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Markets and Trade

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Preferential Taxation of E-Commerce: Imperfectly Competitive Retail Markets and Trade Costs*

Bo Sandemann Rasmussen[†]

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Abstract

E-commerce in physical goods enhances the degree of product market competition but leads also to higher trading costs as goods bought through the internet are shipped individually. Do these features of e-commerce support a case for granting preferential tax treatment to online shopping? This is investigated using a model with a domestic monopolistic retailer and foreign competitive producers that can either deliver a physical good to the retailer (ordinary trade) or directly to domestic consumers (e-commerce). Although it is possible to construct cases of strictly positive welfare effects the general result is that granting tax preferences to e-commerce will have ambiguous welfare consequences.

Keywords: E-commerce, imperfect competition, pro-competitive gains, trade diversion, commodity taxation, physical goods, trade costs.

JEL: H25, L12, F13.

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1 Introduction

The emergence of the internet as an international marketplace for goods and services has changed the way commodity markets work. Consumers are no longer restricted to making purchases from traditional bricks-and-mortar retail shops located in the vicinity of their residence as for many products online competitors of domestic and foreign origins abound. For consumers one of the main implications of e-commerce is the reduced search costs related to buying commodities, leading to increased competitive pressure on existing retailers. This implies that in a world with imperfectly competitive commodity markets¹ e-commerce is likely to lead to pro-competitive gains quite similar to those described in modern trade theory where reduced trade barriers increase product market competition (Brander and Krugman (1983)).² However, as noted in that literature one possible drawback to the pro-competitive effects is that trading costs increase due to higher levels of trade flows. If we concentrate on business-to-consumer (B2C) e-commerce in physical goods the analogy with the Brander-Krugman result is maintained as the presence of shipping and handling costs for e-commerce are likely to exceed the trading cost incurred when consumers choose to buy at conventional retail stores.³

Another implication of online shopping is that tax authorities may find it increasingly difficult to tax these transactions - especially for online trade in digitalized goods (see e.g. Varian (2001) and Rasmussen (2004)). However, for e-commerce in physical goods matters are quite different as the point of delivery of the goods makes an obvious opportunity for verification of the transaction and hence enhances the possibility of effective tax enforcement

¹Freund and Weinhold (2004) argue that existence of fixed entry costs into a particular market limits the degree of competition in the market and that this is particularly relevant for explaining international trade flows. They subsequently model the impact of the internet as a reduction in these entry costs. We will follow a different modelling strategy by focusing on business-to-consumers e-commerce that competes with locally established bricks-and-mortar retail firms.

²Of course, e-commerce will have many other implications e.g. on how firms can use information of recorded trade behaviour of their customers to improve their marketing strategies, see e.g. Vulkan (2003), but we restrict our attention to the pro-competitive effects of e-commerce.

³Assume that a commodity is produced in a foreign country and that the domestic consumers can buy the good either through a domestic retail firm or a foreign online shop. The technology for transporting the good from the foreign country to the domestic economy is likely to exhibit increasing returns to scale, implying that the unit cost of transportation is lower for bulk-trade between the foreign producer and the domestic retailer than for e-commerce between the foreign firm and domestic consumers where goods are being shipped individually. Hence, an excess trade cost for e-commerce exists.

(see Rasmussen (2004) for further details). Thus, in principle tax authorities should be able to tax e-commerce in physical goods should they desire to do so.

The fact that it is possible to tax certain kinds of transactions does not, however, imply that it is desirable to do so; it may, in fact, be desirable to tax e-commerce and conventional retail trade differently. In the literature a couple of potential arguments for granting tax preferences to e-commerce have been discussed. First, if positive network externalities are present these may be internalized through lenient taxation of purchases made through the internet (see e.g. Zodrow (2003)). The conclusion of Zodrow is, however, that these externalities seem so uncertain and weak that they are unlikely to form a case for preferential taxation of e-commerce. If a case for preferential tax treatment should be based on the existence of network externalities it is most likely that internet access fees should be made tax exempt, since it is the access to the internet which generates the most direct externality effects on other users. Secondly, a case for preferential tax treatment of e-commerce could be build around optimal tax arguments, see e.g. Bruce *et al.* (2003), since it is generally the case that non-uniformity of commodity taxes is socially optimal making it possible that tax preferences to e-commerce can be supported by optimal tax arguments.⁴ The main problem with the existing optimal tax models in our context is that they cannot easily comply with the setting relevant for B2C e-commerce where different retail channels exist for the same consumption good. Instead there is a need for building models taking these aspects into account.

This is the point of departure of the present paper: Given that retail markets are imperfectly competitive and that e-commerce and conventional retail trade can be viewed as competing retail channels for the same physical good the welfare implications of granting tax preferences to e-commerce are analyzed. By granting preferential tax treatment to e-commerce the pro-competitive effects of e-commerce are strengthened but if trade is diverted from business-to-business (B2B) trade to B2C e-commerce higher trade costs are incurred. At the same time tax revenues will be affected and all these changes will feed into changes in domestic welfare.

To model this in a very simple way a two country model is proposed. A homogenous good is produced under competitive conditions in the foreign country and can be purchased by domestic consumers either through a do-

⁴Sufficient conditions for uniform commodity taxation to be optimal are that household preferences are separable in the consumption of goods and leisure and homothetic in the consumption of goods, see Deaton (1979). Although both assumptions are often used in applied modelling they are highly restrictive both from a theoretical and an empirical point of view.

mestic retail firm enjoying local monopoly status or directly from the foreign producers through online shopping on the internet. The good is subject to taxation in the domestic economy and at the outset both shopping channels are taxed equally. The possibility of online shopping obviously limits the degree of monopoly power enjoyed by the domestic retail firm but due to excess trade costs associated with e-commerce the domestic retail firm can set a price above marginal costs without losing all its customers. By granting preferential taxation to e-commerce the degree of competitive pressure exerted on the domestic retail firm can be increased generating a positive pro-competitive gain. However, to the extent trade diversion is induced by the preferential tax treatment of e-commerce the welfare gain is reduced through the excess trade costs being incurred, leaving the sign of the overall welfare effect undetermined. The likelihood of a positive welfare effect increases when the tax preferences do not induce substantial trade diversion and in the (unrealistic) case where the tax preferences can be adjusted directly to the market conditions for the particular commodity in question it is always possible to design the tax preferences such that a welfare gain is guaranteed. Under less ideal circumstances, e.g. when the policy-makers are unable to set the tax on e-commerce conditional on market specific information, the welfare effect will generally be ambiguous.

Although the modelling framework is extremely simple it shows some possible side-effects of granting preferential tax treatment to e-commerce. Consumers are generally favoured by the preferential tax treatment through the lower consumer prices. However, if the consumers face different trade costs associated with e-commerce it is possible that granting preferential tax treatment to e-commerce will make some consumers - in particular those with high trade costs - worse off. A similar counter-intuitive result is that granting preferential tax treatment to e-commerce may lead to an increase in - and not a decrease in - the commodity tax revenue due to the pro-competitive effect raising the aggregate consumption of the good. As a more general point our analysis shows that when estimating the tax revenue losses following preferential tax treatment of e-commerce it is important to take into account that these pro-competitive gains will tend to increase tax revenues thereby mitigating the direct revenue loss following from the preferential tax treatment of e-commerce. By just focusing on the direct revenue loss the estimated revenue losses will generally be overstated.

The remaining part of the paper is structured as follows. Section 2 considers some of the administrative problems that need to be resolved for taxation of e-commerce in physical goods to be possible. In section 3 a model with an imperfectly competitive retail market and e-commerce subject to trade costs is set up while section 4 deals with various analyses of granting preferential

tax treatment to e-commerce. Section 5 discusses some policy implications of our analysis while section 6 concludes.

2 Destination Taxation of E-Commerce in Physical Goods

Even though our interest lies in discovering conditions under which granting preferential tax treatment to e-commerce can be welfare improving it is still important to find out whether it is possible to tax e-commerce should it be desirable to do so. In the political debate it is often argued that e-commerce makes enforcement of commodity taxes a rather complicated matter. For e-commerce in digitalized goods that may indeed be the case as verification of a purchase of goods that can be fully transferred from the seller to the buyer through the internet is - if not virtually impossible - extremely costly to perform (see Rasmussen (2004) for further details). Also in the case of e-commerce in physical goods between different states in the US the current legislation (and court rulings) seem to make e-commerce practically untaxable⁵ whereas countries with proper value added tax systems (e.g. the EU countries) may be better equipped to tax e-commerce in physical goods.

A typical aspect of e-commerce is that the seller and the buyer reside in different tax jurisdictions - either different countries or different states in the US case.⁶ Most countries apply the destination principle in commodity taxation implying that it is the location of the buyer that determines the tax to be levied on an e-commerce transaction. To apply the destination principle effectively to e-commerce transactions the tax authorities must be able to verify the transaction related to the buyer's acquisition of the purchased good. The important property of physical goods compared to digitalized goods is that they have to be delivered physically to the buyer making the

⁵For out-of-state purchases a so-called use tax is levied on the buyer. Collection of the use tax is made by the seller in case the seller has physical presence, or "nexus", in the buyer's state of residence but without nexus collection of the use tax is left to self reporting by the buyer. Since the compliance rate of use taxes is next to nothing (see Varian (2001)) most consumers regard out-of-state purchases from firms without nexus as tax free. This is especially relevant for e-commerce since many of the large companies specializing in e-commerce (like amazon.com) tend to have nexus in only a few states. Notice, however, that this is basically a case of tax evasion on part of the buyers of e-commerce.

⁶Firms engage in e-commerce to expand the mass of potential buyers. Hence, unless tax jurisdictions are "large" in either a geographical or in an economic sense it is quite likely that a major part of the demand will emanate from e-shoppers from outside the tax jurisdiction of the firm. The empirical analysis of Freund and Weinhold (2004) seems to confirm that the international aspect of internet trade is important.

point of delivery an obvious possibility for verification of the transaction. How the verification should take place would - *inter alia* - depend on whether or not the tax jurisdiction of the buyer has customs control. With an effective customs control direct verification is possible as the good passes through the customs control. Without customs control indirect verification is still possible since the physical good has to be handed over to the buyer by a courier. By auditing⁷ the courier firm the required verification can be established implying that it should be possible to use destination taxation of e-commerce in physical goods.⁸

There are, however, some more practical matters that have to be considered mainly with respect to the administrative procedures used to make sure that the right tax liability is levied on and collected from a given transaction. These administrative procedures are important as they affect the incentives of both firms and households to participate in e-commerce markets. For firms it is important how much of the tax collection (on behalf of "foreign" tax authorities) they are required to be involved in since unduly complicated administrative procedures will be considered an additional cost for the firms participating in e-commerce. For households the administrative procedures may affect the degree of uncertainty involved in trading with (more or less) anonymous sellers on the internet, and if some procedures increase the perceived level of uncertainty this is likely to discourage households from using e-commerce.

For the administrative procedures consider the following two options. Either, the selling firm calculates, collects and forwards the tax on a given transaction based on the tax rate prevailing in the tax jurisdiction of the buyer for that kind of commodity. This creates full certainty for the consumer regarding the total price of the good purchased, including tax and shipping costs, at the point in time when the purchase is made. Such a procedure does, on the other hand, impose substantial administrative burdens on firms by effectively requiring them to register with the tax authorities in all the tax jurisdictions (countries) they do trade with.⁹ Alternatively, all the responsibilities regarding tax calculation and tax collection can be removed

⁷For purely domestic transactions the tax authorities usually rely on auditing of firms to verify that transactions have taken place, see Rasmussen (2004).

⁸Notice that even though the tax authorities cannot audit the foreign seller the courier is operating within its tax jurisdiction and can therefore be subjected to auditing.

⁹Formal registration with "foreign" tax authorities will both guarantee that the right tax rates are being used and make the transfer of the tax payments an easy task. The registration itself is, however, a costly burden that may make some firms reluctant towards entering e-commerce. Some commentators like Nellen (2001) have argued that such requirements will put online shops at a disadvantage compared to traditional retail firms and therefore should be avoided.

from the seller and delegated to the courier firm handling the shipment of the good. For the consumers this will certainly add some uncertainty about the total price of the good at the point of sale. For the courier firms additional handling costs are imposed (which obviously must be passed on to the consumers as higher shipping costs). Which of these procedures should be preferred is not obvious as they both have their pros and cons. Requiring the seller to handle all the tax administration will presumably reduce the number of firms selling through the internet, thereby effectively reducing the degree of competition on that market leading to higher consumer prices. Similarly, letting the courier firms handling the tax administration will lead to increased uncertainty about the final consumer price leading to reduced demand from (risk averse) consumers. Of course, the selling firms could try to resolve that uncertainty by informing their customers about relevant tax regulations but that advice would be merely informative and not legally binding.

Thus, even though destination taxation of e-commerce in physical goods can be enforced there are some administrative problems that need to be taken into consideration when evaluating the pros and cons of granting tax preferences to e-commerce.

3 The Model

The purpose of the theoretical analyses will be to provide examples of the kind of welfare effects to be expected from granting preferential tax treatment to e-commerce when e-commerce and traditional retail trade through bricks-and-mortar shops compete about the same consumer demand. For this reason the basic structure of the model to be used in our analyses is kept at an extremely simple level. The model is a two country model with a Home and a Foreign country. The foreign economy plays the role of producing good X that can be sold either through the internet to households in the domestic economy or through a traditional retail store located in the domestic economy. It is a partial equilibrium model by only considering the market equilibrium for good X while the market for the composite good Y is not explicitly considered.¹⁰ The model is built around two main properties that ought to be important for the question in hand: First, that the domestic retail market is imperfectly competitive and second, that excess trade costs associated with e-commerce exist. To capture these properties in a very simple way it is assumed there exists a single domestic retail firm having a (local) monopoly. The monopoly retail firm buys the good from foreign

¹⁰At a little more complexity a general equilibrium of the domestic economy could be described by adding a perfectly competitive production sector for good Y .

competitive producers at a constant price (equal to the constant marginal production cost plus some fixed unit costs of bulk-transportation). Households then have two options for buying this consumption good: They can either buy the good from the domestic retail firm or they can buy the good directly from the foreign producers through the internet (e-commerce).¹¹ In case of an e-commerce transaction the buyer incurs a trade cost exceeding the cost of trade between a foreign and the domestic firm. The size of this e-commerce trade cost can either represent shipping costs - in which case it is reasonable to assume that all households face the same trade cost - or they can represent anything that allows the domestic retail firm to set a higher price than the online price without making consumers switch to e-commerce - e.g. due to uncertain delivery times, possible security worries regarding the payment system, problems (and expected costs) of returning the goods etc. - in which case the trade cost may not only exceed the bare shipping costs but also vary among consumers. In our setting existence of different trade costs for different consumers will be important for having equilibria where e-commerce and domestic retail trade coexist.

The good is subject to a commodity tax levied according to the residence principle in the domestic economy and the size of the tax is exogenously given.¹² The main question is then whether we by taxing e-commerce at a different tax level can generate a welfare improvement relative to equal tax treatment of e-commerce and ordinary retail trade. Thus, we consider welfare improving tax reforms starting from a situation with equal tax treatment of the two retail channels for the commodity.

3.1 Households

Households in the domestic economy consume the two goods, the good we take interest in, X , and the composite good Y . Their preferences are assumed to be quasi-linear in Y and quadratic in X :

$$U(X, Y) = Y + \left(\alpha X - \frac{\beta X^2}{2} \right),$$

where α and β are positive constants. Using the composite good as the numeraire the budget constraint reads

$$Y + qX = m,$$

¹¹Both consumers and firms have perfect market information leaving no role for price search. In reality, one of the advantages of e-commerce is the lower search costs compared to conventional retail trade. To simplify, that aspect is left out here.

¹²To explain the optimal tax on the good in question we would need a much more elaborate model including other consumption goods and endogenous choice of labour supply.

where q is the (relative) consumer price of X and m is (real) income. Maximizing utility leads to a linear demand function for X (here given in inverse form):

$$q = \alpha - \beta X. \tag{1}$$

The quasi-linearity of preferences implies absence of income effects in the demand for good X which in turn implies that we can use consumer surplus as a concise measure of household welfare. The quadratic functional form of the subutility function for good X generates a linear demand function which is not really needed for our results, but it is convenient especially in the case with heterogenous household characteristics. Normalizing the number of households to one the demand function, equation 1, is also the domestic market demand function for commodity X .

Households can either buy good X from the domestic retail firm (in an amount denoted X_R) or from a foreign online shop (in an amount denoted X_E) and since households take prices as given they simply choose the supplier offering the lowest price (including taxes, shipping costs etc.).

3.2 Firms

Commodity X is produced by perfectly competitive firms in the foreign country at a constant marginal cost, c . To simplify, the marginal cost of production includes the unit cost of transportation for bulk-trade between the foreign firms and the domestic firm implying that the domestic retail firm can buy the good at the price c . By assuming competitive foreign firms any pricing-to-market behaviour on part of the producers is eliminated and the e-commerce market in itself becomes perfectly competitive.¹³

Consumption of good X is subject to a unit tax t at least for the part of the consumption of X delivered through the domestic retail firm. The effective marginal cost for the domestic retail firm is thus $c + t$. The impact of e-commerce on the domestic retail firm is through the demand facing the retail firm. To model the impact of e-commerce it is assumed that trade costs differ for the two types of trade, mainly due to differences in the mode

¹³The behavioral assumptions about the online shops are, admittedly, extremely simple. The online shops simply post their (fixed) price on their website and supply whatever is demanded at that price. This is basically what Vulkan (2003) calls "first-generation" e-commerce. Technologies allowing firms to use "dynamic pricing" by delegating the authority to do transactions to automated procedures - called "second-generation" e-commerce - are emerging but as noted by Vulkan (2003) the bulk of the e-commerce in the immediate future is likely to be of the first-generation kind. Therefore, we concentrate on first-generation e-commerce, acknowledging that it may become necessary to allow for second-generation e-commerce at some future point in time.

of physical transportation. For most physical goods it seems reasonable to assume that economies of scale are present in the transportation of the goods, such that the unit cost of transportation is smaller for large shipments of the good than when small amounts of the good are being transported (in the case of e-commerce the typical mode of transportation is to use a courier). Therefore, it is assumed that there is an excess cost of transportation (shipping cost) when the good is sold through e-commerce assumed to be given at a constant per unit level.¹⁴ The total trade cost associated with e-commerce may exceed the shipping cost - e.g. due to perceived cost of uncertain delivery times, uncertain credit card security etc. - and may vary among consumers. To begin with we assume that the shipping costs are the only trade costs associated with e-commerce and these shipping costs are given at the same constant level, γ , for all households. Later we will introduce heterogeneities among households by assuming that households face different trade costs.

Allowing e-commerce to receive preferential tax treatment relative to retail trade the full e-commerce price facing domestic consumers equals

$$q_E^* = c + \gamma + t_E,$$

where $t_E \leq t$ is the unit tax on e-commerce such that for $t_E < t$ preferential tax treatment is granted to e-commerce. The effective demand facing the domestic retail firm is then zero at consumer prices exceeding q_E^* while it equals the market demand curve for prices below the e-commerce price, so using that $q = q_E^*$ for $X = \frac{\alpha - c - \gamma - t_E}{\beta}$ the effective (inverse) demand facing the domestic retail firm can be written as¹⁵

$$q = \begin{cases} c + \gamma + t_E, & \text{for } X_R \leq \frac{\alpha - c - \gamma - t_E}{\beta} \\ \alpha - \beta X_R, & \text{otherwise.} \end{cases}$$

The production/pricing decision for the domestic retail firm is then quite simple as it maximizes profits by equating marginal costs and marginal revenue

¹⁴More realistically e-commerce is associated with fixed shipping costs per unit of shipments. With our quasi-linearity assumption such shipping costs would have no marginal effect on the demand for good X since the shipping cost would only affect the demand for the composite good through the income effect (a fixed shipping cost will, of course, influence whether or not the consumer buys through the internet). Therefore, our assumption of constant unit shipping costs implicitly presupposes that all households order the same amount of good X at a time through e-commerce.

¹⁵In case the domestic price and the e-commerce price are equal it is assumed that the households buy at the domestic retail store implying that the domestic retail firm can eliminate e-commerce sales by charging exactly the e-commerce price. For an equilibrium with positive consumption of X to exist we assume that $\alpha > c + \gamma + t$.

subject to a non-negativity constraint on profits.¹⁶ As long as all households face the same trade cost this first-order condition will generate a unique equilibrium. However, when the trade costs differ among households there may be multiple solutions to the first-order condition (due to potential non-monotonicity of the marginal revenue function) in which case we have to compare profit levels at the various output levels satisfying the first-order condition to determine equilibrium output.

3.3 Market Equilibrium and Social Welfare

A market equilibrium is characterized by households choosing the retail channel offering the lowest consumer price (including taxes and trade costs) in the amounts X_E^* and X_R^* , the foreign e-commerce firms offering commodity X in the amount X_E^* at the price $q_E^* = c + \gamma + t_E$ while the domestic retail firm chooses its profit maximizing price-output combination subject to the effective market demand for commodity X .

For such a market equilibrium we will take interest in the total social welfare (or social surplus) generated in the domestic economy.¹⁷ Disregarding any concerns of the distribution of welfare the social welfare measure is simply the sum of consumers surplus, CS , producers surplus, PS , and tax revenue, T . By the quasi-linearity of household preferences consumers surplus is an exact measure of how much welfare households attribute to participating in the market for good X . The producers surplus accrues to the owners of the domestic retail firm so assuming domestic ownership (or a 100% profit tax levied by the domestic tax authorities) this should count along with consumers surplus in domestic social welfare. For the tax revenue to enter the social welfare measure on a one-for-one dollar basis along side consumers and producers surpluses we basically have to assume that the tax revenue is returned in lump sum fashion to the households. But then it is questionable why the consumption of good X is taxed in the first place. More realistically the tax on X is just one of many distortionary taxes¹⁸ so if granting tax preferences to e-commerce changes the revenue from taxing the consumption of good X other taxes would have to be changed. The marginal social cost

¹⁶With negative profits the domestic retail firm ceases to exist and $X_R^* = 0$ will materialize.

¹⁷The welfare level in the foreign economy will not depend on the characteristics of the equilibrium attained in the domestic economy. This would even hold for non-constant marginal costs of producing good X if the domestic economy is small compared to the foreign economy (the rest of the world).

¹⁸As noted earlier, our set up is far too simple to explain how the tax on good X is determined, but in an optimal tax analysis inclusion of other taxed consumption goods (and untaxed leisure) would be needed.

of obtaining an extra dollar in tax revenue from alternative sources - the marginal cost of public funds - is then the appropriate weight that should be attached to the tax revenue (see e.g. Huizinga and Nielsen (2003) for a similar approach in a different context). Usually the marginal cost of public funds exceeds unity¹⁹ but to simplify matters we just put a weight of one on the tax revenue in the measure of social welfare. Hence our social welfare (or social surplus) measure is

$$SW = CS + PS + T.$$

In the formal definition of social welfare any costs of administering tax schemes are not taken explicitly into account but in the discussions of the various tax schemes we do try to recognize the importance of administrative costs. A reasonable ranking of the costs of administering taxes on e-commerce is the following: The lowest costs are incurred when e-commerce is fully tax exempt²⁰ followed by equal tax treatment of the two kinds of transactions while partial (and possibly differential in the multi-good case) tax preferences to e-commerce generates the highest level of administrative costs. This implies that any social welfare gains from granting preferential tax treatment to e-commerce may be outweighed by the costs of administering the scheme unless the social welfare gains are substantial.

4 Preferential Taxation of E-Commerce

The analysis of granting preferential taxation to e-commerce is complicated by the non-monotonicity of the marginal revenue function of the domestic retail firm, especially if the tax preferences represent discrete changes in taxes. For preferential tax treatment involving only marginal changes in taxes the analysis is more straightforward as standard calculus techniques can be applied. Even though the analysis of such marginal tax preferences may be a convenient starting point marginal tax preferences granted to e-commerce are not necessarily the most relevant ones to consider. Since the possible gains from granting marginal tax preferences to e-commerce will be small, existence of (even small) costs of administrating a preferential tax scheme could easily outweigh any positive welfare effects. Therefore, it is necessary to consider preferential tax treatment of e-commerce involving discrete changes in taxes.

¹⁹An important case where the marginal cost of public finance may fall short of unity is when markets are imperfectly competitive, see e.g. Andersen *et al.* (1996).

²⁰The costs in this case may not equal zero as there may be costs of preventing claims of tax exemption from non-e-commerce trades.

Hence, as the next step the existence of welfare improving tax reforms granting discrete tax concessions to e-commerce will be considered. Our analysis will show that designing such tax preferences guaranteeing a welfare gain requires exact knowledge of several key market specific parameters. This implies, first of all, that if these parameters are not known exactly the implemented tax preference scheme may turn out to be welfare reducing. Secondly, these tax preference schemes involving partial tax exemptions imply a differentiated tax structure for different goods bought through e-commerce. In other contexts it is often argued that even though a differentiated tax structure may be optimal from a social point of view the costs of administrating a differentiated tax structure may make a uniform tax structure socially optimal (in our case uniform taxation is equal tax treatment of online and offline purchases). As the last step, we will consider granting full tax exemption to online trade.²¹ One advantage of full tax exemption is that it saves on administrative costs associated taxing e-commerce.

One of the important assumptions in our model regards the nature of the trade costs, especially whether or not they differ among households. Two distinct cases will be considered. First, we will consider the most simple case of equal trade costs for all households. Subsequently, we will allow for households facing either a high or a low trade cost for exercising e-commerce.

4.1 Equal Trade Costs for Households

When all households face the same trade cost only one retail channel will be active in equilibrium and which one will depend on the size of the trade cost, γ , and the taxes, t and t_E . The effective (inverse) demand function facing the firm is

$$q = \begin{cases} c + \gamma + t_E, & \text{for } X_R \leq \frac{\alpha - c - \gamma - t_E}{\beta} \\ \alpha - \beta X_R, & \text{otherwise.} \end{cases}$$

As a reference point consider the market equilibrium with a neutral tax policy for e-commerce, i.e. with $t_E = t$. Disregarding the case where the trade cost is so high that the domestic retail firm can charge the (unrestricted) monopoly price,²² $q^M = \frac{\alpha + c + t}{2}$, the equilibrium will be one where the competition from the e-commerce business of the foreign firms acts as an effective

²¹This is more or less the *de facto* treatment of e-commerce in the US where online purchases from out-of-state shops are subject to a use tax the collection of which is left to self reporting by the buying consumer. The experience shows that the compliance rate is practically zero for such purchases (see e.g. Varian (2001)) making e-commerce from remote sources effectively tax exempt.

²²This requires that $q_E^* < q^M$ or $\gamma < \frac{\alpha - c - t}{2}$.

price ceiling for the domestic retail firm, restricting it to set a price equal to the e-commerce price:

$$q_E^* = q_R^* = c + \gamma + t; X^* = X_R^* = \frac{\alpha - c - \gamma - t}{\beta}; X_E^* = 0.$$

Obviously, no e-commerce takes place in equilibrium since the domestic retail firm can always obtain a positive profit by undercutting the price offered by the online shops due to the presence of trade costs associated with e-commerce and the neutral tax policy. Still, the bare possibility for consumers to buy commodity X through e-commerce has a positive effect on domestic welfare by restricting the price mark-up set by the domestic retail firm. This can be considered a "pro-competitive" effect of e-commerce on domestic imperfectly competitive retail markets and it will also be one of the main welfare effects associated with granting tax preferences to e-commerce.

4.1.1 Marginal Tax Preferences to E-Commerce

To study the effects of granting preferential tax treatment to e-commerce we begin by considering a marginal reduction in the tax on e-commerce holding the tax on conventional retail trade constant. The equilibrium is now

$$q_E^* = q_R^* = c + \gamma + t_E; X^* = X_R^* = \frac{\alpha - c - \gamma - t_E}{\beta}; X_E^* = 0. \quad (2)$$

Using equations 2 the effects of reducing the tax on e-commerce can easily be derived to be

$$\begin{aligned} \frac{\partial X^*}{\partial t_E} &= -\beta^{-1} < 0 \\ \frac{\partial q_R^*}{\partial t_E} &= 1. \end{aligned}$$

With a lower consumer price and higher consumption of good X the social welfare effects of reducing t_E are unambiguously positive. Formally, denoting the market demand for good X by $X(q) = \frac{\alpha - q}{\beta}$ social welfare can be written as²³

$$\begin{aligned} SW &= \int_{q_R^*}^{\alpha} X(q) dq + (q_R^* - c - t)X_R^* + tX_R^* \\ &= \frac{1}{2\beta}(\alpha - c - \gamma - t_E)^2 + \frac{(\gamma + t_E)}{\beta}(\alpha - c - \gamma - t_E), \end{aligned} \quad (3)$$

²³This expression for social welfare only holds for equilibria with no e-commerce.

where the first term in equation 3 is consumers surplus, the second term is producers surplus while the last term is the tax revenue from the domestic retail sale. As

$$\frac{\partial SW}{\partial t_E} = -\beta^{-1} < 0, \quad (4)$$

social welfare increases with a reduction in the tax on e-commerce. So does the tax revenue as

$$\frac{\partial T}{\partial t_E} = -\frac{t}{\beta} < 0. \quad (5)$$

Thus, when the pro-competitive gain of granting preferential tax treatment to e-commerce is taken into account the fears of revenue losses from undertaxed e-commerce expressed by tax authority representatives and politicians may be overstated: Tax preferences to e-commerce may actually increase tax revenues! Of course, this result hinges on the non-existence of e-commerce in equilibrium implying that the tax preferences to e-commerce are merely "potential" rather than "actual" tax concessions. However, as we show below the positive tax revenue effect may persist even when a positive amount of e-commerce exists in equilibrium.

4.1.2 Discrete Tax Preferences to E-Commerce

To study the potential for designing welfare improving discrete tax preferences to e-commerce it is convenient to distinguish between two qualitatively different cases, *viz.* when γ is less than or larger than t . Starting with the case of $\gamma > t$ notice that in this case even full tax exemption of e-commerce, $t_E = 0$, will not deprive the domestic retail firm the possibility of setting a price exceeding the marginal cost implying that e-commerce will not take place even if it is untaxed. This implies that for any non-negative tax on e-commerce, $t_E \in [0, t]$, the equilibrium will be as stated in equation 2. Since equations 4 and 5 also apply in this case reducing t_E as much as possible, i.e. setting it equal to zero,²⁴ generates the highest possible welfare and tax revenue levels. Thus, in this case a discrete tax preference scheme granting full tax exemption to e-commerce generates a strict welfare improvement.

For $\gamma < t$ a sufficiently small tax on e-commerce will make the domestic households switch retail channel from the domestic bricks-and-mortar shop to e-commerce as the domestic retail firm no longer can compete with the online shops being granted preferential tax treatment. At the point where the

²⁴A small negative tax on e-commerce satisfying $c + \gamma + t_E \geq c + t$ will actually increase welfare (and tax revenues) even further but taking the costs of administering such a subsidy scheme into account it is quite likely that the full tax exemption case, $t_E = 0$, will generate the highest level of welfare.

domestic households switch retail channel the social welfare function becomes discontinuous due to the "trade diversion" effect representing the additional costs incurred when the goods are being shipped individually by couriers. The switch of retail channel occurs when the marginal cost of the domestic retail firm, $c + t$, becomes equal to the e-commerce price, $c + \gamma + t_E$, or when $t_E = t - \gamma$, such that the equilibrium prices and quantities are

$$\begin{aligned} t_E &\geq t - \gamma : \\ q_E^* &= q_R^* = c + \gamma + t_E; X_R^* = \frac{\alpha - c - \gamma - t_E}{\beta}; X_E^* = 0. \end{aligned}$$

$$\begin{aligned} t_E &< t - \gamma : \\ q_E^* &= c + \gamma + t_E; q_R^* = c + t; X_R^* = 0; X_E^* = \frac{\alpha - c - \gamma - t_E}{\beta}. \end{aligned}$$

Letting subscript E and R denote the separate cases where only e-commerce and domestic retail trade are present, respectively, the social welfare functions can be written as

$$\begin{aligned} SW_R &= \int_{q_R^*}^{\alpha} X_R(q) dq + (q_R^* - c - t)X_R^* + tX_R^* \\ &= \frac{1}{2\beta}(\alpha - c - \gamma - t_E)^2 + \frac{(\gamma + t_E)}{\beta}(\alpha - c - \gamma - t_E), \end{aligned}$$

$$\begin{aligned} SW_E &= \int_{q_E^*}^{\alpha} X(q) dq + t_E X_E^* \\ &= \frac{1}{2\beta}(\alpha - c - \gamma - t_E)^2 + \frac{t_E}{\beta}(\alpha - c - \gamma - t_E). \end{aligned}$$

Notice, that when e-commerce is the only active retail channel social welfare equals the sum of consumers surplus and the tax revenue (since the domestic producers surplus equals zero). Evaluating these at the switch point, $t_E = t - \gamma$, reveals the downward jump in social welfare as trade is redirected from the domestic retail store to e-commerce:

$$SW_E(t_E = t - \gamma) = \frac{1}{2\beta}(\alpha - c - t)^2 + \frac{(t - \gamma)}{\beta}(\alpha - c - t)$$

$$SW_R(t_E = t - \gamma) = \frac{1}{2\beta}(\alpha - c - t)^2 + \frac{t}{\beta}(\alpha - c - t) > SW_E(t_E = t - \gamma), \quad (6)$$

Moreover, since

$$\frac{\partial SW_R}{\partial t_E} = -\beta^{-1} < 0$$

any discrete tax preference to e-commerce satisfying $t_E \geq t - \gamma$ will be welfare improving. Thus, even when trade costs are small relative to the tax on commodity X it is always possible to obtain a welfare improvement by granting partial tax preferences to e-commerce. However, reducing the tax on e-commerce further may well lead to a fall in social welfare due to the trade diversion effect.

4.1.3 Full Tax Exemption to E-Commerce

Finally, the potential for generating welfare improvements by granting full tax exemption to e-commerce should be considered. For the case of relatively high trade costs, $\gamma > t$, we have already shown that full tax exemption is welfare improving relative to equal tax treatment of e-commerce and ordinary retail trade. Evaluating the case of relatively low trade costs, $\gamma < t$, is somewhat complicated by the discontinuity of the social welfare function at the point where trade is diverted from ordinary retail trade to e-commerce (see equation 6). Equal tax treatment of the two retail channels implies that only the ordinary retail channel is used actively and generates a social welfare level of

$$SW(t_E = t) = \frac{1}{2\beta}(\alpha - c - \gamma - t)^2 + \frac{(\gamma + t)}{\beta}(\alpha - c - \gamma - t).$$

Full tax exemption implies that all purchases take place as e-commerce and leads to a social welfare level of

$$SW(t_E = 0) = \frac{1}{2\beta}(\alpha - c - \gamma)^2.$$

The welfare implications of granting full tax exemption to e-commerce are thus

$$SW(t_E = 0) - SW(t_E = t) = \frac{1}{2\beta} \{ \gamma^2 + t^2 - 2\gamma(\alpha - c - t) \} \geq 0,$$

implying that it is generally ambiguous whether full tax exemption will be welfare improving when starting from equal tax treatment. There is a positive welfare effect of granting preferential tax treatment to e-commerce from the lower consumer price of good X leading to an increase in consumers surplus but since all transactions shift from domestic retail trade to e-commerce there is a welfare loss due to lost producers surplus and tax revenue. Which effect dominates cannot be determined unambiguously. Notice, however, that for sufficiently small trade costs (for a given level of the commodity tax) full tax exemption to e-commerce strictly dominates equal tax treatment. Intuitively this makes sense since for small trade costs the loss generated by trade diversion will be small.

4.2 Heterogenous Households: High and Low Trade Cost Households

One of the unsatisfactory properties of the model with homogenous households is the absence of equilibria where the two retail channels are active simultaneously. An obvious extension of the basic model that will allow for coexistence of e-commerce and ordinary retail trade is to assume that households face different trade costs. Of course, if trade costs are just shipping costs it is difficult to justify that households should face different trade costs but if trade costs are interpreted in a broader sense to include anything that prevents households from buying through e-commerce even though the price (including shipping costs and taxes) is lower than in the domestic retail store, it is quite likely that trade costs will differ among households.

To be specific assume that the domestic households consist of two types differing only in the size of their trade costs associated with e-commerce. Type L households face a (low) trade cost of γ_L while type H households face a (high) trade cost of $\gamma_H > \gamma_L$. Type H households amount to a share of $0 < \theta < 1$ of the total number of households. With two types of consumers it would be in the interest of the domestic retail firm to use price discrimination. For price discrimination to work the domestic retail firm should be able to segment the market according to the size of the trade cost of the consumers. However, since the trade cost of a particular household is unobservable (and probably poorly correlated with any observable attribute of the household) market segmentation is not viable. Instead, the domestic retailer must set a single price taking into account the alternative shopping options their potential customers face.²⁵

The effective (inverse) demand function facing the firm is

$$q = \begin{cases} c + \gamma_H + t_E, & \text{for } X_R \leq \frac{\theta(\alpha - c - \gamma_H - t_E)}{\beta} \\ \alpha - \frac{\beta}{\theta} X_R, & \text{for } \frac{\theta(\alpha - c - \gamma_H - t_E)}{\beta} \leq X_R \leq \frac{\theta(\alpha - c - \gamma_L - t_E)}{\beta} \\ c + \gamma_L + t_E, & \text{for } \frac{\theta(\alpha - c - \gamma_H - t_E)}{\beta} \leq X_R \leq \frac{\alpha - c - \gamma_L - t_E}{\beta} \\ \alpha - \beta X_R, & \text{otherwise.} \end{cases}$$

It is assumed that the domestic retail firm cannot charge the unrestricted

²⁵In the so-called "second-generation" e-commerce (see Vulkan (2003)) one of the advantages of doing e-commerce for firms is exactly that *online* firms may be able to monitor the trading behaviour of their costumers more closely and potentially use this information to price discriminate. Bricks-and-mortar shops, on the other hand, are unlikely to be able to engage in price discrimination.

monopoly price without inducing any e-commerce (implying that the possibility of e-commerce trading will always affect the equilibrium outcome of the domestic retail market).²⁶

As in the previous section we begin describing market equilibria when a neutral tax policy is pursued, i.e. when $t_E = t$. With heterogenous households and equal tax treatment of the two retail channels three qualitatively different equilibrium outcomes may exist. First (Case 1), the retail firm may set the price at the e-commerce price facing type H households thereby only serve the high-trade cost consumers while the low-trade cost households buy through the internet (so here the two retail channels coexist in equilibrium). Second, (Case 2), the domestic retail price may be set above the e-commerce price of the type L households but below the e-commerce price of the type H households in which case the domestic retailer again only serves the households with the high trade cost. Finally (Case 3), the retail firm may set a price equal to the e-commerce price of type L households and consequently serve both types of households.²⁷ The details of these equilibria are given in the appendix.

4.2.1 Marginal Tax Preferences to E-Commerce

For marginal tax preferences granted to e-commerce the qualitative nature of the equilibrium is not affected by a small reduction in t_E . In Case 3 a small decrease in the tax on e-commerce lowers the consumer price and increases the consumption of good X from the domestic retail source without inducing any households to switch to e-commerce,

$$\begin{aligned}\frac{\partial X^*}{\partial t_E} &= -\beta^{-1} < 0 \\ \frac{\partial q_R^*}{\partial t_E} &= 1,\end{aligned}$$

implying that social welfare and tax revenue increase

$$\begin{aligned}\frac{\partial SW}{\partial t_E} &= -\beta^{-1} < 0, \\ \frac{\partial T}{\partial t_E} &= -\frac{t}{\beta} < 0.\end{aligned}$$

²⁶The exact condition is that $\gamma_L < \frac{\alpha - c - t}{2}$ for $t_E = t$.

²⁷We have ruled out that the trade costs can be so high that the domestic retail firm can set the unrestricted monopoly price without inducing any e-commerce. As a consequence the domestic retail firm will never set its price below the e-commerce price of the low trade cost households.

Notice that this case is just like the case with homogenous households (since the domestic retail firm finds it profitable to serve all domestic households even though their trade costs differ).

Turning to Cases 1 and 2 we have that the two types of households use different retail channels and therefore are affected differently by the tax preference scheme. In Case 2 the domestic retail price is not affected by the lower tax on e-commerce implying that only the low-trade cost households are affected. Hence, in this case

$$\frac{\partial q_R^*}{\partial t_E} = \frac{\partial X_R^*}{\partial t_E} = 0,$$

while

$$\begin{aligned} \frac{\partial X_E^*}{\partial t_E} &= -\frac{1-\theta}{\beta} < 0 \\ \frac{\partial q_E^*}{\partial t_E} &= 1. \end{aligned}$$

Regarding social welfare the part stemming from the consumption of e-commerce goods can be written as

$$\begin{aligned} SW_E &= \int_{q_E^*}^{\alpha} X_E(q) dq + t_E X_E^* \\ &= \frac{1-\theta}{2\beta} (\alpha - c - \gamma_L - t_E)^2 + \frac{(1-\theta)t_E}{\beta} (\alpha - c - \gamma_L - t_E). \end{aligned}$$

Differentiating with respect to t_E reveals that social welfare increases in response to a (marginally) lower tax on e-commerce:

$$\frac{\partial SW}{\partial t_E} = -\frac{(1-\theta)t_E}{\beta} < 0,$$

implying that it is possible to obtain a social welfare gain from granting tax preferences to e-commerce even if the level of e-commerce increases as a response to the lower tax. Tax revenues are in this case only affected through the revenue from taxing e-commerce, $T_E = t_E X_R^*$, and as

$$\frac{\partial T_E}{\partial t_E} = \frac{1-\theta}{\beta} (\alpha - c - \gamma_L - 2t_E) \geq 0,$$

the tax revenue effect is generally ambiguous.

In Case 1 the tax preferences granted to e-commerce stimulates demand from both retail channels implying that social welfare will unambiguously increase. The tax revenue effect will now stem from both sources,

$$\frac{\partial T}{\partial t_E} = \frac{\partial T_R}{\partial t_E} + \frac{\partial T_E}{\partial t_E} = -\frac{t\theta}{\beta} + \frac{1-\theta}{\beta} (\alpha - c - \gamma_L - 2t_E).$$

Assuming that we start from equal tax treatment of the two retail channels, $t = t_E$, we obtain

$$\left. \frac{\partial T}{\partial t_E} \right|_{t_E^0=t} = -\frac{t}{\beta} + \frac{1-\theta}{\beta}(\alpha - c - \gamma_L - t),$$

where given the assumptions made the first term is negative while the second term is positive. Hence, for a sufficiently large share of the households having high trade costs, θ , overall tax revenues will increase in response to the tax preferences granted to e-commerce.²⁸ Notice, that this is not a usual "Laffer-effect" as the tax reduction only applies to part of the total consumption of good X . In a more fundamental sense this result reveals that estimating the revenue loss from granting tax preferences to e-commerce by just calculating the direct loss from not taxing e-commerce transactions fully (see e.g. General Accounting Office (2000))²⁹ will generally overstate the revenue losses if the the lower taxes on e-commerce succeed in improving product market competition in offline commodity markets.

4.2.2 Discrete Tax Preferences to E-Commerce

Once tax preferences granted to e-commerce involve a discrete change in t_E we have to take into account that the qualitative nature of the equilibrium may change in response to the lower tax on e-commerce thereby complicating the welfare evaluation of the tax change. However, by conducting an appropriate change in the tax on e-commerce it may be possible to design tax changes that will be unambiguously welfare improving.

Consider first case 3 where the domestic retail firm under equal tax treatment of the two retail channels finds it profitable to serve all domestic customers at the price

$$q_R^* = c + \gamma_L + t_E.$$

Reducing the tax on e-commerce from $t_E = t$ has initially a positive social welfare effect (as shown above) but when t_E is reduced discretely the qualitative nature of the equilibrium may change leading to a discontinuity (a fall) in social welfare. One way to guarantee a positive welfare effect is to reduce t_E just to the level before the qualitative nature of the equilibrium

²⁸Of course, we have to consider whether a Case 1 equilibrium exists when θ is large. Notice, however, from the conditions given in the appendix a large value of θ increases the likelihood of a Case 1 equilibrium to exist.

²⁹Another often made mistake is to calculate the direct effect on tax revenues as the volume of e-commerce multiplied by the relevant tax had the transaction occurred through the normal retail channel, thereby disregarding that the demand would have been lower if e-commerce were taxed as normal retail trade.

changes. In this case two constraints on the level of t_E exist. First of all, for the domestic firm to be able to compete with the foreign e-commerce firms we need $t_E \geq t - \gamma_L$ (or $t_E = 0$ if $t < \gamma_L$). Thus, by setting the tax on e-commerce equal to

$$t_E = \max \{t - \gamma_L, 0\},$$

the domestic firm enjoys non-negative profits. Secondly, the domestic retail firm must find it more profitable to serve the entire home market than just serving the high-trade cost households. Defining \tilde{t}_E as the tax on e-commerce making profits from serving the entire home market equal to the profits from serving type H consumers only,³⁰

$$\pi(\tilde{t}_E) = \pi_H(\tilde{t}_E),$$

where the profit functions are defined in the appendix, the overall condition securing a positive welfare effect of a discrete tax preference to e-commerce can be written as

$$t_E = \{\max t - \gamma_L, 0, \tilde{t}_E\}. \quad (7)$$

It should be quite obvious from equation 7 that this is a very complicated condition requiring detailed information not only on trade costs (as in the case of homogeneous households) but on the entire profit function of the domestic retail firm.

In Cases 1 and 2 where both retail channels are active even without preferential tax treatment of e-commerce it is the high-level trade cost that inflicts constraints on the domestic retail firm. Reducing the e-commerce tax will reduce the domestic retail price (in Case 2 at least for a substantial decrease in t_E) and increase social welfare (as shown above). The profits of the domestic firm will be reduced as

$$\frac{\partial \pi_H}{\partial t_E} = \frac{\theta}{\beta} (\alpha - c - 2\gamma_H - 2t_E + t) > 0,$$

but as the profits from serving the entire domestic market falls by even more

$$\frac{\partial \pi}{\partial t_E} = \frac{1}{\beta} (\alpha - c - 2\gamma_L - 2t_E + t) > \frac{\partial \pi_H}{\partial t_E},$$

there is no risk for the qualitative nature of the equilibrium to change. Hence, by reducing t_E all the way down to

$$t_E = \max \{t - \gamma_H, 0\}$$

an unambiguously positive social welfare effect can be obtained. Reducing the tax on e-commerce further (for $t > \gamma_H$) would induce a trade diversion effect and make the welfare effect ambiguous.

³⁰The value of \tilde{t}_E is not necessarily positive (or unique).

4.2.3 Full Tax Exemption to E-Commerce

With heterogenous households giving full tax exemption to e-commerce will generally have ambiguous welfare effects. In Case 3 a zero tax on e-commerce may induce the domestic retail firm to serve the high-trade cost households only in which case the overall social welfare effect becomes ambiguous due to the trade diversion effect. This may lead to the somewhat surprising result that (some) consumers may actually become worse off under full tax exemption for e-commerce. For this to happen the removal of taxes on e-commerce must induce the domestic retail firm to "give up" serving the low-trade cost households (since they can buy now at very attractive conditions on the internet) and only serve the high-trade cost household at a price that is no longer constrained by the low level trade costs and therefore may well be higher than without preferential taxation of e-commerce where the domestic firm serves all domestic households at a relatively low price.

In Cases 1 and 2 the analysis of discrete tax preferences to e-commerce revealed that as long as the high-level trade cost exceeds the tax, $\gamma_H > t$, a positive welfare effect is sure to follow. If $\gamma_H < t$ the welfare effect will be ambiguous.

5 Policy Implications

What do these analyses imply for how e-commerce should be taxed? First of all, for our analyses to be relevant local retail markets must be imperfectly competitive as the possible welfare gains from granting tax preferences to e-commerce stem from reduced price mark-ups in the retail sector. Given that the retail sector is subject to (significant) imperfect competition it is then, in principle, always possible to generate a welfare improvement by granting some degree of tax exemption to e-commerce. However, in order to set the tax on e-commerce such that the welfare effect is unambiguously positive the policy-makers will need substantial detailed market information. Moreover, with a range of goods - instead of just a single good - that can be purchased online the e-commerce tax structure will generally be non-uniform for positive welfare effects to emerge. Since differential tax structures may be quite costly to enforce and in our case also informationally demanding to design for the welfare effects to be positive it is quite likely that the relevant alternatives to be considered by the policy-makers are either to tax e-commerce in line with conventional retail trade or to leave e-commerce untaxed altogether. In case full tax exemption is granted to e-commerce the welfare effects will generally be ambiguous due to the risk of trade diversion from domestic

retail trade to e-commerce causing incurred trade costs to rise. However, since tax exemption to e-commerce will not only stimulate e-commerce trade (and possibly also domestic retail trade through the pro-competitive effects) but also make tax administration much more simple the option not to tax e-commerce may not be so bad after all.

One aspect of tax exempting e-commerce which was not possible to analyze in our modelling set-up is whether the tax exemptions should regard e-commerce of both foreign and domestic origin. In the US the *de facto* taxation of e-commerce only treats remote (originating from another state) e-commerce as tax free as all online firms with "nexus" in the state of residence of the buyer are required to collect the use tax on e-commerce transactions. Hence, this nexus condition implies that "domestic" e-commerce is taxed just like conventional retail trade and it prevents bricks-and-mortar retail shops from having online terminals in the shopping area so that the customers could order their goods online from inside the retail shop and pick them up on the way out. This would effectively make all trade qualify for preferential tax treatment, implying that the "non-nexus requirement" may be quite reasonable if tax preferences are granted to e-commerce.

6 Concluding Remarks

Granting tax preferences to e-commerce may be one way of putting competitive pressure on domestic markets. A simple interpretation of our analyses is that provided the policy-makers - for whatever reason - lack effective instruments to regulate imperfectly competitive commodity markets granting preferential tax treatment to e-commerce can (partially) substitute for direct market regulation. Another possible interpretation is to view the analysis from a public finance perspective where the result that granting tax preferences to e-commerce may be welfare improving is a typical second-best result: With imperfect competition in domestic retail markets it may improve domestic social welfare to tax e-commerce and conventional retail trade differently.

One particular result of our analysis that should hold quite generally is that if the revenue losses from granting tax preferences to e-commerce are estimated only by considering how much more revenue would be generated if the tax on offline trade were also applied to online trade these estimated revenue losses will exaggerate the true revenue losses. By inducing more demand for goods sold in the traditional retail markets through pro-competitive effects the tax revenue from offline transactions increases thereby mitigating any revenue losses from online transactions.

The modeling framework has admittedly been extremely simple both in terms of the underlying market structure and the extensive use of specific functional forms for preferences and technologies. One way of extending the modelling framework would be to allow for more sophisticated firm behaviour, e.g. by allowing firms located in one country to set up an online facility servicing domestic as well as foreign markets. One strategic decision to be made by a firm is then which markets to participate in through physical presence and whether or not to have an online outlet as well. Obviously, there are costs associated with setting up physical stores and online stores and these costs will influence the kind of market structures that will be established. In our context the tax treatment of e-commerce will affect the incentives to set up the different business facilities. By having retail stores and e-commerce outlets owned by the same agents it may turn out that these agents will generally oppose tax preferences being granted to e-commerce since that will increase product market competition and reduce profit margins of these firms. Such a result would be consistent with the presence of the "e-Fairness Coalition"³¹ - an organization consisting of both shopping centres and online firms - arguing for tax neutrality between online and offline trade. Another interesting extension would be to allow the online firms to use advanced marketing strategies - like automated trades as described by Vulkan (2003) - which could imply use of price discrimination by the online shops. The analysis of these matter are, however, left for future research.

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7 Appendix

Characterization of equilibria under equal tax treatment of domestic retail trade and e-commerce when households differ with respect to their trade cost. E-commerce is taxed at t_E (so in case of equal tax treatment of e-commerce and domestic retail trade $t_E = t$).

Case 1: Both kinds of trade exist, domestic retail price equal to e-commerce price for high-trade cost households.

$$\begin{aligned} q_R^* &= c + \gamma_H + t_E \\ X_R^* &= \frac{\theta}{\beta}(\alpha - c - \gamma_H - t_E) \\ q_E^* &= c + \gamma_L + t_E \\ X_E^* &= \frac{1 - \theta}{\beta}(\alpha - c - \gamma_L - t_E). \end{aligned}$$

The profits of the domestic retail firm are

$$\pi_H = (q_R^* - c - t)X_R^* = \frac{\theta}{\beta}(\gamma_H + t_E - t)(\alpha - c - \gamma_H - t_E),$$

where the H subscript indicates that the domestic retail firm only serves type H households. For this equilibrium to exist we must require that

$$c + \gamma_H + t_E < \alpha - \gamma_H,$$

(implying that marginal cost equals the relevant section of marginal revenue), that profits are non-negative and that

$$\frac{\theta}{\beta}(\gamma_H + t_E - t)(\alpha - c - \gamma_H - t_E) > \frac{\gamma_L}{\beta}(\alpha - c - \gamma_L - t_E),$$

(implying that profits are higher than when all domestic households are served by the domestic retail firm). Using the notation

$$\begin{aligned} X_1 &= \frac{1 - \theta}{\beta}(q - \alpha) \\ X_2 &= \frac{\theta}{\beta}(q - \alpha), \end{aligned}$$

for demand from the two types of households, social welfare can be written

as

$$\begin{aligned}
SW &= \int_{q_E^*}^{\alpha} X_1(q) dq + t_E X_E^* + \int_{q_R^*}^{\alpha} X_2(q) dq + (q_R^* - c - t) X_R^* + t X_R^* \\
&= \frac{1-\theta}{2\beta} (\alpha - c - \gamma_L - t_E)^2 + \frac{t_E(1-\theta)}{\beta} (\alpha - c - \gamma_L - t_E) \\
&\quad + \frac{\theta}{2\beta} (\alpha - c - \gamma_H - t_E)^2 + \frac{(\gamma_H + t_E)\theta}{\beta} (\alpha - c - \gamma_H - t_E).
\end{aligned}$$

Case 2: Both kinds of trade exist, domestic retail price below the e-commerce price for high-trade cost households.

$$\begin{aligned}
q_R^* &= \frac{1}{2}(\alpha + c + t) \\
X_R^* &= \frac{\theta}{2\beta}(\alpha - c - t) \\
q_E^* &= c + \gamma_L + t_E \\
X_E^* &= \frac{1-\theta}{\beta}(\alpha - c - \gamma_L - t_E).
\end{aligned}$$

The profits of the domestic retail firm are

$$\pi_H = (q_R^* - c - t) X_R^* = \frac{\theta}{4\beta} (\alpha - c - t)^2.$$

For this equilibrium to exist we must require that:

$$\begin{aligned}
c + \gamma_H + t_E &> \alpha - \gamma_H \\
c + \gamma_L + t_E &< \alpha - \gamma_H,
\end{aligned}$$

(for marginal cost to equal the relevant part of marginal revenue) and that profits are non-negative and that

$$\frac{\theta}{4\beta} (\alpha - c - t)^2 > \frac{\gamma_L}{\beta} (\alpha - c - \gamma_L - t_E),$$

(implying that profits are higher than when all domestic households are served by the domestic retail firm). Social welfare is now

$$\begin{aligned}
SW &= \int_{q_E^*}^{\alpha} X_1(q) dq + t_E X_E^* + \int_{q_R^*}^{\alpha} X_2(q) dq + (q_R^* - c - t) X_R^* + t X_R^* \\
&= \frac{1-\theta}{2\beta} (\alpha - c - \gamma_L - t_E)^2 + \frac{t_E(1-\theta)}{\beta} (\alpha - c - \gamma_L - t_E) \\
&\quad + \frac{\theta}{8\beta} (\alpha - c - t)^2 + \frac{(\alpha - c + t)\theta}{4\beta} (\alpha - c - t).
\end{aligned}$$

Case 3: The domestic retail firm serves all domestic households.

$$\begin{aligned} q_R^* &= c + \gamma_L + t_E \\ X_R^* &= \frac{1}{\beta}(\alpha - c - \gamma_L - t_E) \\ X_E^* &= 0. \end{aligned}$$

The profits of the domestic retail firm are

$$\pi = (q_R^* - c - t)X_R^* = \frac{1}{\beta}(\gamma_L + t_E - t)(\alpha - c - \gamma_L - t_E),$$

where the absence of a subscript indicates that all households are being served by the domestic retail firm. For the equilibrium to exist this profit level must be non-negative and exceed the profits emanating from serving the high-trade cost households only (as stated in cases 1 and 2 above). Social welfare is in this case

$$\begin{aligned} SW &= \int_{q_R^*}^{\alpha} X(q)dq + (q_R^* - c - t)X_R^* + tX_R^* \\ &= \frac{1}{2\beta}(\alpha - c - \gamma_L - t_E)^2 + \frac{\gamma_L + t_E}{\beta}(\alpha - c - \gamma_L - t_E). \end{aligned}$$

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