

The Digital Services Tax as a Tax on Location-Specific Rent

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Abstract: In 2018, the European Council and the UK and Spanish governments each proposed to introduce a Digital Services Tax (DST), to be levied on the revenue of large digital platform companies earned from advertising, online intermediation, and/or the transmission of data. We offer a rationalization of the DST as a tax on location-specific rent (LSR). That is, just as many countries already levy royalties on rent earned from extracting natural resources, one can think of the DST as a tax levied on economic rents earned by digital platform companies from particular locations. We provide stylized examples showing how rent earned by digital platforms can be traced to specific locations, even when users from multiple jurisdictions participate. We then elaborate the analogy between the DST and resource royalties, and analyze the DST's economic incidence as well as its effect on consumer welfare using a simple model. Finally we explain why the DST's significance goes beyond current concerns about multinational tax avoidance, in that it indicates directions for redesigning international taxation in the age of labor-replacing AI technology.

Introduction

In 2018, the European Council, the UK government, and the Spanish government each proposed to introduce a Digital Services Tax (DST), to be levied on the revenue of large digital platform companies earned from advertising, online intermediation, and/or the transmission of data. These governments have motivated their respective proposals by arguing that the current international income tax regime applicable to multinational companies results in the under-taxation of the latter, and that the regime must be reformed soon to allocate greater taxing rights to jurisdictions where users of digital platforms create value. They then present the DST as a short-term remedy to the under-taxation of digital platforms, before a new consensus on multilateral tax reform can be secured within the OECD.

DST proposals represent one of most intriguing global developments in tax policy in recent years. Most academic and policy commentators are surprised by how quickly they followed upon—and threaten to overtake—the OECD's Base Erosion and Profit Shifting (BEPS) project, which only recently began to be implemented by national governments. Even the basic idea of a DST, let alone its detailed design, was virtually unheard of about a year ago, yet the governments of quite a number of countries have already seized upon it and demonstrated substantial resolve regarding its implementation.³ The DST also has no intellectual proponent: as far as we are aware, it has not been anticipated in existing public finance or other academic literature.⁴ For these reasons, much of the initial commentary the DST has received treats it as a policy proposal with no intrinsic appeal, and as motivated purely by protectionism, populism, or political opportunism.

In this paper, we offer a rationalization of the DST as a tax on location-specific rent (LSR). That is, just as many countries already levy royalties, rent taxes, and the corporate income tax on rent earned by

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³ OECD 2018, European Commission 2018.

⁴ Taxes on advertising revenue and subscription fees earned by digital platforms are discussed in France Stratégie 2015, Bourreau et al 2018, Kind & Koethenbueger 2018, Belleflamme & Toulemonde 2018, and other recent theoretical literature, but generally within the domestic context.

businesses from natural resource extraction, one can think of the DST as a tax on economic rents earned by digital platform companies from particular locations. Taxes on LSR possess two highly desirable features. First, they generate tax revenue with minimal distortions to business decisions. Second, rent that can be attributed to specific locations permits a natural allocation of taxing rights: the jurisdictions in which the rent is located can reasonably claim primary taxing right, which in turn implies natural solutions to coordination problems in mitigating the risk of excessive taxation.

To justify the DST as a tax on LSR, one must be able to show that (1) digital platforms earn substantial rent, and that (2) such rent can be traced to particular user countries when platforms operate internationally. Regarding the first point, the literature on the economics of platforms strongly suggests that large economic rent is possible, because of direct and indirect network effects.⁵ Some digital platforms (e.g. Google and Facebook) are famously profitable in large part because of such network effects. Firms in other sectors of the digital economy, even if less profitable, still tend to enjoy considerable market power because of network effects. Moreover, the existence of monopoly rent is compatible with the ideas that substantial investments may have to be made to capture it, and that, during periods when firms aim to build market share, they can show low accounting profits or even persistent losses. We rely on the existing economic literature on multi-sided business models to support the plausibility of these intuitions. Our more original arguments concern the second point—how platform rent can be traced to particular jurisdictions.

Analogizing the activities of platform users to natural resources seems easy in some instances. For example, data generated by user activity, to the extent that such data have significant economic value, can be viewed as similar to natural resources with definite locations. However, the most important tax base for the DST in the near future is revenue from advertising and intermediation of consumption transactions. To see such business models as generating LSR, two intuitions are useful. First, in some instances, it may be possible to identify *causal origins* of platform rent: new producer or consumer surplus arise because of changes in one of the jurisdictions where platform users reside. Second, more generally, when a technology's deployment in one country has no opportunity cost in terms of its simultaneous deployment in other countries—when the use of that technology is non-rival—it is plausible to attribute any rent generated by such technology from its deployment in a given country to that country. This is so even if the technology can be deployed remotely, and even if the technology is invented elsewhere. We elaborate these intuitions through some motivating examples.

Once platform rent is seen as location specific, familiar tax policy frameworks become available for analyzing the DST. For example, the choice between a revenue-based tax and a tax defined over a rent base is familiar in the context of taxing natural resources. The former is easier to implement and more robust against tax planning and profit shifting than the latter, and provides revenue to governments earlier. The latter is less distortionary but both practically and politically more challenging to put into effect. Moreover, both royalties and rent taxes are frequently adopted alongside the corporate income tax, which displays a mixture of the advantages and flaws of the first two tax instruments. The simultaneous imposition of these different taxes should thus be no more objectionable in the digital sphere than in the natural resource sector. Finally, the taxation of LSR is already an important feature of existing international allocations of taxing rights, and the relationship of a DST—designed as a tax on LSR—to existing income tax treaties is straightforward to describe.

⁵ Rysman 2009, Levin 2011, Weyl & White 2014, White 2012, Evans & Schmalensee 2015.

Of course, the multi-sided market business models of digital platforms differ from natural resource extraction in many ways. The economic incidence and welfare effects of a DST levied on digital service revenue depend on a highly complex array of factors, some of which we highlight in a simple model.⁶ Uncertainty about the effect of a DST, however, should not be taken as militating only against DST proposals. Once platform rent is conceived as location-specific, there is a wide range of business models that can potentially be subjected to taxes on LSR, and the DSTs currently proposed by the EC, UK and Spain only target a small portion of these models. Potentially, much can be learned from the actual implementation of the DST in a narrow range of sectors.

Indeed, DST-like taxes may uniquely contribute to inter-nation equity in a future global economy dominated by artificial intelligence and labor-replacing technology. This is because they reasonably permit a country to extract foreign businesses' profits even in scenarios where the local resources utilized by such businesses (i) have little or no opportunity cost (i.e. they have no market), and, as a result, (ii) engender neither payment to or from the country. In such scenarios profit taxes that rest their jurisdictional claims on streams of payment are easily eroded, whereas DST-like taxes will remain capable of forcing inter-nation redistribution.

This paper proceeds as follows. Section 1 sets out some stylized examples showing how rent earned by digital platforms can be traced to specific locations—even when users from multiple jurisdictions participate. Section 2 then explains how the DST can be viewed as a tax on LSR and analogized to resource royalties. Section 3 sets out an economic model of the DST as a second-best tax on LSR, and explores consequences of the DST in terms of incidence and welfare. Section 4 shows why conceiving of platform rent as location specific (as we propose) has far reaching consequences, and why it might become especially relevant as a result of labor-replacing AI technology. The Conclusion discusses directions for further research.

1. Location-specific platform rent

Governments proposing the DST in 2018 have appealed to a notion of “user value creation” that many critics have taken as merely metaphorical. Some scholars, for example, consider the reference to “user value creation” as reflecting an (inexplicably late) recognition that “economic value”—that is, presumably, aggregate surplus—is created not just by producers/sellers, but also by consumers/buyers.⁷ In contrast, we believe that “user value creation” can have much more precise interpretations: it is a matter of identifying specific causal-locational origins of producer or consumer surplus.

Consider a hypothetical tech company, “Googl”, that has developed a technology (“Search Algorithm”), incurring large fixed costs and ongoing R&D expenses. Googl designs a Web interface in Country X’s language mainly for Country X individual users (alongside interfaces in many other languages for other countries), which also requires an upfront investment and maintenance spending. Googl operates servers in a low-tax jurisdiction Country Z to support its search engine and multiple interfaces, consuming much of Country Z’s electricity supply. Despite these very large non-marginal costs, Googl’s marginal cost from its revenue-generating business, targeted ad placement based on user searches, is

⁶ We show that when the marginal cost of providing services to advertisers/producers is not zero, a tax on platform revenue will be incident on both the platform and advertisers/producers, while the effect on consumers is ambiguous.

⁷ See, e.g. Becker and Englisch (2018).

almost zero. Googl is able to charge purchasers of advertising at well above marginal cost, because of the market power it possesses by virtue of network effects on the search platform.

Consider specifically one line of Googl' business, ad placement on the Country X interface targeted at Country X users. Among purchasers of advertising space on Googl are not only Country X businesses, but also producers/sellers of goods and services from other countries, including Country Y. The revenue Googl earns from ads targeted at Country X consumers and paid by Country Y producers is roughly its gross profit from this business because of zero marginal cost. Suppose that after allocating and deducting the non-marginal (e.g. electricity, depreciation of servers, etc) costs Googl incurs in Country Z against this profit, net profit π_{XY} remains. (The computation of π_{XY} does not yet take into account Googl's other non-marginal, e.g. R&D, expenditures.) It seems plausible to attribute this profit to Country X, if the following two conditions are satisfied:

- (a) The production functions and supply curves of Country Y producers (i.e. the purchasers of ad space) do not change because of Search Algorithm or the Googl's Country X interface.
- (b) Googl's earning of the profit π_{XY} does not interfere with its deployment of Search Algorithm in other countries.

The intuition behind condition (a) is that R_{XY} is extracted from additional producer surplus that Country Y producers expects to earn by making sales to consumers in X. If such expected surplus arises even if production functions have not changed, then it must come from a shift in the demand curve of the consumers in Country X, caused by the ads placed on Googl. That is, Googl's profit, earned from Country Y producers, has a causal origin in Country X, namely Country X consumers' engagement with the Googl platform. Importantly, although individuals doing online search and advertisers are all "users" of Googl, condition (a) articulates a situation where one can say that "user value creation" arises in one, but not the other, of the user jurisdictions. In this case, it is the consumer jurisdiction.

The intuition behind condition (b), on the other hand, is that since the deployment of Search Algorithm in Country X has no opportunity costs, it is plausible to view the entire profit π_{XY} as earned from Country X. This is so even if the infrastructural support for the platform is located in Country Z. While this infrastructure is entirely mobile, π_{XY} is immobile because it can be earned only in connection with Country X. Moreover, not only would π_{XY} not be attributed to Country Z (since the computation of π_{XY} already takes into account costs incurred there), it would also not be attributed to whatever country it is that is home to the R&D behind Search Algorithm.

The intuitions behind each of conditions (a) and (b) require further articulation and reflection. To that end, consider a second hypothetical example. Another tech company, "AirBB", has developed a technology, "Sharing Economy", that intermediates between consumers in need of short-term accommodation and property owners. AirBB has a similar cost structure as Googl, i.e. large fixed cost of investment in technology (endogenous to expectations of net profits), additional fixed costs associated with country interfaces, and zero marginal cost in facilitating transactions. The infrastructural support for AirBB's country interfaces can be located in any country and is again located in Country Z. AirBB earns revenue from charging consumers (i) who book accommodation located in Country X, and (ii) who may reside in another Country Y. After deducting non-marginal costs allocable against this revenue, AirBB profit from this line of business is π_{XY} .

An important difference between Googl and AirBB is that the latter's revenue is extracted from consumers, as a result of additional consumer surplus that the digital platform creates. This surplus arises thanks to the ability of AirBB to reduce transactions costs for property owners and bring them to

market. Therefore, it is plausible to postulate that while condition (b) holds for AirBB just as it does for Googl, instead of condition (a), an analogue condition holds:

(a*) The demand curve of Country Y consumers does not change because of Sharing Economy or the Country X interface.

Both landlords and tourists are users of AirBB. However, condition (a*) posits that “user value creation” arises mainly in the producer jurisdiction: changes in the supply curve are causally responsible for the increase in consumer surplus, which in turn generates revenue for AirBB. For this reason, it is plausible to attribute the latter’s profit to Country X and not Country Y.

What the AirBB example shows is that even when consumer platform use is involved, the location of platform profit is not a matter of the location of “final consumers”.⁸ Profit may be attributed to either producer or consumer locations, depending on the circumstances. Indeed, platform profit may arise not only from intermediated transactions with consumers, but also from intermediation of business-to-business transactions, business-investor transactions, and so on. One possible general formulation is that if a platform offers monopoly access to a good (be it consumer attention, sharable assets, etc), then the users owning the good are usually subsidized in the use of the platform, and profit is earned from those who want to access the goods. In these cases, it is the jurisdictions in which the good is located that are the sites of “user value creation”.

Of course, many platform technologies cause both supply and demand curves to shift. It may be both conceptually and empirically impossible to determine how much platform profit arises from one side as opposed to another. In these situations, if the two sides of the market are located in different jurisdictions, there are two locational sources of increases in producer and consumer surpluses, and no counterpart to condition (a) or (a*) exists to facilitate profit location attribution. Nonetheless, as long as condition (b) holds, it is still possible to attribute platform profit to the user jurisdictions—as opposed to Country Z (where the “production” of intermediation services occurs), or the countries in which the platform technologies are developed.

The preceding examples illustrate some basic intuitions about how platform profits can be attributed to specific locations. They are certainly not the only relevant intuitions. Take user data, for example. To the extent that user data is economically valuable and allows a platform company collecting such data to earn substantial profit—either by selling the data, or using the data to improve a propriety technology that in turn is profitable—one might have the intuition that profits generated from the data may at least in part be attributed to the locations of the users. The “mining” of data could be directly analogized to the mining of natural resources.⁹ Even something as mundane as user reviews that are now a pervasive feature of digital platforms may also help to tie platform profits to particular locations. Suppose that user reviews in Chinese are shown to substantially increase the number of Chinese buyers making purchases from an online retailer, the corresponding increase in the retailer’s profit may be attributed to the location of the community of Chinese users.

⁸ The idea of platform LSR is thus very different from suggestions for apportioning tax bases on a “destination basis” (e.g. Avi-Yonah et al 2009, Devereux and Vella 2018).

⁹ Such an intuition would still be strengthened if the user data provide unique value that is not obtainable from data generated by users elsewhere, and/or the realization of the value of such data does not have opportunity cost in terms of realizing the value of data from users elsewhere.

Some of the intuitions suggested here have radical implications. Suppose that American companies dominate the world in inventing powerful technologies accessed by users in all countries in the world, and that they earn monopoly profits in business models that depend on the participation of the users. Although the U.S. is the country in which the technologies are invented, by the profit-attribution reasoning we described above, only the profit derived from American users are attributable to the U.S. In the context of taxation, this means that the U.S. need not be the primary claimant to the profits that result from the technologies its companies invent. As long as the use of the technologies is non-rival, the countries in which the users are located may turn out to be primary claimants instead. We explore further implications of these intuitions in Section 4.

So far, we have spoken of platform “profit” attributable to specific locations, rather than directly of platform LSR. This is because in the examples given, although the marginal cost of earning platform revenue is basically zero, non-marginal costs must be considered: running costs (e.g. server depreciation and electricity usage in Country Z); country-specific upfront costs such as for setting up a Country X interface; and general investments costs for R&D. While running costs must be taken into account for determining whether a business is currently profitable, any net profit after the deduction of such costs still constitute only quasi-rent (short-term economic profit conditional upon prior investment). Pure economic rent can be measured only if the upfront expenditures are also taken into account. Conceptually, the measurement of true economic rent that is location specific would allow deductions for all investment costs, with such deductions allocated to the jurisdictions in which the expenditures for corresponding input purchases are made.

The definition and measurement of economic rent have been a subject of controversy and often confusion in the economic literature.¹⁰ In the context of services provided by digital platforms, the applicable concept is the Ricardian definition of rent. That is, rent is the amount earned by a factor of production or a resource in excess of the sum necessary for this resource to be supplied (Wessel, 1967). Where the crucial resource for a platform is either data supplied or activities pursued by individual users, it is non-rival at the point of supply and thus has no opportunity cost for the resource owner. Hence, it generates a Ricardian rent transferred from the individual users to the platform. This leads a natural justification of the taxation of this rent by the jurisdiction where the users are located. If the right to tax is the sovereign right of the state over its residents, in exchange for provision of protection and access to public goods and institutions, then the state is within its rights to tax the rent appropriated by a (non-resident) platform whenever the value of this rent is created by that state’s resident individuals. This is similar to the justification of royalties imposed by a state on the extraction of mineral resources from a territory over which that state has sovereign rights. In either case the rent is location-specific.

The significance of pure economic rent lies in the idea that a tax on such rent is non-distortionary. Moreover, if an item of pure economic rent can be attributed to a specific jurisdiction, the government in that jurisdiction would not only be able to claim primary taxing right over such rent but also impose a revenue-maximizing tax on the rent that is distinct from other taxes it levies on other tax bases (such as corporate income that may be neither rent nor location-specific). We now turn to the taxation of platform LSR.

2. The DST analogized to resource royalties

¹⁰ See Appendix for the discussion of the different definitions of rent.

Taxing LSR is an important policy objective of governments around the world. In fact, in recent years, as researchers converge on the conclusion that some traditional justifications for corporate income taxation (such as the prevention of shareholder deferral) have lost much relevance, taxing foreign shareholders on rent earned by domestic corporations (mostly through domestically-located activities) has come to be seen as one of the few remaining plausible arguments for keeping the source-based corporate income tax.¹¹

Governments also adopt a rich array of tax and non-tax instruments in addition to the corporate income tax to collect revenue from the rent-rich sectors of their economies. In the natural resource sector, for example, governments can reap revenue through auctioning licenses for resource extraction, taking public ownership in resource extraction enterprises, imposing sector-specific profit taxes, or adopting gross-revenue-based royalty regimes, among other means.¹² Moreover, governments often levy sector-specific taxes on extraordinary, “excessive-” or “super-” profit taxes, sometimes on temporary basis, to achieve both revenue-raising and distributional objectives.

In all these instances, there is a recognition that when above-normal profits are earned, governments can impose higher rates of taxation without distorting business decisions. This policy motivation is relevant even when the instruments used for extracting LSR are not designed perfectly to target economic rent. For example, the corporate income tax, tariffs on import, and export taxes can all succeed in capturing some LSR (Bankman et al 2018), even though they may also lead to the taxation of normal returns, risk taking, entrepreneurial effort, or savings, and generate corresponding distortions.

One of the most common ways in which governments tax LSR arising from natural resource extraction is the resource royalty: a flat rate charge on gross revenue.¹³ Most gross-revenue royalties either do not take current and capital costs incurred in resource extraction into account, or do so only to very limited degrees. At first blush, this seems highly distortionary. There will be situations where businesses abandon projects too early because the royalty makes a project with low margins unprofitable. Businesses are also discouraged from projects where they face any risk of not being able to recover costs. These objections are frequently made by private businesses, and may be responsible for one common feature of royalties, namely that they are typically set at low rates. Not surprisingly, an academic objection to low-rate royalties—that they under-tax resource rent and fail to maximize government revenue—is less frequently mentioned by business critics.

However, many have also recognized important virtues of resource royalties. Besides their administrative simplicity, royalties allow governments to collect revenue earlier and expose them to less risk, which is beneficial for governments in less wealthy countries (or sub-national jurisdictions) that do not enjoy the strongest state capacity. The revenue base of royalties also makes them robust to tax planning and profit shifting.¹⁴ Royalties can also be used to counter inefficient incentives of firms to extract resources either too fast or too slowly (Keen and Boadway 2015). Moreover, some of the key objections to royalties, such as that they discourage risk taking, also apply to income taxes and real-world rent taxes: few countries are willing, for example, to compensate businesses for final losses. The

¹¹ Auerbach et al 2010, Auerbach et al 2017, Boadway and Tremblay 2014.

¹² Keen and Boadway 2010, Lund 2014.

¹³ In Canada, for example, gross-revenue royalties levied by provincial governments dominate rent taxes and license auction revenue collected by the same governments (Boadway and Dachis 2015).

¹⁴ Since many firms in the natural resource sector are vertically integrated and conduct multi-national operations, a rent or profit tax’s vulnerability to profit shifting is particularly acute.

difficulty of implementing a pure tax on economic rent lends strong credentials to the resource royalty as a second best tax. Indeed, most recent commentaries on optimal design of natural resource taxation recommend the use of a mix of tax instruments in taxing resource rent, in which the resource royalty continues to play an important role.¹⁵

The DST is straightforwardly analogous to a resource royalty, when it is imposed by a government on the revenue of a digital platform earning quasi-rent that arises from the government's jurisdiction. Even though, seen as a tax on LSR, it suffers from many of the same flaws as resource royalties—the most important of which is that it is a tax on quasi-rent and thus may discourage investment—it can also avail of itself of some similar defenses, e.g. that it is robust to profit shifting. Indeed, for two reasons that are distinctive about digital platforms, one might argue that the DST may function even better as a tax on LSR than resource royalties.

The first is that the marginal cost of platform revenue is often (close to) zero. When marginal cost is different from zero, a tax on the revenue effectively alters the relative price of the inputs and outputs (tax makes inputs relatively more expensive). This distorts the production decision of the producer—and its pricing decision, when the producer has market power—and adds to the loss of welfare. Near-zero marginal cost results in a smaller distortionary effect. A tax on revenue then has an effect close to that of a tax on profit. Moreover, a company's shut-down decision will be determined only by average costs and not marginal costs. Insofar as average costs are more predictable than marginal costs, it may be easier to design a low-rate gross-revenue tax that approximates a tax on profit.¹⁶

The second is that the investment firms make to capture platform rent may differ from upfront investments in natural resource extraction in some significant ways. Much of this investment may be aimed at building market share, subsidizing users to begin using a platform and luring them away from existing services. Indeed this has been offered as one reason why, even though many platforms resemble natural monopolies, they are characterized by oligopolies and market fragmentation (Weyl and White 2014) All such investments thus generate only private, firm-specific returns and provide more limited benefits to consumers and no benefit to competing firms. As a result, the no-tax equilibrium in platform competition may well be inefficient. In the presence of such inefficiencies, the DST can serve as a corrective tax, in addition to being a rent tax on incumbents.

To our best knowledge, these two points have not received sufficient notice in the extant literature. Research modelling distortionary taxation of revenues of digital platforms, focuses on their effect on prices and tax revenues, and do not specifically discuss the deadweight loss or its relationship to the marginal cost of production. In a similar vein, theoretical models with different market structures focus on the effect of competition between platforms on prices and the effect of taxes on the pricing decisions of a monopoly platform or competing platforms in an oligopoly. They do not specifically address the issues of potential excessive entry and the effect of a revenue tax on market structure.¹⁷

¹⁵ Keen and Boadway 2015, Lund 2014. Governments have also tried to improve the efficiency of royalties by allowing royalty paid to be credited against subsequent rent tax liabilities (Boadway and Dachis 2015), by using fluctuating rates and negative rates (Wen 2018, Lund 2014), and in other ways.

¹⁶ [For instance, if a company expects minimum revenue in a given year that is greater than the total non-marginal cost (AC) for that year, the revenue tax can be set at a rate that ensures that the corresponding profit tax rate does not exceed a certain desired level.]

¹⁷ Existing work tends to simply assume a given market structure in carrying out analysis.

These important considerations merit attention especially for the medium- and long-term tax policy analysis.

3. A revenue-based tax as a second-best tax

Various options of platform taxation have recently attracted attention in the economics literature.¹⁸ In general, when firms are profit-maximisers, a profit tax is the best in the sense of being the least harmful to productive and allocative efficiency. A tax on revenue is equivalent to the tax on profit when a platform's marginal cost of service production is zero. It can, however, affect the shut-down and market entry-exit decision when there are fixed costs.

Existing theoretical analyses focus primarily on the market equilibrium effects of specific and ad valorem taxes in the presence of direct and indirect externalities among platform users, and on the relative merits of these two types of tax in terms of revenue and welfare effects.¹⁹ One important finding is that, in two-sided markets, in contrast to the "standard" markets, an ad valorem tax does not necessarily welfare-dominate other taxes (such as the specific tax), because of the interdependence of tax bases. Moreover, the effect of an increase in ad valorem tax rates can be opposite to the effect of an increase in specific tax rates.²⁰ Another observation, especially important for policy analyses, is the non-trivial incidence of tax which crucially depends on the nature and extent of externalities. The overall conclusion in the literature is that, because of the problems with measuring externalities in the relevant markets, the tax incidence is hard to predict.

a. Theoretical framework

Theoretical models of a platform usually describe it as a two-sided market in the spirit of Rochet and Tirole (2006). There are two types of users, one on each side; the platform sells two separate products (typically online services) to the users. The users are price-takers. On each side, the users' demand for the platform service depends on the number of users on the opposite side (an indirect externality). In addition, it may depend on the number of users on own side (a direct externality). Either externality can be positive or negative. Externalities not reflected in prices create distortion: negative externalities are over-supplied, and positive externalities are under-supplied (both relative to the socially optimal quantity). The platform "knows" about the direct and indirect effects among users and can, at least partly, internalise the externality by charging the users for the opportunity to interact.²¹ A market is two-sided if cost on one side cannot be fully passed through to the other side (for example,

¹⁸ Notable contributions include a collection of papers commissioned by France Stratégie, a public think-tank, published in a special issue of the *Journal of Public Economic Theory*, v. 20, 2018; available online at <https://onlinelibrary.wiley.com/toc/14679779/2018/20/1>, and a series of papers by Hans Jarle Kind and co-authors: see, for example, Kind et al. (2007, 2008, 2009a&b, 2010, 2013) and Kind and Koethenburger (2018).

¹⁹ Other aspects of digital taxation explored in recent literature include competition between platforms, competing provision of physical and digital media by the same firm, data collection and privacy choice, international competition, and location choice by multinationals.

²⁰ Kind et al. (2010); Kind and Koethenburger (2018).

²¹ Much of the literature on two-sided markets has been developed originally for credit cards and media markets in the late 1990s. The focus of analysis was on the regulation of competition. More recently, this literature has undergone a massive revival with the surge in policy debate around taxation of large internet companies in the wake of global financial crisis.

using side transfers).²² In other words, keeping the sum of two prices fixed, a platform can, by changing the allocation of prices, alter the number of transactions (or participation rates) and increase profits.

It is useful to distinguish between two types of two-sided markets: non-transaction and transaction type (Filistrucchi et al., 2013). A classic example of the former is media (either physical or internet-based): an interaction between users on two sides is present but not observable; hence a membership is feasible but not fees per transaction/interaction. In contrast, a classic example of a transaction-type two-sided market is payment cards: here transactions are observable, and all three pricing instruments—membership fee, usage fee, and two-part tariff—are feasible.

In its simplest formulation (Roson, 2005), the objective of a platform is to maximise profit,

$$\pi_{XY} = [p_X + p_Y - c_{XY}]I(N_X, N_Y) + [P_X - C_X]N_X + [P_Y - C_Y]N_Y - F$$

where N_j , $j=X,Y$ is the number of users of type j , p_j is the charge per interaction, or the usage fee, applied to type- j user, c_{XY} is the cost of creating an interaction between users, I is the number of interactions, P_j is the access fee, or the membership fee, charged to type- j user, C_j is the cost of creating access to type- j user, and F is the fixed cost. The market interaction is modelled as a two-stage game. In the first stage, the platform chooses prices, given availability of pricing instruments and given the structure of the market where the platform operates. In the second stage, the potential users decide whether or not to join the platform

We present an example below of a platform where type- X users are potential buyers of a good produced by type- Y users. The producers advertise their product on the platform. The technology allows to register “clicks”; each click is an interaction between two users on the opposite sides of the platform.²³ Thus, it is a transaction-type market, and the platform can charge usage fee, in addition to the access (membership) fee. We focus on the situation where the profit-maximising platform charges only transaction fees (but not access fees) to producers-advertisers.²⁴ As is common in the related literature, we further simplify the exposition by assuming that there is only one type of producers and only one type of consumers. Moreover, assuming the producers can be described by a representative firm, N_Y is interpreted as the number of ads posted by the firm, or the intensity of advertising.²⁵

In the analysis of the effect of tax increase on consumers the existing literature has tended to ignore the effect of adverts on the consumers’ demand for the advertised product, focusing entirely on

²² Consider the example of heterosexual nightclubs, which often charge entry fee to men but not to women. Charging men \$10 entry fee and letting women in free of charge can attract, say, 50 men and 50 women, while charging \$5 to everyone puts women off, and without women attracts only 70 men. A complete pass-through is possible if a man and a woman are an established couple who share resources (i.e. can make “side payments” to each other). Then it does not matter how the entry fee of \$10 is split between them. (Filistrucchi et al., 2013)

²³ One can interpret this as representing either (i) pay-per-click-based advertising offered by Google, Facebook, and other social media platforms, or (ii) online marketplaces such as Amazon or ASOS.com where the platform charges sellers commissions.

²⁴ This assumption is not overly restrictive: first, many online market places provide free access to buyers, and sales of advertising spaces is their primary source of revenue; second, it simplifies the exposition but the main results can be derived also for the case where potential buyers have to pay access fee.

²⁵ We think of a representative firm in the Marshallian sense, i.e. a firm whose supply curve and, in this context, whose demand for the platform services, coincide with the aggregate supply and aggregate demand of the industry.

the consumers' disutility from viewing adverts.²⁶ We fill this gap by analysing the effect of tax increase on consumer surplus with reference to the market for advertised product.

b. Effects of a revenue-based tax

The platform charges advertisers a usage fee ("pay-per-click"). There is an ad valorem tax at rate t on the revenue earned this way by the platform. The objective of the platform is to maximise the net of tax profit, taking the tax rate as given:

$$\pi_{XY} = \left[\frac{p_Y}{1+t} - c_{XY} \right] I(N_X, N_Y) + [P_X - C_X]N_X - F,$$

In addition to the standard assumption on the number of interactions, $\frac{\partial I}{\partial N_X} > 0, \frac{\partial I}{\partial N_Y} > 0$, we make the following assumptions about N_X and N_Y :

Assumption 1. $N_X = N_X(P_X, N_Y), \frac{\partial N_X}{\partial P_X} < 0, \frac{\partial N_X}{\partial N_Y} < 0$.

Assumption 2. $N_Y = N_Y(p_Y), \frac{\partial N_Y}{\partial p_Y} < 0$.

These assumptions state that the demand for the platform services is decreasing in price. In addition, Assumption 1 states that for any given access fee the consumers' demand for the platform service is lower, the greater is the number of ads to which they are exposed.

The market in this example is subject to two indirect externalities. There is a negative externality from producers to consumers, because consumers dislike the adverts. There is also a positive externality from consumers to producers, because an increase in the number of consumers using the platform raises the value of the platform to the producers by increasing the volume of sales.²⁷ These externalities are partly internalised by the platform through the fees charged to the users.

As in Rochet and Tirole (2003), we assume that $I(N_X, N_Y) = N_X N_Y$. If there is no restriction on prices, the profit-maximising prices satisfy the first-order necessary conditions,

$$(1) \quad 0 = \frac{\partial \pi_{XY}}{\partial p_Y} = \left[\frac{p_Y}{1+t} - c_{XY} \right] \left[N_Y \frac{\partial N_X}{\partial N_Y} + N_X \right] \frac{dN_Y}{dp_Y} + [P_X - C_X] \frac{\partial N_X}{\partial N_Y} \frac{dN_Y}{dp_Y} + \frac{1}{1+t} N_X N_Y,$$

$$(2) \quad 0 = \frac{\partial \pi_{XY}}{\partial P_X} = [P_X - C_X] \frac{dN_X}{dP_X} + N_X$$

Now we introduce the following notations:

²⁶ Bourreau et al. (2018) compare the effect of taxes on ads and on data collection in a model where consumers benefit from targeted, or personalised, ads. They do not, however, analyse the effect of taxes on the market for advertised goods.

²⁷ It is straightforward to analyse this external effect on producers' profits by considering the market for advertised goods, similarly to our analysis of consumers' surplus in Section 3ii.

$$\varepsilon_X \equiv -\frac{P_X}{N_X} \frac{\partial N_X}{\partial P_X}, \varepsilon_Y \equiv -\frac{p_Y}{N_Y} \frac{dN_Y}{dp_Y}, \sigma_{XY} \equiv -\frac{N_Y}{N_X} \frac{\partial N_X}{\partial N_Y}.$$

By Assumptions 1 and 2, all these three quantities are positive. The first two quantities are the standard price elasticities of demand of type- X and type- Y users, and the third quantity is the elasticity of demand of type- X users with respect to the type- Y usage intensity. It is defined as the percentage change in the number of consumers viewing the ads in response to one per cent increase in the number of ads, and it captures the extent of the negative externality.

Equation (2) can be rewritten as $\mu_X = \frac{1}{\varepsilon_X}$, where $\mu_X \equiv \frac{P_X - C_X}{P_X}$ is the markup over marginal cost.²⁸ That is, if the equilibrium solution is in the interior, the platform charges the consumers the standard monopoly markup (the inverse elasticity rule). In reality, we observe that by and large the consumers, or potential buyers, have free access to the online shops (apart from paying to their overall internet service providers). This would be the case when the profit-maximising price is negative, and it is not feasible for the platform to subsidise the consumers.²⁹ Then, the platform will choose to provide them with free access and earn revenues from the advertisers.

In what follows we will focus on this particular case, as it is most relevant for the practical purpose. In addition, without loss of generality, we will assume that the marginal cost of giving access to consumers is negligible, $C_X = 0$. This assumption can be relaxed without changing our main analysis.

We now focus on the optimal choice of the usage fee for advertisers. Setting $P_X = C_X = 0$, rewrite equation (1) in the form

$$(3) \quad \frac{1}{1+t} N_X N_Y = \left[\frac{p_Y}{1+t} - c_{XY} \right] \left[N_Y \frac{\partial N_X}{\partial N_Y} + N_X \right] \left[-\frac{dN_Y}{dp_Y} \right]$$

We assume that the second order condition holds, $H \equiv \frac{\partial^2 \pi_{XY}}{\partial p_Y^2} < 0$.

At the optimum, the platform equates the marginal benefit and the marginal cost of increasing the usage fee by one unit. When usage fee charged to advertisers is increased by 1 unit, the net of tax amount received by the platform is $\frac{1}{1+t}$ times the number of interactions, or “clicks. This is the expression on the left-hand side (the marginal revenue of price increase). Higher price reduces the number of adverts by $\frac{dN_Y}{dp_Y}$. This changes the number of consumers who are willing to join the platform by $N_Y \frac{\partial N_X}{\partial N_Y}$. Thus, the total change in the number of clicks is $\left[N_Y \frac{\partial N_X}{\partial N_Y} + N_X \right] \frac{dN_Y}{dp_Y}$, and the associated loss of profit is the expression on the right-hand side (the marginal cost of price increase).

Equation (3) can be rearranged as

²⁸ An alternative definition of markup used in the economic literature is $m \equiv \frac{p}{c}$, where p is price and c is marginal cost; it is related to our definition by $\mu = \frac{m-1}{m}$.

²⁹ See Schmalensee (2011) for the detailed analysis of the conditions for negative optimal prices.

$$1 = \frac{p_Y - c_{XY}[1+t]}{p_Y} \left[1 - \left[-\frac{N_Y}{N_X} \frac{\partial N_X}{\partial N_Y} \right] \right] \left[-\frac{p_Y}{N_Y} \frac{dN_Y}{dp_Y} \right],$$

and, using the notations for elasticities, expressed as

$$(4) \quad \mu_Y(t) = \frac{1}{\varepsilon_Y[1 - \sigma_{XY}]}.$$

This is, again, the inverse elasticity rule, but now the (net of tax) markup, $\mu_Y(t) \equiv \frac{p_Y - [1+t]c_{XY}}{p_Y}$, is equated to the inverse elasticity of demand adjusted to take into account the externality between the two sides of the platform. For the solution to be meaningful it must be the case that $\varepsilon_Y[1 - \sigma_{XY}] > 1$, otherwise the variable profit will be negative.

We are now in the position to investigate how the burden of an increase in tax will be distributed among the market participants. Note first that when all marginal costs of platform's operation, including the marginal cost of user interaction (c_{XY}), are zero or near zero, the sales revenue is identical or nearly identical to (variable) profit. In this case tax does not affect the pricing decision.

When the marginal cost of user interaction is positive and non-negligible, without externalities, an increase in tax would lead to a higher price charged to advertisers, and there is no effect on consumers. This is not necessarily the case in the presence of externalities: the price on either side of the platform can increase or decrease, depending on the sensitivity of the users' demands.

i. Tax incidence on advertisers

To calculate the effect of a marginal increase in the tax rate on the usage fee charged to advertisers we differentiate the first-order condition with respect to the tax rate and apply the envelope function theorem. The expression we obtain is the following:

$$(5) \quad \frac{dp_Y}{dt} = \frac{1}{-H} \frac{N_X N_Y}{[1+t]^2} [-1 + \varepsilon_Y[1 - \sigma_{XY}]] = \frac{1}{-H} \frac{N_X N_Y [1 - \mu_Y(t)]}{[1+t]^2 \mu_Y(t)}.$$

Clearly, as long as the mark-up is between zero and one, usage fee increases with tax. This increases the advertising expenditure for producers and depresses their profits.³⁰

ii. Tax incidence on consumers

We evaluate the effect of tax on consumers by calculating the change in the consumer surplus in the market for advertised good. Let p and q be the price and the quantity demanded of the advertised good. We make the following assumption.

Assumption 3. $q = q(p; N_X, N_Y)$, $\frac{\partial q}{\partial p} < 0$, $\frac{\partial q}{\partial N_X} > 0$, $\frac{\partial q}{\partial N_Y} > 0$.

³⁰ In the standard framework, advertising expenditure is part of the fixed cost for the producer.

This assumption states that the quantity demanded is a decreasing function of price, that it increases in the number of consumers viewing online adverts on the platform, and that it increases in the intensity of advertising. The second and the third part mean that advertising can be both informative and persuasive: it alerts consumers to the product and increases their willingness to pay for it by shifting the demand curve outwards for any given price.

Let p_0 be the choke price (the maximal price, above which the demand is zero), and let p^* be the market-clearing price of the advertised good. The consumer surplus is defined as

$$CS \equiv \int_{p^*}^{p_0} q(p; N_X, N_Y) dp.$$

Note that for the purpose of the production decision the advertising expenditure is a fixed cost, and so the supply curve is not affected by the tax on platform's revenue from advertising.³¹ The tax will, of course, change the intensity of advertising. Straightforward calculations show that

$$\frac{dCS}{dt} > 0 \Leftrightarrow \frac{\vartheta_Y}{\vartheta_X} < \sigma_{XY} < 1 - \frac{1}{\varepsilon_Y},$$

where $\vartheta_X \equiv \frac{N_X}{q} \frac{\partial q}{\partial N_X}$ and $\vartheta_Y \equiv \frac{N_Y}{q} \frac{\partial q}{\partial N_Y}$ are the elasticities of demand with respect to the number of online advert viewers and the intensity of advertising; both quantities are positive. The necessary condition for this double inequality to hold is that $\frac{\vartheta_Y}{\vartheta_X} < 1 - \frac{1}{\varepsilon_Y}$, which is more likely with low ϑ_Y and high ϑ_X . In other words, it is possible that an increase in tax on platform's advertising revenue raises consumer welfare when the demand for advertised product is less sensitive to the intensity of advertising than to the number of consumers viewing the adverts.

iii. Tax incidence on the platform.

This is a straightforward result, and we present it here for completeness:

$$\frac{d\pi_{XY}}{dt} = -\frac{p_Y}{[1+t]^2} N_Y N_X < 0.$$

Thus, an increase in tax is always detrimental for the platform and for the advertisers, but may be beneficial for the consumers. The overall effect on the social welfare in that case is ambiguous. An additional consideration, which is outside our simple model, is the welfare effect of a platform going out of business in a market with multiple platforms. If the business exhibits economies of scale, there may be an additional welfare gain from concentration and elimination of excessive investment.

4. Taxing Platform Rent and the Future

The current global debate about the DST focuses almost entirely on its role in promoting reforms of international income taxation: specifically, its desirability is taken to hinge on the possibility

³¹ The supply curve of a price-taking producer is the part of the marginal cost curve above the average cost, or the shut-down price level. Higher advertising expenditure increase the average, but not the marginal cost. Thus, as long as the average cost remains below the market price, the supply curve does not change.

of countries coming to an agreement about a reallocation of taxing rights under their income taxes.³² Not only business lobbies, but also the OECD and EU and even individual governments advocating the DST, have promoted the notion that the DST merely anticipates the *replacement* of the current assignment of taxing rights, and it could not justifiably be imposed in the long term *on top of* the corporate income tax. It is commonly claimed—and accepted—that the reallocation of international taxing right must be achieved through the negotiation of tax treaties, lest international taxation collapses into chaos.

Our analogy of the DST to taxes on resource rent in general and resource royalties in particular, however, casts doubt on whether this is a compelling way to assess the DST's merits. Countries impose taxes on LSR through a wide variety of tax and non-tax instruments. Whenever they thus extract a share of LSR earned by foreign investors, (loosely speaking) taxing rights among nations are being allocated. Yet most of such rent taxes, not to mention non-tax instruments for extracting private rent, are not subject to international coordination. If, for example, one country discovers a new mineral resource and imposes export tariffs on mineral exports, it would be quite odd for other countries to demand that the country make income tax concessions or modify its income tax treaties. Yet the DST has no greater intrinsic connection than such tariffs (or many other existing policy instruments) with corporate income taxation.³³

Indeed, taxing platform rent may have much greater policy significance than the reform of the corporate income tax. Recent debates about labor-replacing technology based on artificial intelligence (AI) has suggested the possibility of a more fundamental tax policy problem looming in the future. According to one narrative (Lee 2017), AI-fueled automation will replace most low-skilled and much high-skilled labor in rich and poor countries alike. In high-income countries, employment may shift towards service (such as care-giving) jobs, and because of the overall shrinking labor share, much of it would have to be financed publicly, either directly or indirectly through a universal basic income scheme. High-income countries can support such public spending through high rates of taxation imposed on firms reaping the returns to automated production. However, the distribution of technology firms is likely to be highly uneven among countries, with firms in countries (such as the U.S. and China) that have large populations and invested early and effectively in AI taking an insurmountable lead in AI research and application.³⁴ Most other countries without such firms would not have a corporate tax base with which to supplement or replace their dwindling labor income tax bases. By the same token, they would also lack capacity to finance the purchase of newer, non-automated services. In other words, automation could create extreme inter-nation inequality through eroding the labor tax base of technology-poor countries, while augmenting the tax base of technology-rich countries.

While this dystopian story is purely speculative, it is consistent with recent economic analyses of the existing international tax and transfer system, which have exposed the system's vulnerabilities. In particular, an important theme of the international taxation literature has been the mobility of capital and in particular of locations of production. Unless there is location-specific rent in the country of production, such country is unlikely to capture much of the return to capital, and automation would only make this problem worse. An alternative approach is to allocate taxing power according to where

³² The DST is considered necessary only if countries cannot agree on such a reallocation and continue to adhere to the existing income tax treaty framework.

³³ For further discussion, see Cui 2018.

³⁴ For academic work touching on this theme, see Goldfarb and Trefler 2018, and Korinek and Stiglitz 2017. See also Acemoglu et al 2017.

consumption occurs. However, this approach would favor the rich countries that can afford high levels of consumption, and aggravate both existing inter-nation inequality and potentially worse versions of such inequality in the future.

The approach to identifying location-specific rent that we describe in this paper, however, suggests another approach to allocating taxing power. The rent earned by technology, even if delivered from a mobile remote location, need not be treated as mobile itself, but can be attributed to jurisdictions without whose active participation the rent would not arise. Moreover, a tax base does not need to be associated with streams of payment: a jurisdiction in which consumers obtain services “for free”—in exchange for their personal data, attention, etc.—may still lay claim to a tax base if their citizens critically enable the generation of profits. All that is required is that some resource in the country generates a Ricardian rent—even if the party that can monetize such rent, e.g. a digital platform company—operates remotely.

These ideas—that the location of rent earned by technology-capital deployment can be decoupled from the locations of invention and production, and from the origins of payment—are important modifications of existing notions of what constitute LSR. They can be seen as the essence of what is conceptually novel about the DST. We believe that these ideas could take on greater normative significance in a future.

Conclusion

We have argued that conceiving of the DST as a tax on location-specific rent has important implication both for the current debate about reforming international taxation and for inter-nation redistribution in the future. While we believe our perspective is a novel justification of the introduction of DST, there are clearly many questions that we have not attempted to address.

In terms of the short-term policy objective of designing a DST that both generates revenue and minimizes distortions and disruptions to businesses, existing theoretical or empirical research sheds limited light. While claims that the burden of the DST will be completely passed onto consumers using digital platforms are probably not only exaggerated but even misguided in many instances,³⁵ it does not seem implausible that some of the cost of the DST may be passed onto purchasers of online advertising, online sellers, or even consumers.³⁶ Pass-through may arise from substantial running costs incurred by digital platforms, or from the impact of the DST on the relative margins a platform company charges on different sides of its businesses. Pass-through may also have distributional consequences. Smaller online sellers may be hurt more than larger ones. At the same time, if small online sellers in Germany are hurt by a DST imposed by the UK on transactions concluded with UK users, such effects are likely to be ignored by the UK government.

Evidence from the real-world implementation of the DST may help us understand these issues better. Another issue that actual DST implementation may reveal is its effect on market entry. We have suggested that the DST can be conceived not only as an efficient rent tax, but also as an efficiency-enhancing corrective (Pigouvian) tax on excessive market entry. An economic assessment of this effect

³⁵ In the case of advertising, for example, a DST may increase the fixed cost of advertising without changing marginal costs for sellers. In competitive markets the latter costs determine the price faced by consumers.

³⁶ When the DST is imposed on AirBnB, for example, it may be that consumers bear more of the burden of the tax (that is not borne by AirBnB itself) than landlords.

requires careful analysis of the DST in a dynamic setting, in particular, taking into account potential trade-off between cost-efficiency and competition. At the present, actual DST proposals all contain exemptions based on business size, which in theory could diminish the benefit of the DST as a Pigouvian tax. However, various commentators have suggested various legal challenges to size-based DST exemptions. How such legal issues are resolved may also affect the benefits of the DST.

All these effects are all the more worth studying, however, once we see the DST not as some arbitrary way of tinkering with the corporate income tax to achieve goals that could be accomplished otherwise. Instead, the DST, even while quite simple in design, is a genuinely innovative tax by virtue of targeting a genuinely novel tax base, e.g. platform rent that is location specific. The uncertainties and compliance costs associated with its introduction must be viewed in light of this fundamental benefit.

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Appendix. The definitions and measurement of rent.

Many tax instruments used by government to capture some of the economic rent earned by firms, such as the corporate income tax or tariffs on import and export, typically are not based on the precisely measured economic rent. The very definition of rent is a subject of controversy and often confusion in economics literature (see Suenaga, 2016, for a comprehensive list of sources and citations).

The Ricardian definition of rent is the amount earned by a factor of production or a resource in excess of the sum necessary for this resource to be supplied. In contrast, the Paretian definition of rent is the earning in excess of the sum necessary to keep this resource in its present occupation (Wessel, 1967). Thus, in the latter definition a rent is earning accrued to the resource in its specific use, in excess of the opportunity cost. A third, Marshallian definition of rent refers to the surplus in excess of the amount to induce supply of a resource fixed in the short run, and in this sense is a type of quasi-rent (Brar, 1977). Rent can also be defined as a differential surplus which takes into account non-pecuniary advantages of the resource owner (Mishan, 1959).

The definition and the measurement also depend crucially on whether the rent refers to a firm, an industry, or an economy. Thus, according to Shepherd (1970), for a competitive industry the rent in the Pareto sense is equivalent to the producer surplus and is measured as the area between the long-run supply curve and the price line. Marshallian rent is measured as the area above the industry's short-run supply curve (Michan, 1968). Brar (1977) demonstrates that the estimates of rent differ depending on the nature of the supply curve (short-run or long-run) and on the concept of rent (Ricardian, Paretian, or Marshallian).

Varian (2010) starts with Ricardian definition of rent and uses an example with land owned by a farm to conclude that, since economic profit must be zero, rent is "whatever it takes to drive profits to zero" (p. 425). Rent is further defined as the difference between the revenues and variable cost (equation 23.1 on p. 425), thus being equivalent to the producer's surplus. For an individual producer the rent can thus be calculated as the "area to the left of the marginal cost curve" (p. 425).

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