set up they study tax incidence of specific, ad valorem and transaction taxes when taxes either are applied at the same rate to both platforms (symmetric taxes) or when taxes differ between the two platforms (asymmetric taxation). Specific and ad valorem taxes affect the cost of customers to access the platform whereas transaction taxes are levied on digital content, that is, the usage of the platform. When taxes are symmetric, Belleflamme and Toulemonde (2018) find that specific taxes are entirely passed to the customers on the side on which they are levied. Consequently, customers on the other side and the platforms are left unaffected. Transaction taxes hurt both customer groups but benefit platforms. In contrast, the effect of an ad valorem tax is generally ambiguous. If an ad valorem tax is imposed on only one customer group, that group may benefit if the platform responds by lowering the price sufficiently to offset the tax. However, it negatively affects customers on the other side of the market, as the tax is partially shifted onto them. Under asymmetric taxation only specific taxes are studied and the setting is one where one of the two platforms has to pay a specific tax per customer on one side. They show that customers on the untaxed side benefit from the tax and at least one platform benefits from the tax.

Bloch and Demange (2018) explore how taxes affect the amount of data collected by a monopolistic internet platform. In their model, users of the platform differ in their privacy costs and the platform chooses an excessive level of data exploitation from the point of view of users. A user benefits from access to the platform (say a web browser) as well as data collection. The latter because data collection enables advertisers to tailor make their offers to users. More users enable the platform to generate higher ad revenues. The platform's optimal strategy is either to serve the entire market (allowing all users access) or to maximize data exploitation by excluding some users. The choice between these strategies depends on the specific shape of the revenue and benefit functions and is unaffected by a tax on profits or revenue. Data collection by the platform is affected by indirect taxes. A key result of the paper is that taxing revenue from user access and ad revenue at different rates can reduce data collection, especially when the tax on income from data exploitation (such as ad revenues) is higher. Similarly, an access tax paid by users can also decrease data harvesting.

Bourreau, Caillaud, and De Nijs (2018) model a monopolistic digital platform that relies on users' personal data to provide personalized services to users and sell targeted advertising slots to online sellers. In their model, web users benefit not only from personalized services but also from being targeted with relevant advertisements. Online sellers benefit from the platform's large user base, especially when the platform leverages personal data collected from users to enhance its targeting technology. This enables more efficient advertising campaigns, maximizing the platform's value for sellers. The novelty of their model is the role data plays as a driver for the network externality. They show that a small tax on data collection reduces the volume of transactions driven by targeted advertising in the market and fails to increase fiscal revenue if the value-added tax (VAT) rate is high enough. This result hinges on an interdependence between the data tax and the value added tax. Additionally, platforms that charge users for basic services may respond to data taxation by introducing or increasing subscription fees. A second set of results from their analysis suggests that there may be cases where an ad valorem tax on subscriptions or advertising can increase fiscal revenues, regardless of the VAT rate, while also enhancing welfare.

Tremblay (2018) sets up a model with a monopolistic platform that caters to buyers and sellers. He studies the effects of an ad valorem tax (access tax) imposed on consumers and a specific tax (transaction tax) levied on sellers. The price consumers pay can be interpreted as a subscription fee whilst the price sellers pay can be compared to a membership fee that allows the seller to contact the platform's consumers. In his model, there is heterogeneity in network effects: consumers differ in how much they value the variety of seller options, while sellers vary in their marginal benefit from consumers. He finds that an ad valorem tax (access tax) on consumers leads to a price reduction, increasing consumer participation, but results in decreased participation by sellers. In the case of a specific tax (transaction tax) the effects on prices and participation are ambiguous and depend on network tax incidence created by the transaction tax, and the platform's pricing strategy. In terms of welfare, his analysis indicates that welfare can either increase or decrease with either tax. The welfare effect of an ad valorem tax, for example, depends on which side of the market experiences greater network effects. In contrast, a specific tax increases welfare when the side of the market with the greater network gain also has the smaller network tax incidence.

Sánchez-Cartas (2021) study how ad valorem and specific taxes affect intellectual property policies of multi-sided digital platforms under monopoly and duopoly. He sets up a model with a developer and a consumer that uses a digital platform. The model has three stages. At stage one, the platform decides on which proportion of the platform is open to the developer and the time the developer has exclusive rights to his development. At the second stage, the developer innovates using the platform's resources and sells his app to the consumer and pays royalty to the

platform. At stage three, the platform takes over ownership of all or parts of the technology. The platform faces two key trade-offs. First, it must decide how much intellectual property it wants to make available for developers. By sharing more intellectual property, the platform broadens the range of technologies available for developers to innovate upon, potentially increasing the value of subsequent innovations and boosting royalties in the second stage. However, by retaining more intellectual property, the platform can directly monetize its technologies instead. Under monopoly he finds that ad-valorem taxes reduce the platform openness, and the exclusivity period granted to developers to exploit their innovations. Unit taxes have an ambiguous effect. Under duopoly the length of the exclusivity period is shortened by ad valorem taxes and the set of tools available to developers is smaller. The effect on welfare is ambiguous.

The main purpose of the research summary above is to show why the inherent attributes of digital products and platforms can qualitatively alter the impact and optimal structure of indirect taxation compared to that in one-sided markets. Without taking this into account, policymaking risk implementing counter-productive, or at best highly inefficient, strategies.

5 International tax initiatives and digital platforms

Companies in the digital economy have increasingly come under scrutiny, prompting public policy initiatives aimed at addressing the challenges they pose to tax revenue. Pillar 1 and Pillar 2 are two major components of the OECD/G20 Base Erosion and Profit Shifting (BEPS) framework designed to address the challenges of taxing multinational enterprises in a globalized and digitalized economy. They are focused on ensuring that multinational firms contribute a fair share to the tax base in different jurisdictions, thereby safeguarding against revenue losses for economies worldwide.

The objective of Pillar 1 is to allocate a portion of the profits from the largest and most profitable multinational enterprises, many of which are digital platforms, to the countries where their consumers or users are located, regardless of the company's physical presence. Pillar 1 has two main goals. First, to redefine the presence a business must have in a country to become liable for taxation, moving beyond the traditional physical presence requirement to consider factors like significant economic presence, including sales, users, or marketing efforts (this goal is often referred to as nexus). Second, to allocate a portion of profits to be taxed in jurisdictions where they have substantial consumer-facing activities or significant economic presence, regardless of physical presence (often referred to as profit allocation or apportionment). The details and implementation of Pillar 1 are still subject to ongoing negotiations and discussions among participating countries in 2024 within the OECD's Inclusive Framework. As far as we know, there

does not exist research on how Pillar 1 would affect multi-sided platform firms given that the rules of Pillar 1 are yet to be agreed upon.

The discussions over Pillar 1 are focused on how to best apportion profit to countries where digital platforms do not pay corporate taxes but earn profit. The taxing task is to find weights that reflect activity in different jurisdictions that can be used to apportion profits. Federal countries like the US and Canada use formula apportionment (FA) to allocate tax revenue across states. Under FA, a multinational company consolidates the income of its affiliates into a single measure of taxable global income, which is then allocated to jurisdictions based on a common formula that reflects real activity within each jurisdiction. The FA system thereby eliminates the incentive to shift profits by transfer prices. However, separate accounting (SA) is more common internationally, such that each individual country computes the income generated by affiliates of a MNC located within its jurisdiction using arm's length prices on intra-firm transactions, and subsequently applies the national tax rate to it. A major difference between the FA system and the SA system is that the former is based on reported activity whilst the SA system is based on reported income. It is well known that MNCs have incentives to manipulate activity under FA, whereas they manipulate income under SA.¹⁶ Bloch and Demage (2021) show that FA and SA systems have different effects on the behavior of a monopolistic digital platform serving users in two different countries. They also show that tax revenue differs across countries under SA and FA depending on whether the country is a high- or a low-tax country. We will revisit this study later.

Pillar 2, like Pillar 1, is part of the global efforts to address the challenges of taxing multinational enterprises (MNEs) in the context of the digital economy. In October 2021, 136 countries reached an agreement on Pillar 2. The agreement establishes a minimum tax of 15 % for large MNEs with consolidated revenues of more than 750 million Euro. The aim of Pillar 2 is to reduce profit shifting to tax havens and ensure that profits are subject to a minimum level of taxation globally. To guarantee that corporations pay a tax of a minimum of 15 %, the effective tax rate of a subsidiary in a low-tax country must be calculated. If this rate is below 15 % the MNE must pay a top-up tax to bring its rate to 15%. The top-up tax percentage is the difference between 15% and the subsidiary's effective tax. This rate is applied to the gross income used to calculate the subsidiaries effective rate of tax and is called GLOBE income. However, the subsidiary may deduct from the GLOBE income costs related to its physical presence in a low-tax country. This deduction, called Substance-based Income Exclusion (SBIE), allows the subsidiary to tax-deduct a percentage share of 5 % (in the long run) of payroll costs and user costs of tangible assets from

¹⁶ Nielsen et al. (2010) study how differences in taxes on profits across countries affect capital formation, input choice, and transfer pricing, as well as spillovers on tax revenue in one-sided markets. They show that a move from SA to FA will not eliminate such spillovers and will, in cases identified in the paper, actually aggravate them.

its GLOBE income before the top up tax is applied. Since costs related to payroll and tangible assets are also deductible when GLOBE income is calculated, these costs are partly deducted twice, and for a sufficiently large cost share of labor and/or capital, the SBIE is equivalent to a production subsidy.¹⁷ The SBIE is only applicable if a firm has a physical presence in a low-tax country. Digital platforms with shell companies in tax havens will face an effective tax rate of 15% because they do not qualify for the SBIE. As a result, these firms will see their after-tax profits decline, and relocating will not improve their tax situation.

A key question is whether Pillar 2 will impact the pricing strategies of multi-sided platforms. Pillar 2 does not aim to standardize tax rates at 15% across all countries. Instead, it seeks to pressure low-tax jurisdictions to raise their tax rates to meet the minimum threshold. While it does not eliminate tax competition over capital —high- and low-tax countries will still exist—Pillar 2 diminishes the advantages of profit shifting and booking profits in zero-taxed jurisdictions.

To understand how Pillar 2 may affect digital platforms consider the web browser Chrome offered by Google. Chrome is given away for free, but users in different countries allow Goggle to harvest data that can be sold to advertisers. Suppose the revenue from ads is in the books of a tax haven affiliate that is currently not paying corporate taxes. This affiliate will see after-tax profits fall following Pillar 2. But it cannot save tax by relocating to another jurisdiction that has enacted Pillar 2 because the burden of tax would be the same. It can, however, relocate to a jurisdiction that has not implemented Pillar 2 if it sees this as a viable option.¹⁸ Arguably, the countries that are outside of the Pillar 2 agreement seems unlikely candidates for a firm like Google. If relocation is not an issue, the next question is if Pillar 2 impacts the price advertisers must pay? Our basic profit function can be modified to answer this question. Recall that profits were $\pi = [np^N(n) + p^A(a, n)a - C(a, n)]$ in the absence of corporate taxation. Since Chrome is given away for free the price of good n is zero and profits by the tax haven affiliate is reduced to

$$\pi = (1 - t)[p^A(a, n)a - C(a, n)], \quad (6)$$

where t is the global minimum tax. It is seen from (6) that the minimum tax is a tax on pure profits and therefore does not affect the price of ads. Consequently, Google has no incentive to alter the price to advertisers following the introduction of Pillar 2.

¹⁷ Schjelderup and Stähler (2023) show that Pillar 2 dampens tax-motivated transfer pricing, but that the SBIE distorts employment, investment, and import incentives. For companies with substantial costs tied to labor or capital, the SBIE can effectively act as a production subsidy. The effect of Pillar 2 has recently been analyzed by Johannessen (2022) and Janeba and Schjelderup (2023). Neither of these studies model the behavior of multi-sided platforms.

¹⁸ Prominent countries that have not fully implemented or signed onto Pillar 2 include China, Hungary, Kenya, Nigeria, Pakistan, and Sri Lanka.

Several countries have implemented a Digital Services Tax (DST), which is a unilateral measure to tax revenue generated by digital companies in countries where these firms are not tax domiciled. France, Italy, Spain, and the United Kingdom are prominent examples among European countries, and a number of countries in Asia and Latin-America have also implemented versions of a DST tax. DSTs have generally been seen as a stop-gap measure to immediately address perceived tax base erosion due to the digital economy and lack of tax domicile and is intended to fall on revenue from digital services for very large digital companies.¹⁹

Countries that have implemented a DST have generally imposed it on revenues earned by large multinational digital companies that provide specific digital services within their jurisdictions. DST is usually applied to gross revenue (not profits) generated from specific digital services. These services often include online advertising, sale of user data, and intermediation services (e.g., digital marketplaces). We can investigate the effect of the DST by using our profit function in (6) above. Let t be the corporate tax and τ the DST tax that falls on advertising revenue. The profit of the platform is

$$\pi = (1 - t)[(1 - \tau)p^A(a, n)a - C(a, n)], \quad (7)$$

The first order condition is given by $\partial\pi/\partial a = 0$,

$$p^A + ap_a^A = \frac{c_a}{(1-\tau)}. \quad (8)$$

Since there is no tax distortion to the tax base of the platform (true profits are equal to taxable profit), it is only the DST that affects how the platform behaves. The DST makes it more costly to sell advertising in the high-tax country. But if the operating costs of the platform are negligible ($C(a, n) = 0$), the right-hand side of (8) is zero and the DST does not affect the behavior of the platform.

¹⁹ France was one of the first major economies to implement a DST. The French digital tax applies a 3 percent tax on the revenues from digital services for companies with global revenues of more than euro 750 million and more than euro 25 million from within France. Other countries that have imposed a DST is the UK (a 2 percent tax on the revenues of search engines, social media services, and online marketplaces deriving value from UK users), Italy (2 percent), Austria (5 percent), Turkey (7,6 percent) and India (2 percent). If no international agreement is reached on Pillar 1, various DST regimes are likely to become a permanent feature of national tax legislation. Köthenbürger (2020) reviews the theoretical literature on taxation of multi-sided platforms and the recent proposals of digital service taxes in Europe.

6 Profit shifting, tax competition and multinational digital platforms

The literature on digital platforms and profit shifting is scant. In an interesting paper, Bloch and Demange (2021) analyze how Formula Apportionment (FA) and Separate Accounting (SA) systems influence the behavior of a monopolistic digital platform serving users in two different countries. In each country the platform serves two different types of users. The platform can discriminate according to the residency of the two types in the two jurisdictions and chooses the optimal number of users in each jurisdiction, anticipating their willingness to pay to access the platform. The volume of use of the platform is fixed and identical across users. Revenue in each jurisdiction is equal to price times quantity for the two groups. In their main analysis they assume that demand and the willingness to pay for a good in one jurisdiction depend on the number of users in the other jurisdiction. An increase in the tax rate of the high-tax country reduces pre-tax profits in the high-tax country but increases pre-tax profits in the low-tax country by exploiting externalities in consumption across the two jurisdictions. Consequently, tax revenue in the low-tax jurisdiction increases. This type of profit shifting is costly as the global pre-tax profits fall.

Under FA (Formula Apportionment), the platform's tax liability in a jurisdiction is calculated by multiplying its total profits by the average proportion of users in that jurisdiction, relative to its total users of each type across both jurisdictions, with the result being adjusted by two apportionment weights (each for each type). An increase in the tax rate of the high-tax country results in a decrease in the share of users of the two types in the high-tax jurisdiction and an increase of the share of both types of users in the low-tax country. As in the case of SA, tax revenue in the low-tax country increases. An interesting result that follows from Bloch and Demange's analysis is that tax revenue in the high-tax jurisdiction is higher under SA than under FA. Conversely, tax revenues in low-tax jurisdictions are higher under FA than under SA, suggesting that countries may disagree on the choice of profit-splitting regime.

Schindler and Schjelderup (2010) study profit shifting by a monopolistic platform firm that is headquartered in one jurisdiction and owns subsidiaries in many jurisdictions. The parent firm produces two goods. Good A (advertising) is sold worldwide by the parent. Good X is exported to the subsidiaries at transfer prices. How much each affiliate buys from the parent is a function of the transfer price and local market conditions. Goods A and X are linked by a network externality, meaning the willingness to pay for good A increases as sales of good X rise. In the absence of taxes, the network externality between good A and X implies that the transfer is set below the marginal cost of production of good X. The reason is that a low transfer price will increase the sale of good X. Differences in corporate taxes across countries provide the platform with an incentive to use transfer prices to shift profit. The profit shifting motive may cause the transfer price to either

diverge further from production costs or align more closely with the actual production cost, or even exceed the costs of production.

Kotsogiannis and Serfes (2010) study tax competition between two jurisdictions, each hosting a multi-sided platform that caters to shoppers and firms. The jurisdictions compete in a Tiebout-style model by offering different levels of public goods and tax rates to attract shoppers and firms. The network effect in their model is based on that consumers value variety (many firms) and firms value market size (many shoppers). Shoppers are located along a Hotelling segment, and two platforms are formed at both ends of the segment. Each firm selects a platform, while shoppers decide which platform to use based on the number of businesses available on each platform and the distance to their chosen platform. The two jurisdictions choose their level of public goods and taxation, and shoppers and firms choose their platforms all at the same time. If both jurisdictions offer similar levels of public goods and taxation competition is intense and a possible outcome is that all shoppers and firms choose one of the platforms. The equilibrium of the fiscal competition game results in asymmetric shares between firms and consumers across the two jurisdictions, depending on the strength of the cross-group externality. If the benefit between groups (cross-group externality) is very strong, all firms will choose to locate in the jurisdiction that invests more in public goods. As a result, this jurisdiction may increase taxes to fund even more public goods, leading to a "race to the top" in taxes.²⁰

7 Empirical studies

The empirical literature on multi-sided platforms remains limited. Multi-sided platforms with different business models not only compete among themselves but also against traditional one-sided firms. For instance, there is fierce competition for advertising revenue between newspapers and giants like Facebook and Google. Despite not being traditional media firms, Facebook and Google leverage their extensive data harvesting capabilities to attract advertisers. Facebook and Google cater to both users and advertisers, whereas newspapers serve readers and advertisers. As a result of the partly overlapping customer bases between platform firms and their direct competition with traditional one-sided firms, assessing the impact of public policy on platforms is empirically challenging.

²⁰ Agrawal (2012) study the effect the digital economy may have on sales tax rates. He shows that when legal limitations imply that it is up to consumers, not sellers, to pay taxes on online purchases, online sales might become essentially untaxed. This situation, where the tax base becomes more mobile, may lead jurisdictions to lower their tax rates to lessen the loss of revenue to the internet, which in this case serves as a tax haven.

Platforms in the media business have been affected by various policy initiatives aimed at fostering circulation, supporting the economic well-being of small newspapers, and ensuring a diverse landscape of newspapers. Among these initiatives, most notable in European countries, is the implementation of reduced VAT rates or even exemption from VAT.

Murschetz (1998) conducts a comparative study of state support for the daily press in Austria, France, Norway, and Sweden. Over an extended period, these countries implemented various policies, both direct and indirect, aimed at increasing circulation. Examples of such support include subsidized journalistic training and VAT exemptions. A notable case from Murschetz's study is Sweden, which implemented a rule granting selective production subsidies only to newspapers with 40% or less household coverage in a specific geographic area. Murschetz concluded that these policies did little to enhance circulation among subsidized newspapers. Instead, they harmed competition and cemented existing structures in the newspaper business

Picard and Grönlund (2003) find that most subsidies in Europe have had little effect on the financial situations of newspapers and do not provide a mechanism for their long-term viability. Picard's (2003) study of Swedish press subsidies and newspapers' accounting figures reveals that the Swedish policy, aimed at strengthening financially weak newspapers, did not enhance circulation or ad revenues sufficiently to make these newspapers economically viable.

Depken (2004) analyzes the effect of VAT on market structure in the magazine industry. He utilizes cross-sectional variation in VAT rates across 23 countries. Kind and Møen (2015) refers to the findings in his study as follows: "He finds that "a one-unit increase in an ad valorem tax (e.g., from 6% to 7%) correlates with a reduction in 21 consumer magazine titles, on average, and 52 business titles". In a country with an average number of consumer and business magazines, these numbers correspond to a 2.1 % and 3.9 % decrease in magazine titles, respectively. These numbers are arguably surprisingly high and underline the need for further studies." It is worth mentioning that Depken's (2004) study was conducted before the literature on platform firms was well-developed, and this may have led to specification errors that potentially can explain his findings.

Several of the largest multi-sided platforms, such as Google, Facebook, TikTok, and Instagram, predominantly rely on technology for their business models. One prominent example of this technology is search-engines utilizing artificial intelligence (AI). Empirical studies indicate that large multinational companies strategically domicile ownership of their intellectual property in tax havens to minimize their corporate tax liabilities. As highlighted by Hall (2001) and Zingales (2001), intellectual property serves as a significant value driver within corporate groups, making it attractive to locate in low-tax jurisdictions. Furthermore, intellectual property functions

similarly to common goods, allowing profits to be shifted to low-tax jurisdictions through licensing fees (or royalty) among multiple affiliates in different countries, thereby reducing taxable income and saving on taxes.

There is a substantial literature that documents that profit shifting activities are larger in multinationals with high content of intellectual property (see e.g., Grubert (2003); Karkinsky and Riedel (2012)). These studies suggest that the corporate tax rate has a significant negative impact on the number of patent applications by subsidiaries in high-tax countries and that MNEs often distort the location of their corporate patents to favor low-tax affiliates.

In the empirical literature on profit shifting by large multinationals, it is widely acknowledged that disparities in statutory corporate tax rates significantly drive profit shifting (Grubert and Mutti, 1991; Huizinga et al., 2008; Heckemeyer and Overesch (2017), and Dharmapala, (2014)), resulting in substantial volumes of profits being relocated to low-tax jurisdictions (Dowd, 2017; Bilicka, 2019; Tørsløv, 2023). Notably, many of these multinationals are digital platforms. However, the cited literature does not suggest that corporate taxes influence these firms' business models. Instead, higher corporate taxes appear to encourage the transfer of intellectual property to low-tax countries.

Several countries have implemented a Digital Services Tax (DST), which is a unilateral measure to tax revenue generated by digital companies and platform firms operating within their jurisdictions, particularly from activities that exploit user participation and data. DSTs will generally apply to large platform firms such as Instagram, Google, Facebook and X, and have generally been seen as a stop-gap measure to immediately address perceived tax base erosion due to the digital economy. We are not aware of any empirical studies that assess the impact of DST on platform firms. This is surprising given that several countries have implemented the DST and that this tax mainly falls on multisided platforms.

Recently, Lassmann et al. (2020) exploit how a change in accounting practices adopted by Facebook affects its daily online ad prices. The change in accounting practice meant that Facebook no longer booked its advertising revenue outside the US in Ireland but switched to book in the countries where it was derived. The switch effectively meant that the tax on advertising revenue rose, but with differences across countries. It is interesting to note that the switch can be interpreted as an increase in the corporate tax or the introduction of a digital service tax on ad revenue. Lassmann et al. (20120) estimate the effect of a tax increase on ad prices using panel and spatial models. They find that ad prices rose by 10 to 32 percent of the average ad price before new booking practice was introduced. In trying to reconcile their results with theory, they set up a model with a multinational digital platform where the users of the platform are exposed to local

and foreign ads. Users like those of Facebook can access the platform for free, and the platform exposes the users to a limited quantity of ads as users dislike ads. The effect of a tax increase is that the platform reallocates some of its supply of ads to from advertisers in the country that increases its rate to users in other countries. Consequently, the reduction in supply increases the ad price in the country where the tax goes up. Both their empirical findings and the theory model suggest that there are price spillovers following a change in the taxation of ad revenue.

8 Concluding Remarks

A key insight emerging from the research on multi-sided platforms is that traditional tax policies often yield unintended outcomes, and the principles gleaned from conventional markets are not directly transferable. Notably, the classic preference in public finance for ad valorem taxes over unit taxes does not necessarily apply in multi-sided markets. Additionally, in such markets, the price of a product may actually decrease following the imposition of an ad valorem tax.

The reason why traditional tax policy advices may be misleading, is that they fail to take into account the externalities among the different customer groups served by multi-sided platforms. The magnitude of the cross-group externalities plays a pivotal role in shaping market outcomes. Traditional approaches to taxation might produce effects contrary to the intended objectives. This situation is particularly concerning given that some of the largest multinational enterprises operate as multi-sided platforms, including major companies such as Apple, Facebook, and Google. Therefore, it is essential to advocate for further research that considers the international context in which these firms operate. Differences in corporate taxation across countries may interact not only with the externalities between customer groups in multi-sided platforms but also with indirect taxes. It is crucial to gain a comprehensive understanding of these effects to formulate effective public policies that specifically target multi-sided platforms.

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