11-18-2019

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Citation Details
Wei Cui & Nigar Hashimzade, "The Digital Services Tax as a Tax on Location-Specific Rent" (2019) [unpublished].

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

Wei Cui* and Nigar Hashimzade†

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 platforms 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 from extracting natural resources, one can think of the DST as levied on rent earned by digital platforms from particular locations. We provide stylized illustrations of how platform rent can be assigned 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 incidence and effect on private and social welfare using a simple model. Finally, we argue that the DST suggests useful directions for redesigning international taxation in the age of labor-replacing AI technology.

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Introduction

On 24 July 2019, French President Emmanuel Macron signed legislation enacting the digital services tax (DST), thereby giving real life to a tax policy idea that, though virtually unheard of before 2018, has become perhaps the most controversial subject in international taxation. The French DST, a 3% tax levied on the revenue of large digital platform companies earned from advertising, online intermediation, or the transmission of data, is modeled on a similarly-named tax that had been proposed in March 2018 as a European Council Directive (European Commission 2018). The United Kingdom (UK) government had also staked out its own DST in March 2018, and in July 2019 released detailed proposed legislative language, draft administrative guidance, as well as further policy explanations (HM Revenue and Customs 2019a and 2019b; HM Treasury 2019). Spain, Austria, and the Czech Republic have also introduced DST legislation.

Just as importantly as these national developments, the European Commission (EC), UK and French DSTs have spurred into action one of the highest-profile and highest-stake negotiation processes in recent years at the Organization for Economic Cooperation and Development (OECD). In May 2019, the OECD announced a “Programme of Work to Develop a Consensus Solution to the Tax Challenges Arising from the Digitalisation of the Economy”, which explicitly considers, in addition to several other proposals, methods that refer to “user participation” for revising the profit allocation rules under international income taxation (OECD 2019a, b). In September 2019, Margrethe Vestager, the incoming EC vice president, indicated that if no effective agreement is reached at the OECD by the end of 2020, the EC would enact a European Union-wide DST. This was followed by the OECD Secretariat Proposal (OECD 2019c) for a “Unified Approach” released for public consultations in October 2019. In the meantime, the United States government and U.S. multinationals have bitterly protested against the French DST, with Donald Trump threatening retaliatory tariffs against imports from France. The
sentiment is widely expressed that if the U.S. cannot stop the French DST, similar taxes would certainly proliferate.

Despite its frequent appearance in news headlines in the last year, the DST remains poorly understood by the public. Before its proposal by national governments and the EC, the DST had no intellectual proponent: as far as we are aware, it was not anticipated in the existing public finance or other academic literature. Critics often portray the DST as nothing more than a protectionist tariff, or at best a poorly-designed cascading tax on consumption (Congressional Research Service 2019). Some commentators go further in demonizing the DST, asserting that it violates income tax treaties, World Trade Organization rules, and European Union principles, creates unacceptable double taxation, represents aggressive unilateral action and bad faith in international relations, and/or fails to achieve its intended purpose. The news media has tended to parrot these allegations, frequently also conflating the DST with the value added tax imposed on imported digital services. Even OECD officials, perhaps hoping to leverage the opposition to the DST to induce commitment to an OECD consensus, have taken to portray the DST as something to be avoided at all costs.

In contrast to this prevailing negative discourse about the DST, we offer a justification of the DST as a tax on location-specific rent (LSR). That is, just like royalties levied by many national and sub-national governments on revenue from natural resource extraction, the DST can be thought of as a tax on economic rents earned by digital platform companies from particular locations. Once the DST is analogized to resource royalties, it immediately becomes transparent that many of the legal objections against the DST are misguided. For instance, just as income tax treaties typically do not cover resource royalties, the DST is almost certainly not a “covered tax” and poses no threat to tax treaties. It is also

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1 Taxes on advertising revenue and subscription fees earned by digital platforms are discussed in France Stratégie 2015, Bourreau et al 2018, Kind & Koethenbuerger 2018, Belleflamme & Toulemonde 2018, Kind et al. (2008, 2009a, 2009b, 2010), and other recent theoretical literature, but generally within the domestic context.
highly distinct from tariffs and unlikely to trigger WTO scrutiny. Finally, it is standard practice to offer only a deduction, and not a foreign tax credit, under the income tax for foreign taxes on LSR, so that there should be no presumption that the DST should be creditable.

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. Moreover, the existence of monopoly rent is compatible with the observations 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 (IMF, 2019). However, the most important tax base for the DST in the near future is likely to be revenue from advertising and intermediation of consumption transactions. To see such business models as generating LSR, two observations are useful. First, 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. Second, in some instances, it may be possible to identify causal

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origins of platform rent: new producer or consumer surplus arise because of changes in one of the jurisdictions where platform users reside.

Indeed, we believe that these two observations correspond to two genuinely new problems in international taxation which are of interest independently of the DST (but to which DST proposals provide attractive solutions). The first is that the non-rival use and remote deployment of digital technology generate a significant new class of LSR that the international tax system has not previously recognized. The second is that two-sided business models operating at a global scale create misalignments between sources of value creation and origins of payment. Recognizing these problems is crucial to understanding the DST, and the first intended contribution of our paper is to provide a clear statement of these problems.

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, which has been explored in the existing literature only in a limited fashion. In the second contribution of our paper, we model the incidence of ad valorem tax levied on the platform’s sales revenues in the presence of indirect externalities. We calculate the effect of tax on the platform and on the two types of users, buyers and sellers/advertisers, in the presence of indirect externalities and relate it to the sign and the extent of the externalities. We show that tax can be beneficial (raise the surplus) for buyers or sellers, or, indeed, for both types of users. Finally, we derive the necessary conditions for the tax to be welfare-improving: it must be the case that tax leads to an increase in the number of advertisers on the platform. This holds when both indirect externalities are positive with at least one being sufficiently weak, or when the indirect externality from sellers to buyers is negative (more sellers/advertisers make platform less attractive for buyers).
A third contribution of our paper is to put the DST within a familiar tax policy frameworks. 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 existing literature on natural resource taxation recognizes that revenue-based taxes are easier to implement and more robust against tax planning than the latter, as well as providing revenue to governments earlier. Rent taxes are less distortionary, but both practically and politically more challenging to put into effect. Moreover, both (revenue-based) royalties and rent taxes are frequently adopted alongside the corporate income tax, and the latter displays a mixture of the advantages and flaws of the first two tax instruments. The simultaneous imposition of these different taxes is no more objectionable in the digital sphere than in the natural resource sector.

The only existing economic analyses of the DST we are aware of (developed independently from and simultaneously with our paper) are found in Pellefigue (2019) and Richter (2019). Pellefigue (2019) provides informal arguments concerning the French DST’s incidence. More notably, Richter (2019) demonstrates that when digital services can be delivered remotely at zero marginal cost, it may be rational even for small countries to impose tariff-like taxes on the remote delivery of digital services. Richter (2019) argues (in our view correctly) that the remote delivery of services at zero marginal cost raises vital international tax policy questions to which the traditional international tax framework, which focuses on permanent establishments and transfer pricing to determine the scope of source country taxation, provides no relevant guidance (for related arguments, see Cui 2019). We also agree with Richter that the growing international trade in digital services is likely to remain asymmetrical, because technological innovation is likely to be characterized by agglomeration effects. Indeed, we believe this is why it is important to articulate intuitions about how rent from technology deployment should be attributed. Our paper differs from Richter (2019) in two main respects. First, the DST Richter models is a tariff-like tax on business-to-business transactions (e.g. cloud-computing). The main applications of the French, UK, and EC DSTs as discussed in 2019, however, are not tariff-like and feature online
intermediation involving consumers. Our model thus better fits the actual DSTs. Second, we emphasize normative intuitions about attributing rent to locations. In effect, we highlight senses in which service importing countries may not only be rational (in terms of national-welfare-maximization) in imposing DSTs, but also be reasonable and acting fairly in doing so.

The rest of the paper proceeds as follows. Section 1 sets out the basic arguments about how rent earned by digital platforms can be traced to specific locations—even when users from multiple jurisdictions participate. It also explains why these forms of LSR are neglected under the traditional international taxation framework. Section 2 then discusses how the DST can be analogized to resource royalties. Section 3 sets out an economic model that explores the DST’s incidence and impact on welfare. Finally, in Section 4 we briefly discuss why conceiving of platform rent as location specific (as we propose) has far reaching consequences, and why it might become especially relevant in the age of asymmetrical technological growth.

1. Location-specific platform rent

Governments proposing the DST appeal to the notion of “user value creation”: digital platforms derive their profit from the value-generating activities of their users (EC 2018, HM Treasury 2019). Many critics have dismissed this concept as hopelessly metaphorical. In contrast, we believe that “user value creation” potentially affords precise interpretations: it does not merely acknowledge that there are different types of participants in platform profit generation; instead it articulates specific and normatively appealing ways in which platform rent can be attributed to particular locations.

Consider a stylized example of a digital platform, Googl (based on Google, one of the companies subjected to the DST). Suppose that Googl’s technology is developed in the United States and its entrepreneurs reside there. Among many of its interfaces designed for users in different countries, Googl has an interface in French mainly targeted at individual users in France. Googl operates servers in
a low-tax jurisdiction, say Ireland, to support its search engine and multiple interfaces. Googl’s IP-holding subsidiary, where most of its profit is booked, is also formed in Ireland. Finally, suppose Googl earns advertising revenue from German carmakers who wish specifically to target French consumers. Googl’s marginal cost from its main revenue-generating business, targeted placement of advertisement based on user searches, is close to zero. Therefore, the revenue Googl earns from German producers for ads targeted at French consumers is roughly its gross profit from this line of business. Suppose that after allocating and deducting non-marginal costs (e.g. electricity, server, etc.) that Googl incurs in Ireland against this profit, a net profit remains. Such profit represents a form of quasi-rent: it would not have been possible without large upfront investments and ongoing R&D expenses incurred by Googl.

For such profit to be realized, the contributions of at least four types of participants, from four different countries, seem relevant:

- Producers willing to pay for advertising slots (Germany);
- Consumers at whom the ads are targeted (France);
- The servers enabling the remote delivery of online advertising services (Ireland);
- The investors and entrepreneurs who invented Google’s technology and business (United States)

Under the current international tax regime, much of Googl's profit would be allocated not to France or Germany, but to Ireland (where the relevant legal entity resides). The United States, as the country of Googl’s R&D and entrepreneurship, has the choice of allocating more of Googl’s profit to itself (through transfer pricing and controlled foreign corporation rules), but declines to do so. France levies the DST on Googl’s revenue from advertisements targeted at French consumers, claiming that French users create value. Yet skeptics ask: What is special about France? One can say, with respect to persons in each of all four countries above, that “but for” their participation, Googl’ profit would not be
realized. Thus, it may seem that value is created in all four countries, with no place being “the” place of value creation. Assigning Googl’s profit only to France, the skeptics argue, is completely arbitrary.

Such skeptical claims, however, fail to acknowledge certain strong intuitions about how rent might reasonably be attributed to specific locations. To begin, there are strong reasons to think that attributing Googl’s profit to Ireland would be mistaken. This is because Googl could have chosen to locate its server and IP-holding entity in any number of other tax haven jurisdictions. To attract Googl to itself, Ireland cannot claim any of Googl’s rent.

Next, important arguments can also be made that Googl’s profit cannot be attributed to Germany. First, note that the production functions of German carmakers do not change because of Googl’s advertisements targeted at the French. German carmakers are willing to pay for advertisement on Googl because of the additional producer surplus that they expect to earn by making sales to French consumers. But this expected producer surplus arises not because of any change in production, but from an expected shift in the demand curve of French consumers that occurs without anything changing in Germany. In addition, German carmakers come to Googl for the users of Googl’s search engine; French users do not come to Googl’s interface because of advertisements for German cars. Googl’s ability to profit from German carmakers depends on its control of access to French users.

Second, while the marginal cost of placing advertisements is almost zero, selling advertising slots to German carmakers may have opportunity costs for Googl. If the tolerance of French users of Googl for advertisements is finite, Googl’s placement of advertisements by German carmakers come at the expense of other potential advertisers. Thus at least some of the profit Googl earns from German carmakers could have been made from advertisers elsewhere (even though German carmakers were the highest bidders). In this sense, too, it would also be wrong to attribute Googl’s profit to Germany.
These same arguments, however, make it potentially compelling to attribute Googl’s profit to France. First, the success of Googl’s advertising business in the hypothetical example depends on Googl’s ability to bring French users onto the platform. Second, the business of targeting ads at French consumers is non-rival with respect to the business of targeting ads at consumers elsewhere. That is, the revenue to be earned from providing access to French consumers can be earned only from targeting French consumers. The rent is attached to France in a way that it is not to Ireland (because of the existence of many substitutes for Ireland) or to Germany (because German advertisers replace those from elsewhere for limited advertising space, and because no activity transpires in Germany).

By this line of reasoning, the United States is the only remaining contender with France for attributing Googl’s rent. Given that user activity on Googl requires both French users and Googl’s unique technology, why shouldn’t the rent be attributed to the U.S., where the technology is invented and developed into a successful business model? The reply is that it is again significant that Googl’s technology can be simultaneously deployed in difference places in the world. If this were not the case—if the technology being deployed in one place has opportunity costs in it not being deployable elsewhere—then any rent Googl earns from a given place does not attach to that place. In such a scenario, if the rent were to be assigned anywhere, it may need to be assigned to the place where the technology is invented or where its owner resides. However, in the case of non-rival use of technology, the rent earned from a given place does not displace the earning of rent elsewhere. Thus while any rent from the technology’s deployment in the U.S. (i.e. for U.S. users) should be attributed to the U.S., the rent from the technology’s deployment vis-a-vis French users should be attributed to France.

The foregoing arguments suggest that in the hypothetical example of Googl, it is possible to make meaningful distinctions between the four countries involved in Googl’s operation. The assignment of Googl’s rent earned from French-targeted ads to France goes beyond the platitude that “but for” French consumers, Googl cannot make a profit in this way. If our ability to draw such distinctions is
stable and coherent, it would be wrong to assert that all we can say about “value creation” is (the platitude) that all countries are needed to create value.

To demonstrate the stability of the intuitions motivating the reasoning above, consider another hypothetical example. Another tech company, AirBB, is owned by entrepreneurs from the U.S. who developed the relevant technology there. AirBB intermediates between property owners and consumers in need of short-term accommodation. AirBB has a similar cost structure as Googl, i.e. large fixed costs of investment in technology, additional fixed costs associated with country interfaces, and zero marginal costs in facilitating transactions. AirBB’s server and IP-holding subsidiary are again in Ireland. AirBB earns revenue from charging French consumers who book accommodation located in the U.K. After deducting fixed costs allocable against this revenue, AirBB earns a net profit from this line of business.

As in the case of Googl, French consumers participate in AirBB’s operations. They in fact make direct payments to AirBB. The reasoning offered above, however, suggests attributing AirBB’s profit not to France, but to the UK. This is because in AirBB’s business model, 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. The UK property owners on AirBB are the counterpart to the French consumers on Googl: just as Googl pushes the demand curve of French consumers outward, AirBB pushes the supply curve of UK property owners outward. Both are brought to market through subsidies, and generate opportunities for earning platform rent that is non-rival with technology deployment elsewhere. Conversely, French consumers using AirBB are like German carmakers purchasing ads on Googl: Both go to the digital platform to access opportunities uniquely available from the other side. The use of the platform by each generates opportunity costs for the platform (due to limited ad slots targeted at consumers, or limited properties for rental). One can even imagine that just as the German carmakers’ supply curve is unchanged, the French tourist’s demand curve for UK property remains unchanged.
In other words, the logic of rent attribution not only can distinguish between different participants on the same platform in terms of their roles in “value creation”, but also can distinguish between the value creation roles of the same participants on different platforms. The AirBB example shows, for instance, that “value creation” is not a matter of consumer residence.

In the AirBB example, however, the intuition that the platform’s rent should not be attributed to Ireland remains as before. And assuming that AirBB’s technology can have non-rival deployment in different countries just like Googl’s search and advertising platform, the rent earned by AirBB from the participation of UK landlords should not be attributed to the place of the invention of AirBB technology, or the residence of AirBB’s owner.

Thus far, we have suggested an interpretation of “user value creation” in terms of the appropriate attribution of platform rent. The definition and measurement of economic rent have been a subject of controversy and often confusion in the economic literature. In the context of services provided by digital platforms, the applicable concept we advocate 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 has no opportunity cost for the resource owner. Hence, a Ricardian rent is transferred from the individual users to the platform. This leads to a natural justification of the taxation of such 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 rent is created by that state’s resident individuals. Moreover, if an item of pure economic rent can be attributed to a specific jurisdiction, the government in that jurisdiction would be able not only to claim primary taxing right over
such rent, but also impose a revenue-maximizing tax that is distinct from other taxes it levies on other tax bases (such as corporate income that may be neither rent nor location-specific).

Insofar as the above reasoning about platform rent attribution is accepted, two challenges for international taxation can be immediately identified. First, the location of platform rent (France in the case of Googl and UK in the case of AirBB) may be completely different from the source of payment (Germany in the case of Googl and France in the case of AirBB). Because income tax rules frequently determine the source of income by reference to the source of payment, they do not easily allow the governments in locations where rents arise to capture such rent. In fact, even tariffs are generally imposed by countries from which payments are made, which means that they cannot solve the problem arising from the misalignment between rent location and payment either. Second, there is no coherent guidance under traditional income taxation about how to locate the return to technology. Whether the deployment of technology is non-rival has rarely been recognized as a relevant consideration.

It is its attempt to deal with these two challenges that the DST stands out as a policy innovation. The DST would allow France to impose a levy on payments that Googl receives from Germany, or the UK to levy a charge on what AirBB receives from France. The DST is thus fundamentally unlike both income taxes and tariffs. Moreover, it targets platform technologies that have non-rival use, and boldly challenges the assumption that countries of technology development and ownership alone are entitled to tax the return to technology.

2. The DST analogized to resource royalties

Taxing LSR is an important policy objective of governments around the world. In fact, in recent years, researchers have converged on the conclusion that traditional justifications for corporate income taxation, such as the prevention of shareholder deferral, have lost much relevance (Auerbach et al 2010). Consequently, taxing foreign shareholders on rent earned by domestic corporations (on
domestically located activities) has come to be seen as the main argument for keeping the source-based corporate income tax (Auerbach et al 2017, Boadway and Tremblay 2014).

In reality, in addition to the corporate income tax, governments also adopt a rich array of tax and non-tax instruments to collect revenue from the rent-rich sectors of their economies. In the natural resource sector, governments can reap revenue through auctioning licenses for resource extraction, taking public ownership in resource extraction enterprises, or adopting gross-revenue-based royalty regimes, among other means (Keen and Boadway 2010, Lund 2014). Governments also levy sector-specific taxes on extraordinary, “excessive-” or “super-” profits 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 instruments used for extracting LSR do not perfectly target economic rent. For example, the corporate income tax, tariffs on import, and export taxes can all succeed in capturing some LSR, 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 resources is the resource royalty: a flat rate charge on gross revenue. Most gross-revenue royalties either do not take current and capital costs 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 sufficiently high risks of not being able to recover costs. 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

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3 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).
for governments in less wealthy countries (or sub-national jurisdictions). Moreover, since many firms in the natural resource sector are vertically integrated and conduct multi-national operations, the vulnerability of rent or profit taxes to profit shifting is particularly acute. The revenue base of royalties also makes them robust against tax planning. Royalties can also be used to counter inefficient incentives of firms to extract resources either too fast or too slowly (Boadway and Keen 2015). Finally, some of the key objections to royalties, such as that they discourage risk taking, also apply to income taxes and real-world rent taxes. That is, the 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 the optimal design of natural resource taxation recommend the use of a mix of instruments, in which the resource royalty continues to play an important role (Keen and Boadway 2015, Lund 2014.)

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. Indeed, for two reasons that are distinctive about digital platforms, one might argue that the DST functions even better as a tax on LSR than resource royalties. First, the marginal cost of platform revenue is often (close to) zero. A tax on revenue is close to being a tax on profit. Moreover, a company’s shut-down decision will be determined only by average costs, which may be more predictable than marginal costs and may render it easier to design a low-rate revenue tax that approximates a tax on profit.

Second, 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, the current markets are characterized by fragmentation and prevalence of oligopolies (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 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 does not specifically discuss the relationship of deadweight loss to the marginal cost of production. Similarly, models with different market structures focus on the effect of competition between platforms on prices, or the effect of taxes on the pricing decisions of a monopoly platform or competing platforms in an oligopoly. They do not address the issues of potential excessive entry and the effect of a revenue tax on market structure. While these important considerations also lie beyond the scope of our analysis below, they merit further attention for tax policy analysis.

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

Critics of the DST have made sweeping claims about how the tax is distortionary and would simply be passed on to final consumers. In this section, we develop a model illustrating how we think about the DST’s incidence effects and argue that these effects may fall well within the range of normal policy tradeoffs between revenue needs and distortionary effects.

a. Theoretical framework

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

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

A market is two-sided if costs on one side cannot be fully passed through to the other side (for example, using side transfers). 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: the non-transaction type and the transaction type (Filistrucchi et al., 2013). A classic example of the former is media (physical or internet-based): an interaction between users on two sides is present but not observable; hence a membership or access fee is feasible but not fees per transaction/interaction, or usage fees. In contrast, a classic example of a transaction-type two-sided market is payment cards: here transactions are observable, and a membership fee, a usage fee, or a two-part tariff are all feasible.

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

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

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, \( c \) is the cost of creating an interaction between users, \( I \) is the number of interactions, \( P_j \) is the access or 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

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5 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)
first stage, the platform chooses prices, given the availability of pricing instruments and the structure of the market where the platform operates. In the second stage, the potential users decide whether to join the platform.

We present an example below of a platform where type-\(X\) users are potential buyers of a good produced and/or sold by type-\(Y\) users. The sellers advertise their product on the platform. The technology allows the platform to register “clicks”; each click is an interaction between two users on the opposite sides of the platform. Thus, it is a transaction-type market, and the platform can charge usage fee, in addition to the access (membership) fee. To simplify exposition, we abstract from direct externalities and only consider indirect externalities. We analyse the case of a monopolistic profit-maximising platform which charges only transaction fees (but not access fees) to the users and focus on the situation where it is optimal to charge only the sellers/advertisers and provide free service to the potential buyers. As is common in the related literature, we further simplify the exposition by assuming that there is only one type of sellers and only one type of consumers. Moreover, assuming the sellers can be described by a representative firm, \(N\), is interpreted either as the number of sellers or as the number of ads posted by the representative seller, or the intensity of advertising.

We start with deriving the profit-maximising prices and establishing the free-service condition for buyers. Next, we analyse the incidence of ad valorem tax levied on the platform’s sales revenues in the presence of indirect externalities. We calculate the effect of tax on the platform and on the two types of users and relate it to the sign and the extent of the externalities. We show that tax can be

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6 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.

7 This situation 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 all users have to pay transaction and/or access fee.

8 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.
beneficial (raise the surplus) for buyers or sellers, or, indeed, for both types of users. Finally, we derive the necessary conditions for the tax to be welfare-improving: it must be the case that tax leads to an increase in the number of advertisers on the platform. This happens when both indirect externalities are positive with at least one being sufficiently weak, or when the indirect externality from sellers to buyers is negative (more sellers/advertisers make platform less attractive for buyers). If tax leads to the loss of welfare, in the latter case the welfare loss will tend to be smaller. The detrimental effect of tax is the strongest when both indirect externalities are positive and strong, - that is, when platform internalizes the externalities by bringing the two types of users together and charging usage fees.

b. Profit maximisation by a monopoly platform

The platform charges buyers and advertisers a usage fee. There is an ad valorem tax at rate $t$ on the revenue earned from advertising by the platform. The objective of the platform is to maximise the net of tax profit, taking the tax rate as given:

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

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. $N_X = N_X(p_X, N_Y), \frac{\partial N_X}{\partial p_X} < 0, \frac{\partial N_X}{\partial N_Y} \neq 0$.

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

These assumptions state, first, that the demand for the platform services is decreasing in price. In addition, Assumption 1 states that for any given transaction fee the buyers’ demand for the platform

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9 The analysis can be easily extended to the case where revenue from buyers’ usage fees are also subject to tax.
service can be either higher or lower, the greater is the number of ads to which they are exposed.\(^{10}\)

Assumption 2 states that for any given transaction fee the advertisers’ demand for the platform services is higher, the more potential buyers are using the platform. These indirect 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,

\[
0 = \frac{\partial \pi_{XY}}{\partial p_X} = \left[p_X + \frac{p_Y}{1 + t} - c\right]\left[N_X \frac{\partial N_Y}{\partial N_X} + N_Y \frac{d N_X}{d p_X} + N_X N_Y,\right]
\]

\[
0 = \frac{\partial \pi_{XY}}{\partial p_Y} = \left[p_X + \frac{p_Y}{1 + t} - c\right]\left[N_Y \frac{\partial N_X}{\partial N_Y} + N_X \frac{d N_Y}{d p_Y} + \frac{1}{1 + t} N_X N_Y,\right]
\]

In many situations platform pricing is skewed (Bolt and Tieman 2008; Schmalensee 2013): price paid by one type of users is much lower than the price paid by the other type, and often platform provides free service to users on one side. Bolt and Tieman (2008) analysed the situation where profit is not a globally concave function of prices, and so zero price for users on one side is a corner solution for profit maximisation. Schmalensee (2013) showed that zero price on one side can be profit-maximising when profit is globally concave, but the demands on two sides are very different. Below, we establish when the platform will not charge users in group X (the buyers) in the presence of indirect externalities.

We assume that the profit is globally concave, and the second-order condition holds. That is, the Hessian matrix of the second-order partial derivatives of profit with respect to prices is negative definite, so that its determinant \(H\) is negative.

\(\text{---}\)

\(^{10}\) One can think of a platform with positive indirect externality from advertisers to buyers as a market place, whereas a negative indirect externality from advertisers to buyers may exist on a social media platform if buyers dislike the adverts. More generally, the effect can be non-monotone, - for example, buyers may feel that adverts are useful but become irritated if there is too many of them.
We are interested in the situation where the solutions \( p_X, p_Y \) to the system of equations (1)-(2) are such that \( p_X < 0, p_Y > 0 \). In particular, this implies that \( \frac{\partial \pi_{XY}}{\partial p_X} < 0 \) for all \( p_X \geq 0 \).

We introduce the following notations:

\[
\varepsilon_X \equiv -\frac{p_X}{N_X \frac{\partial N_X}{\partial p_X}} > 0, \quad \varepsilon_Y \equiv -\frac{p_Y}{N_Y \frac{\partial N_Y}{\partial p_Y}} > 0,
\]

\[
\sigma_{XY} \equiv \frac{N_Y}{N_X} \frac{\partial N_X}{\partial N_Y} \neq 0, \quad \sigma_{YX} \equiv \frac{N_X}{N_Y} \frac{\partial N_Y}{\partial N_X} > 0.
\]

The first two quantities are the standard price elasticities of demand of type-X and type-Y users, and the last two quantities are the elasticities of demand (or number) of users on one side of the platform with respect to the demand (or number) of users on the opposite side. For example, \( \sigma_{XY} \) is defined as the percentage change in the number of consumers viewing the ads in response to one percent increase in the number of ads, and it captures the extent of the indirect externality.

Using these notations, rewrite condition \( \frac{\partial \pi_{XY}}{\partial p_X} < 0 \) at \( p_X = 0 \) as

\[
(3) \quad \frac{1}{1 + \sigma_{YX}} < \left( \frac{p_Y}{1 + t} - c \right) \left[ -\frac{1}{N_X \frac{\partial N_X}{\partial p_X}} \right]_{p_X = 0}
\]

This is more likely, the stronger is the indirect externality from buyers to sellers (larger \( \sigma_{YX} \)) and the more price-sensitive is the buyers’ demand for platform services near zero price (a small increase in price from zero leads to a large drop in the quantity demanded).\(^{11}\)

If subsidising users is not feasible, the platform will provide free service to buyers and charge sellers the price that solves

\[
(4) \quad \mu_Y(t) = \frac{1}{\varepsilon_Y [1 + \sigma_{XY}]},
\]

\(^{11}\) See Schmalensee (2011) for the detailed analysis of the conditions for negative optimal prices.
where $\mu_Y(t) \equiv \frac{p_Y - (1+t)c}{p_Y}$ is the monopoly’s price mark-up over tax-adjusted marginal cost.\textsuperscript{12} Equation (4) is the inverse elasticity rule modified to account for the indirect externality. One can see that positive indirect externality from sellers to buyers lowers the mark-up,\textsuperscript{13} whereas negative externality makes it higher.

The platform makes positive profit as long as $\sigma_{XY} > -1$ and $\varepsilon_Y > \frac{1}{1+\sigma_{XY}} > 0$. This condition allows for positive or not too strong negative externality from sellers to buyers. In the context of advertising, the buyers may like or dislike advertising, but the disliking should not be too strong.

The next step is to calculate the effect of tax on the prices and user demand for platform services.

c. Effects of a revenue-based tax on platform pricing and user demand

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 the marginal cost of user interaction is negligible, the sales revenue is nearly identical to (variable) profit. In this case tax has little or no effect on the pricing decision.

When the marginal cost of user interaction is positive and non-negligible, an increase in tax would lead, in general, to a change in prices. 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.

\textsuperscript{12} 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 $\mu = \frac{m-1}{m}$.

\textsuperscript{13} If a monopoly can also charge access fee, or if profit-maximising usage fees are positive for all users, it is possible that for at least one type of users the mark-up is negative, i.e. the profit-maximising price can be below (tax-adjusted) marginal cost.
i. Tax effect on usage fees

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:

\[
\frac{dp_Y}{dt} = \frac{1}{-\bar{h}} \frac{N_X N_Y [1 - \mu_Y(t)]}{[1 + t]^{\frac{1}{2}} \mu_Y(t)}.
\]

Clearly, as long as the mark-up is between zero and one (this ensures that variable profit is positive), the usage fee increases with tax. This increases the advertising expenditure for sellers and depresses their profits. In the context of the debate about adopting the DST, this means that a DST imposed on Google may result in Google charging higher advertising fees (again assuming that the marginal cost of ads is positive), and a DST imposed on Amazon Marketplace may result in higher fees/commissions charged to online sellers. The country imposing the DST, however, may be indifferent to such price increases faced by foreign producers and sellers, especially if such increases in intermediate inputs do not lead to higher consumer prices at home.\(^{14}\) Such a country should care more about price increases (and reduced profits) faced by domestic producers/sellers. However, even such increases may be viewed as a reasonable cost (which may be compensated through separate fiscal transfers to domestic sellers) given that additional revenue can be extracted from the profit of the platform itself— as will be seen below.

The tax-shift rate, or the proportion of tax passed by the platform to the advertisers, is given by

\[
\rho_Y \equiv \frac{1 + t}{p_Y} \frac{dp_Y}{dt} = \frac{1 - \mu_Y}{2 - \frac{\Delta}{[1 + \sigma_{XY}]^{\frac{1}{2}}}},
\]

\(^{14}\) In the standard framework, advertising expenditure is part of the fixed cost for the producer and so does not affect the supply curve. The equilibrium price may change because of a shift in demand caused by the change in the intensity of advertising.
where
\[
\Delta \equiv \frac{1 + \sigma_{XY} p_X^2}{\epsilon_Y} \frac{\partial^2 N_Y}{N_Y \partial p_Y^2} + 2\sigma_{XY} + \frac{N_Y^2}{N_Y} \frac{\partial^2 N_X}{N_X \partial N_Y^2}.
\]

One can see that the tax-shift rate for advertisers can be greater or less than unity, depending on the curvature of the advertisers' demand for platform service and the extent of the indirect externality from sellers to buyers. Specifically, \( \rho_Y > 1 \) (the platform over-shifts tax on advertisers) if
\[
\Delta > [1 + \sigma_{XY}]^2 \quad \text{and} \quad \epsilon_Y > \frac{1 + \sigma_{XY}}{\Delta - [1 + \sigma_{XY}]^2}.
\]

It is possible that the tax is not passed onto buyers. By continuity, if condition (3) holds without tax, it continues to hold for a marginal increase in tax rate from zero. Since higher \( t \) leads to higher \( p_Y \), it is possible that condition (3) also continues to hold as the tax rate rises from zero to some finite \( t > 0 \). Assuming this is the case, the platform will continue providing free service to buyers after the tax is introduced.

ii. **Tax effect on user demand**

The next step is to find the effect of tax on quantities, or the demand of users for the platform’s service. Let \( \nu_{Xt}, \nu_{Yt} \) denote the tax elasticity of user demand for buyers and advertisers, respectively:
\[
\nu_{Xt} \equiv \frac{1 + t}{N_X} \frac{\partial N_X}{\partial t}; \quad \nu_{Yt} \equiv \frac{1 + t}{N_Y} \frac{\partial N_Y}{\partial t}.
\]

We assume that tax has no effect on the free provision of platform service to buyers. Therefore, the only effect on the demand of buyers for platform services is through the effect of tax on the number of advertisers: \( \nu_{Xt} = \sigma_{XY} \nu_{Yt} \). For advertisers we obtain
\[
\nu_{Yt} = \frac{\epsilon_Y \rho_Y}{1 - \sigma_{XY} \sigma_X}.
\]
One can see that the demand for platform services from buyers and advertisers can either increase or decrease with tax, depending on the sign and strength of the indirect externalities. The following cases are possible:

**Case A.** \( \sigma_{XY} \sigma_{YX} > 1 \). In this case \( \nu_{Yt} < 0 \). The number of advertisers on the platform falls. Since \( \sigma_{YX} > 0 \) by assumption, for this to be the case we need \( \sigma_{XY} > 1/\sigma_{YX} \): externality from advertisers on buyers' demand must be positive, and at least one of the indirect externalities must be sufficiently strong. In this case the number of buyers using the platform also falls: fewer sellers/advertisers make the platform less attractive for buyers.

**Case B.** \( \sigma_{XY} \sigma_{YX} < 1 \). In this case \( \nu_{Yt} > 0 \). Note that, since \( \sigma_{YX} > 0 \) by assumption, this outcome is always the case when buyers dislike the adverts \( (\sigma_{XY} < 0) \). This resembles over-provision of negative externality, although the mechanism here is different. More generally, tax leads to more adverts in two sub-cases outlined below. In one of these sub-cases, positive effect of tax on both the usage fee and the number of adverts is also possible when both externalities are positive, as long as they are not too strong, or at least one externality is sufficiently weak.

**Case B.1.** \( \sigma_{XY} < 0 \). When buyers dislike the adverts tax leads to more advertisers \( (\nu_{Yt} > 0) \) and fewer buyers \( (\nu_{Xt} < 0) \).

**Case B.2.** \( 0 < \sigma_{XY} < 1/\sigma_{YX} \). Buyers like the adverts, and at least one of the indirect externalities is sufficiently weak. In this case tax leads to more adverts \( (\nu_{Yt} > 0) \) and more buyers \( (\nu_{Xt} > 0) \).

We summarized these cases in Table 1.
d. Incidence of tax

The incidence of tax, or the pass-through rate, is defined in terms of its effect on the consumer surplus and the producer surplus (Weyl and Fabinger, 2013). When the producer is a monopoly, the producer surplus is the variable profit.

In the context of the two-sided platform, the platform is the producer, and there are two types of consumers (users), the buyers and the sellers/advertisers. Let \( \bar{p}_j(t) \) be the choke price for users of type \( j \) at tax rate \( t \), and let \( p^*_j(t) \) be the usage fee charged by the platform to the user of type \( j \). Recall that each user can interact with every user on the opposite side. Then the consumer surplus for each type is given by

\[
CS_X(t) \equiv \int_{p_X^*(t)}^{\bar{p}_X(t)} N_X \left( p_X; N_Y \left( p_Y(t) \right), N_X(\cdot) \right) N_Y(p_Y(t)), N_X(\cdot) \ dp_X, \\
CS_Y(t) \equiv \int_{p_Y^*(t)}^{\bar{p}_Y(t)} N_Y \left( p_Y; N_X \left( p_X(t) \right), N_Y(\cdot) \right) N_X(p_X(t)), N_Y(\cdot) \ dp_Y.
\]

The choke prices are defined by

\[
N_X \left( \bar{p}_X(t); N_Y \left( p_Y(t) \right), N_X(\cdot) \right) = 0 \\
N_Y \left( \bar{p}_Y(t); N_X \left( p_X(t) \right), N_Y(\cdot) \right) = 0
\]

We assume, as before, that condition (3) holds; then \( p^*_X(t) = 0 \) for the relevant values of \( t \) and, thus, does not depend on \( t \). In this case \( \bar{p}_Y(t) \), the choke price for advertisers, also does not depend on \( t \). For the tax elasticity of \( \bar{p}_X(t) \), the choke price for buyers, we have

\[
\frac{1 + t}{\bar{p}_X} \frac{d\bar{p}_X}{dt} = -\frac{\varepsilon_Y}{\varepsilon_X (\bar{p}_X)} \frac{\sigma_{XY} \rho_Y}{1 - \sigma_{XY} \sigma_{YY}}
\]
In particular, the buyers’ choke price does not change with tax if \( \varepsilon_X (\tilde{p}_X) \to \infty \), which is the case whenever the marginal change in quantity demanded at the choke price is finite, \( \left| \frac{dN_X}{dp_X} \right| < \infty \).

The choke price of buyers falls with tax if \( \frac{\sigma_{XY}}{1-\sigma_{XY}\sigma_{YX}} > 0 \). This corresponds to Case B.2: buyers like adverts, and tax leads to more adverts and more buyers on the platform. Buyers’ demand for platform services rotates counterclockwise: the vertical intercept moves down, and the horizontal intercept moves to the right. In the opposite case, when \( \frac{\sigma_{XY}}{1-\sigma_{XY}\sigma_{YX}} < 0 \), the buyers’ choke price rises. This corresponds to Cases A and B.1. In these two cases the buyers’ demand curve rotates clockwise: the vertical intercept moves up, and the horizontal intercept moves to the left, so that the number of buyers on the platform falls. In Case A buyers like the adverts, and with fewer sellers the platform becomes less attractive. In Case B.1 there is more sellers, but the buyers dislike the adverts, - again, the platform becomes less attractive for buyers when tax is introduced.

Finally, we calculate the change in the surplus, or the incidence of tax on buyers and sellers.

\[
\frac{1 + t \frac{dCS_X}{dt}}{CS_X} = \frac{\int_{0}^{\tilde{p}_X(t)} [1 + \sigma_{XY}] \nu_{yt} N_X N_Y \, dp_X}{\int_{0}^{\tilde{p}_X(t)} N_X N_Y \, dp_X}
\]

This quantity is positive when either \( \sigma_{XY} < 0, \nu_{yt} < 0 \), or \( \sigma_{XY} > 0, \nu_{yt} > 0 \). Looking at Table 1, one can see that tax raises buyers’ surplus if \( 0 < \sigma_{XY} < 1/\sigma_{YX} \) (Case B.2): both indirect externalities are positive and at least one is sufficiently weak (provided that buyers continue enjoying free service after the tax is introduced). Intuitively, the buyers benefit from tax when they like adverts and tax raises the number of adverts on the platform. In two other cases, for \( \sigma_{XY} < 0 \) and \( \sigma_{XY} > 1/\sigma_{YX} \), buyers’ surplus falls.

For the tax incidence on sellers we have

\[
\frac{1 + t \frac{dCS_Y}{dt}}{CS_Y} = -\rho_Y \frac{N_X N_Y p_Y(t)}{\int_{p_Y(t)}^{\tilde{p}_Y(t)} N_X N_Y \, dp_Y} + \frac{\int_{p_Y(t)}^{\tilde{p}_Y(t)} [1 + \sigma_{XY}] N_X N_Y \, dp_Y}{\int_{p_Y(t)}^{\tilde{p}_Y(t)} N_X N_Y \, dp_Y}
\]
The first term is always negative. The second term is also negative when \( \nu_{Yt} < 0 \), which is the case when \( \sigma_{XY} > 1/\sigma_{YX} \) (Case A), and it is positive when \( \nu_{Yt} < 0 \), which is the case when \( \sigma_{XY} < 1/\sigma_{YX} \) (Cases B.1 and B.2). The overall effect of tax on sellers’ surplus can be positive if

\[
(5) \quad \rho_Y|p_Y(t) < \frac{\int p_Y(t) \nu_{Yt} [1 + \sigma_{XY}] N_X N_Y (p_Y, \cdot) dp_Y}{N_X N_Y (p_Y(t), \cdot) p_Y(t)}.
\]

This is more likely to hold, the lower is the sellers’ usage fee, the lower is tax elasticity of the sellers’ usage fee, the higher is the tax elasticity of sellers’ demand for platform service, and the higher is (positive) indirect externality from sellers to buyers.

Finally, one can see that it is possible that users on both sides of the platform can benefit from tax. This can happen in Case B.2, \( 0 < \sigma_{XY} < 1/\sigma_{YX} \), if condition (5) holds.

The profit of the platform falls when tax is introduced (otherwise the platform would not be maximizing profits in the absence of tax). Thus, the burden of tax is always on the platform, but not necessarily on buyers or sellers. Tax incidence on the platform is defined as \( \frac{1 + t}{\pi_{XY}} \frac{d \pi_{XY}}{dt} \), and it is not difficult to show that

\[
\frac{1 + t}{\pi_{XY}} \frac{d \pi_{XY}}{dt} = -[1 + \sigma_{XY}] \epsilon_Y + \nu_{Xt} + \nu_{Yt} = [1 + \sigma_{XY}] \epsilon_Y \left[ \frac{\rho_Y}{1 - \sigma_{XY} \sigma_{YX}} - 1 \right].
\]

The first two factors in the last expression are positive by assumption. The quantity in the last brackets is always negative in Case A: not surprisingly, the tax is the most detrimental when both indirect externalities are positive and sufficiently strong. With tax the number of users on both sides drops and the platform’s profit loss is the strongest. In two other cases, when either the indirect externality from sellers to buyers is negative, or both externalities are positive but at least one is sufficiently weak, the number of sellers increases with tax, and this has countervailing effect on the
platform’s profit. This countervailing effect is further strengthened when the number of buyers also increases with tax. Thus, the platform’s profit loss is the smallest in Case B.2.

e. Welfare effect of tax

Define the total private sector welfare as the sum of surpluses of the users and the profit of the platform, and define the social welfare, \( W \), as the sum of the tax revenues and the total private welfare.

Tax elasticity of social welfare, \( \omega \equiv \frac{1+t}{W} \frac{dW}{dt} \), is then given by

\[
\omega = \frac{\int_0^{p_X(t)} \left( 1 + \sigma_{XY} \right) v_{Yt}N_XN_Y dp_X + \int_0^{p_Y(t)} \left( 1 + \sigma_{XY} \right) v_{Yt}N_XN_Y dp_Y + \left[ p_Y^*(t) - c \right] \left[ 1 + \sigma_{XY} \right] v_{Yt}N_XN_Y}{\int_0^{p_X(t)} N_XN_Y dp_X + \int_0^{p_Y(t)} N_XN_Y dp_Y + \left[ p_Y^*(t) - c \right] N_XN_Y}
\]

The sign of the change in the social welfare is ambiguous, except for the Case A. In this case the social welfare unambiguously falls with tax, since all three terms in the numerator are negative. Tax has the largest deteriorating effect on private welfare when both indirect externalities are positive and sufficiently strong. Case B.2 is the opposite: since in this case the negative effect of tax on profit is the smallest, the overall detrimental effect of tax on welfare is also the smallest, as both buyers and sellers benefit from tax. For the tax to be welfare-improving it is necessary (but not sufficient) that condition \( \sigma_{XY} \sigma_{YX} < 1 \) holds. Effectively, tax can be welfare-improving only if it leads to an increase in advertising.
Table 1. The effect of ad valorem tax levied on platform’s sales revenue.

<table>
<thead>
<tr>
<th></th>
<th>B.1: $\sigma_{XY} &lt; 0$</th>
<th>B.2: $0 &lt; \sigma_{XY} &lt; 1/\sigma_{YX}$</th>
<th>A: $\sigma_{XY} &gt; 1/\sigma_{YX}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$dN_X/dt$</td>
<td>$-$</td>
<td>$+$</td>
<td>$-$</td>
</tr>
<tr>
<td>$dN_Y/dt$</td>
<td>$+$</td>
<td>$+$</td>
<td>$-$</td>
</tr>
<tr>
<td>$dCS_X/dt$</td>
<td>$-$</td>
<td>$+$</td>
<td>$-$</td>
</tr>
<tr>
<td>$dCS_Y/dt$</td>
<td>$+/-$</td>
<td>$+/-$</td>
<td>$-$</td>
</tr>
<tr>
<td>$d\pi_{XY}/dt$</td>
<td>$+/-$</td>
<td>$+/-$</td>
<td>$-$</td>
</tr>
<tr>
<td>$dW/dt$</td>
<td>$+/-$</td>
<td>$+/-$</td>
<td>$-$</td>
</tr>
</tbody>
</table>

$N_j$ is the demand (number) of type-$j$ users; $CS_j$ is users’ surplus; $\pi_{XY}$ is the profit of the platform; $W$ is the social welfare.

The efficiency-enhancing role of taxes on platform revenues is formally analyzed in Kind et al. (2008). In their model the monopoly platform charges access fee (there is no transaction/usage fee) and pays both specific and ad valorem tax. They show that the monopoly output can be larger than optimal, and that this inefficiency can be reduced by imposing negative value-added tax or positive specific tax. Our approach is different: instead of calculating social optimum we calculate the incidence of a given tax on the platform and the users and derive the necessary conditions for the tax to be welfare-improving.

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 of countries coming to an agreement about a reallocation of taxing rights under their income taxes: 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. 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.

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 have long attempted to extract a portion of LSR through a wide variety of tax and non-tax instruments. Whenever they thus extract a share of LSR earned by foreign investors, abstractly 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.

Overall, 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, i.e. platform rent that is location specific. The uncertainties and compliance costs associated with its introduction must be viewed in light of this fundamental benefit.

Indeed, it may be useful to conceive the DST as anticipating certain long-term challenges arising from asymmetrical technological development. According to one narrative (Lee 2017) within recent debates about labor-replacing technology based on artificial intelligence (AI), 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 jobs, and because of the overall shrinking labor share, much of it would have to be financed from public purse. 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. 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 public 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 still speculative, it is consistent with recent economic analyses of the existing international tax and transfer system. An important theme of the international taxation literature has been the mobility of capital and of production locations. 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 consumption occurs. However, this approach would favor the rich countries that can afford high levels of consumption, thereby aggravating existing inter-nation inequality and potentially worsening inequality in the future.

The approach to identifying LSR 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. Instead it can be attributed to jurisdictions.

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

References


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).

References in Appendix


https://www.researchgate.net/publication/319442460_The_Confusion_of_the_Concepts_of_Rent_and

_Economics_
