
JOURNAL OF PUBLIC ECONOMIC THEORY

SHOULD SALES TAXES BE IMPOSED ON E-COMMERCE?

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Abstract

We study the impact of E-commerce across state lines in the United States on tax revenue, public good provision, and real income. In particular, in light of the unenforceable nature of interstate taxation, we evaluate the potential gains from coordinating sales and income state taxes among sovereign jurisdictions. We find that the revenue at risk is small and that the welfare gains or losses of any countervailing policy measures, in particular those associated with the Streamlined Sales Tax Project, are even smaller.

1. Introduction

E-commerce has provided unprecedented convenience, improved selection, and reduced transactions costs for a wide range of products and for a growing share of consumers. These primary benefits, imputable to technological progress, must be clearly distinguished from the purely incidental benefits, at least to buyers and sellers, that stem from the states' jurisprudential and *de facto* inability to enforce the collection of sales taxes from out-of-state retailers.

Indeed, U.S. states are federally restrained in how they tax sales across their borders. It is settled U.S. federal constitutional law that the rate of taxation on imported items can be no higher than on items purchased within the state. Similarly, if an imported item is taxable, then its domestically purchased counterpart must also be taxable. Moreover, remote vendors without a physical presence in the destination state are under no legal obligation to

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We are grateful to Marcus Berliant, Marco Castaneda, Miguel Gouveia, and Charlie Sawyer for very helpful comments on previous drafts.

Received August 28, 2008; Accepted February 13, 2012.

Journal of Public Economic Theory, 00 (0), 2013, pp. 1–26.

collect and remit use taxes. It is for this reason that catalog sales and sales from other remote vendors such as QVC or the Home Shopping Channel into a state do not obligate the vendor to collect and remit use taxes to the Department of Revenue, a clear sales and marketing advantage. While residents are legally responsible under current state use tax law to pay the use tax directly to their department of revenue on such purchases from remote vendors if the item is, in fact, taxable, it is well known that individual taxpayer compliance with this obligation is weak to nonexistent. Goolsbee (2000) estimates that enforcing existing sales taxes on Internet purchases could reduce the number of online buyers by as much as 24%, whereas Alm and Melnik (2005), who assume a much lower own-price demand elasticity for Internet purchases, predict a mere 6% reduction. More recently, Ballard and Lee (2007) estimate that a one percentage point increase in the sales tax rate leads to a significant 0.208 increase in the probability of shopping online, a result that is consistent with Goolsbee's.

Clearly, the inability to enforce compliance with existing state and local tax laws, as well as the constitutional hurdles preventing federal intervention, have led to an erosion of the sales tax base. Bruce and Fox (2000, 2001, 2004) estimate that e-commerce caused a $7 billion revenue loss to state and local governments in 1999 and a $15.5 billion loss in 2003. This controversy has given the issue of optimal tax design among the states a new urgency.

A large number of states are currently pushing for the so-called *Streamlined Sales Tax Project* or SSTP, a reciprocal tax agreement among the states, that would harmonize the States' various tax codes and thus make it easier and less onerous for a vendor to collect sales taxes on behalf of her out-of-state client. So far, the bill has been repeatedly voted down by Congress. Despite the so-far successful counterlobbying by mail order and e-commerce companies, proponents of SSTP may eventually prevail and pass a revised version.

While the taxation of e-commerce ought to be detrimental for remote vendors and beneficial for the states' revenues, the question remains to what extent such taxation would affect the *welfare* of the state's representative consumer. While Rasmussen (2004) shows that a tax *exemption* of e-commerce can actually be welfare *improving* when it can force monopolistically competitive local retailers to undercut online prices, the standard literature on optimal taxation fails to provide an unambiguous answer. Following Bruce, Fox, and Murray's (2003) lead, we review the standard arguments:

(1) According to the Ramsey (1927) rule, a good should be taxed at the same rate whether it is purchased online or locally, if in fact the elasticity of demand for the online good is the same as the elasticity of demand for the local good. To the extent, however, that the two goods are not considered identical by the consumer, they will generally face different demand schedules. The consumption of a

good purchased online is delayed by the time to ship, for example, whereas local shopping takes more time and effort.

(2) The *generalized* Ramsey rule with nonhomogeneous consumers recommends higher sales taxes for consumers with a lower marginal utility of income, that is, for more affluent consumers. *If* a majority of Internet purchases are made by relatively more educated consumers with higher disposable income, the case could be made that Internet sales should be taxed at a *higher* rate than local sales.

(3) Finally, it is well understood that governments should impose a higher tax on complements rather than substitutes to leisure to reduce the inefficiency associated with the lack of a tax on the latter. However, as pointed out by Bruce et al. (2003), goods typically purchased online do not fall squarely into either category.[1]

In our simulations, we explore various policies to balance the budget (either by raising taxes to make up lost revenue or by reducing public good provision) and analyze their welfare consequences. Our model is built on the following three premises: first, a sensible model that seeks to inform practical tax policy should, ideally, include taste for and provision of a public good. This places us in a second-best framework: while zero taxation would imply zero dead-weight losses, the absence of public goods would be welfare decreasing. Second, we allow for an income tax since its presence can significantly change the quantitative impact of sales taxes. Third, we are interested in a multijurisdictional framework, that is, with separate state government budgets as is the case in the United States, for example.

The *second-best* framework justifies the use of a *general* equilibrium (GE) model to explore the questions at hand. In addition, a GE framework also allows us to take into account the interdependence among various markets: a tax imposed on Washington apples, for example, will not only affect the demand for apples, but also the demand for Florida oranges and other goods, and as such carries with it welfare effects on many fronts. The aggregate welfare effects of suboptimal taxation are thus likely to be much larger than under a partial equilibrium model. Goulder and Williams (2003), for instance, estimate that the typical "Harberger triangle" formula (Harberger 1964) can underestimate the true excess burden of commodity taxation by a factor of 10, especially due to distortions in the labor market. We should also note here that our model includes preferences for leisure so that labor-leisure trade-off exists and a Corlett–Hague effect is indeed possible.

Of course, a GE framework turns out to be relatively complex. A purely analytical, as opposed to a computational, approach, would make for a

[1] Seminal references to optimal taxation include Corlett and Hague (1953), McLure (1969), Diamond and Mirrlees (1971), and Feldstein (1976); on optimality in a multijurisdictional framework, see Keen and Wildasin (2004).

tedious exercise for all but the simplest of models, whereas more realistic models are typically too complex to allow for simple, closed-form solutions and comparative statics. The *computable* GE (CGE) approach offers a route out of this impasse.

The situation we have in mind is as follows: a federation consists of two states, A and B. A large "Rest of the World" exports a numéraire good to the federation, which is then retailed in the two states through both e-commerce and local retail channels. The choice of channel thus differentiates the good, with the online version of the good becoming a sometimes more appealing alternative for some consumers and a less appealing alternative for others. Last, but not least, consumers and producers can actively take advantage of tax loopholes by purchasing across state lines.

Our results are robust for a large range of parameter choices, in particular for a wide range of elasticities of substitution defining the consumers' preferences.

We conclude the introduction by briefly discussing two papers that are closely related to ours: Russo (2005) and Zodrow (2006). Both papers support the conventional wisdom, best captured in the December 1999 *Appeal for Fair and Equal Taxation of Electronic Commerce* signed by a group of academic public finance economists, including one of this paper's authors. The Appeal, organized and drafted by Charles McLure, stated:

> Electronic commerce should not permanently be treated differently from other commerce. There is no principled reason for a permanent exemption for electronic commerce. Electronic commerce should be taxed neither more nor less heavily than other commerce.

Zodrow uses a standard, partial equilibrium optimal commodity tax model to find that the optimal sales tax rate on Internet purchases is not significantly lower than the optimal sales tax rate imposed on traditional retail goods and that a uniform taxation of traditional and electronic commerce is thus preferable to the current state of *de facto* exemption for e-commerce, even when the administrative costs of inclusion are high.

Russo, on the other hand, uses a dynamic Ramsey-type growth model with savings to perform simulations that are similar to ours. He finds that a broadening of the tax base to include not only e-commerce, but also services, would lead to significant welfare improvements. His focus on e-commerce, however, includes business-to-business (B2B) transactions, which make up 95% of e-commerce. Thus both quantitatively and qualitatively, comparisons to our more narrow focus on business-to-consumer (B2C) Internet transactions are difficult.

The most significant difference between these two papers and ours is their first-best approach where government revenue is not explicitly spent on a utility-generating public good. Under our second-best approach, estimated welfare losses from suboptimal tax schemes are typically much smaller.

Table 1: GDP data for 2007 (millions of dollars)

GDP	**13,841.3**	**100.0%**
.C	9734.2	70.3%
..C-goods	3911.4	28.3%
..C-services	5822.8	42.1%
.I	2125.4	15.4%
.X-M	−708.0	−5.1%
.X	1643.0	11.9%
..X-goods	1152.9	8.3%
..X-services	490.1	3.5%
.M	2351.0	17.0%
..M-goods	1979.4	14.3%
..M-services	371.6	2.7%
.G	2689.8	19.4%
..G-Federal	976.0	7.1%
..G-State/Local	1713.8	12.4%

Table 2: Stylized GDP data

GDP - I	13,841.3 − 2125.4 = 11,715.9	100.0%
.C + (X-M)	9734.2 − 708.0 = 9026.2	77.0%
..C + (X-M): goods	3911.4 + 1152.9 − 1979.4 = 3084.9	26.3%
..C + (X-M): services	5822.8 +490.1 − 371.6 = 5941.3	50.7%
.G	2689.8	23.0%
..G-Federal	976.0	8.3%
..G-State/Local	1713.8	14.6%

Moreover, we can explicitly vary the additional policy variable of public good provision.

2. Some Data

2.1. U.S. National Accounting

Table 1 breaks down the 2007 U.S. Gross Domestic Product[2] by expenditure, in particular distinguishing between Federal Government spending and State and Local spending.

In Table 2, we adapt the data from Table 1 to our one-period model with balanced trade by removing investments and folding the trade deficit into consumption of goods and services.

[2] Source: http://www.bea.gov/newsreleases/national/gdp/2008/xls/gdp407f.xls

2.2. "E-Commerceable" Goods

The Bureau of Economic Analysis (BEA) breaks down U.S. personal consumption expenditures (PCE) by type of product (see BEA Table 2.4.5 at bea.gov). According to the 2007 data shown in Table 3, Americans spent $1083 billion on durable goods, $2833 billion on nondurable goods, and $5794 billion on services. Goods, not services, are generally subject to sales taxes, and among those goods, we identify a subset that satisfy two criteria: they must be practical candidates for online or catalog interstate commerce (for instance, they can easily be shipped by parcel carrier) and taxation must, for all practical purposes, be unenforceable if the good is purchased across state lines. Food items are thus not included, since parcel carriers do not offer refrigeration service. (We shall ignore the possibility of overnight shipments of high-priced items, such as lobster on dry ice.) Likewise, an automobile purchased through eBay does not qualify, since the unavoidable in-state registration guarantees the imposition of a sales tax. Goods that do qualify are, for example, 'tires, tubes, accessories, and other parts" or "video and audio goods, including musical instruments, and computer goods," just to name two. Their total value adds up to $1657 billion dollars, representing 42.3% of all consumption goods. Note that some of these "e-commerceable goods" will in fact be taxed when the remote vendor has nexus. In this sense, our assumptions somewhat overstate the states' potential revenue losses.

Combining the data from Tables 2 and 3, we can define our benchmark expenditure shares, as shown in Table 4.

2.3. State Tax Revenues

State and local government tax collections[3] are summarized in Table 5.

Comparing Tables 1 and 5, we notice a discrepancy in total State and local spending: $1275 billion according to Table 5 (which is based on revenues) and $1714 billion according to Table 1 (which is based on expenditures). This discrepancy stems largely from the fact that we do not include transfers from the Federal government to the states, net revenues from utilities and insurance trust, and deficits, among others.

State and local government spending accounts for 14.6% of GDP. Currently, the average state sales tax rate in the United States is about 4.8% and the average additional local (that is, city and county) sales tax rate is just under 2% for a total of 6.8%; 34.4% of tax revenue stem from combined general and selective sales taxes. Note, however, that sales tax revenues stem not only from the sale of final consumption goods, but also from sales taxes imposed on B2B transactions. Because of bookkeeping requirements, the latter are generally enforceable.

[3] Source: http://www2.census.gov/govs/estimate/07slsstab1a.xls

Table 3: PCE data for 2007 (millions of dollars)

Durable goods	**1,082,798**
Durable goods: not e-commerceable	**556,565**
New autos	102,046
Net purchases of used autos	56,471
Other motor vehicles	219,087
Furniture, including mattresses and bedsprings	84,964
Major household appliances	32,983
Floor coverings	22,006
Guns	3003
Motorcycles	12,566
Pleasure boats and aircraft	23,439
Durable goods: e-commerceable	**526,232**
Tires, tubes, accessories, and other parts	62,838
Small electric appliances	6232
China, glassware, tableware, and utensils	40,680
Video/audio goods, incl. musical instruments, computer goods	160,819
Clocks, lamps, and furnishings	41,337
Blinds, rods, and other	6988
Writing equipment	3859
Hand tools	15,474
Ophthalmic products and orthopedic appliances	28,270
Sporting equipment	37,627
Photographic equipment	4693
Bicycles	5623
Jewelry and watches	65,494
Books and maps	46,298
Nondurable goods	**2,833,002**
Nondurable goods: not e-commerceable	**1,702,086**
Gasoline, fuel oil, and other energy goods	366,891
Food	1,329,136
Net foreign remittances	6059
Nondurable goods: e-commerceable	**1,130,915**
Clothing and shoes	374,026
Tobacco products	93,374
Toilet articles and preparations	68,380
Semidurable house furnishings	46,836
Cleaning preparations, misc. household supplies, paper products	84,275
Drug preparations and sundries	298,653
Nondurable toys and sport supplies	74,338
Stationery and writing supplies	21,892
Magazines, newspapers, and sheet music	48,577
Flowers, seeds, and potted plants	20,564
Services	**5,794,368**
Total	**9,710,166**

Based on BEA Table 2.4.5 for 2007: Personal Consumption Expenditures by Type of Product.

Table 4: Benchmark calibration of expenditure shares

Expenditure	**Share**
Public sector (g)	23.0%
Services (n)	50.7%
"E-commerceable" goods (x)	11.1%
Other goods (m)	15.2%
Total	100%

Table 5: State and local tax collections in 2007 (thousands of dollars)

	S&L%	**State & Local**	**State**	**Local**
General sales taxes	23.5%	299,232,314	238,303,540	60,928,774
Selective sales taxes	10.9%	139,347,721	113,737,767	25,609,954
Property taxes	30.0%	383,100,800	12,654,512	370,446,288
Individual income	22.7%	289,308,234	265,752,148	23,556,086
Corporate income	4.7%	60,523,712	52,846,053	7,677,659
Motor veh. lic. & other	8.2%	103,989,113	73,584,886	30,404,227
Total taxes	100%	1,275,501,894	756,878,906	518,622,988

Table 6: Benchmark calibration of tax revenue shares

Tax	**Base**	**Rate**	**Revenue**	**Share (S/L)**	**Share (F/S/L)**
Sales tax (final goods)	26.3	6.8%	1.79	12.2%	7.8%
Cascading	77.0	4.2%	3.24	22.2%	14.1%
State income tax	100	9.6%	9.60	65.6%	41.8%
Total	—	—	14.63	100.0%	—
Fed income tax	100	8.3%	8.33	—	36.3%
Total	—	—	22.96		100.0%

Since sales tax revenue from final *goods* consumption only accounts for 1.8% (6.8% × 26.3%) of GDP and the average state and local government budgets represent about 14.6% of the economy, sales taxes on final goods account for 12.3% (1.8/14.6) of the average state and local public sector revenue. The residual 22.1% (34.4–12.3) of sales tax revenue must therefore stem from cascading, that is, sales taxes on intermediate goods. We assume that both goods and services (77% of GDP) are subject to cascading, resulting in a 4.2% implicit sales tax on consumption.

For the purposes of this paper, taxes other than general and selective sales taxes largely behave like a state income tax, are bundled together as such, and make up 65.6% of state and local revenue (41.6% of total tax revenue). The implied income tax rate at the state and local levels is thus 9.6%.

Finally, recall that 42% of final goods are e-commerceable, thus sales tax revenue from "e-commerceable" (though not necessarily traded

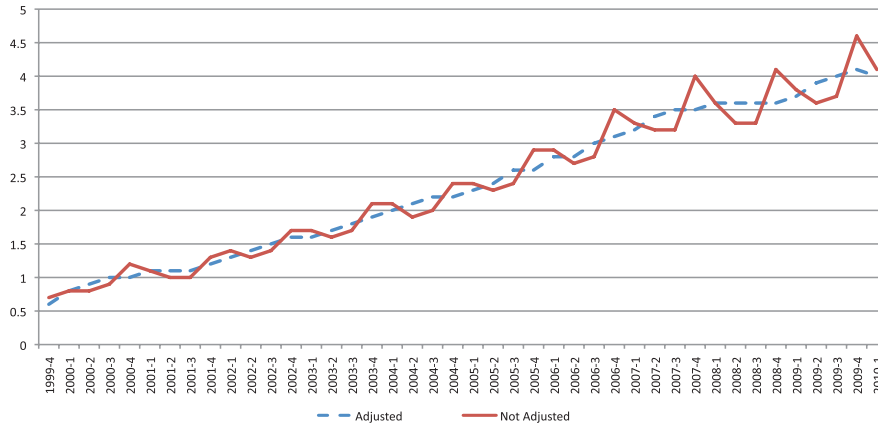


Figure 1: E-commerce as share of total retail (Census Bureau).

across state lines) final goods represents only 3.1% (1.8% × 42.3% ÷ 23%) of combined federal, state, and local public spending (and only 0.72% of GDP), while the remaining 96.9% stems from other sources.

2.4. E-Shoppers

Even though many consumers have broadband connection at work, noty every household has easy Internet access, and a household with access will not always prefer to buy a good online. According to a 2008 survey by the *Pew Internet and American Life Project (PIP)*, 18% of U.S. households have never accessed the Internet, whereas 55% of households have a broadband connection at home. While broadband subscribers are arguably more likely than dial-up users to make online purchases, there remains some considerable reluctance even among Internet-savvy consumers to send credit card and financial information online. Thus, while U.S. e-commerce sales are a growing share of total retail sales (from virtually nil to over 4% from 1999 until 2010; see Figure 1), consumers who *regularly* shop online still constitute a minority.[4] This, however, is changing, with significant projected growth of online retail. According to the U.S. Census Bureau, U.S. online retail exceeded 4% of all retail by the end of 2009, that is, about 9.5% of e-commerceable goods.

[4] According to PIP, "Sixty-six percent of online users have purchased a product online, such as books, music, or clothing, with 6% saying they do this on the typical day."

2.5. Summary

Online retail has been one of the fastest growing sectors in the United States. According to the U.S. Census Bureau data, the share of goods and services purchased online (both in-state and out-of-state) relative to total retail transactions has quadrupled from 1% in 2000 to 4% in 2009. Based on this past trend, its share of total retail would double to about 8% over the next 10 years and its share among e-commerceable goods would exceed 16%. Such extrapolations are, of course, problematic, but it would be informative to explore the implications of an extreme adoption of online shopping, where all consumers are able and, if the price is right, willing to buy online. In short, 42% of all purchased *goods* meet the "avoidable use tax" criterion. Should the share of households readily willing to shop online grow from 40% to 100% (as an extreme scenario), then the sales tax base on final consumption goods that can be considered at risk will increase from roughly 17% to 42%. How much of it would *actually* be lost due to out-of-state purchases depends on preferences and relative prices between retailers and e-tailers as computed in this paper's simulations.

3. The Model

3.1. Modeling the Choice of Retail Channels

Bruce et al. (2003) point out that the literature on optimal taxation is ill-equipped to shed light on the optimal taxation of e-commerce, because many of the results' necessary assumptions are not met. In particular, the literature has not considered the case where consumers can obtain the same good through alternative channels.

Presumably, once in the hands of the consumer, the latest Harry Potter book purchased online and the latest Harry Potter bought at the local bookstore provide the same level of utility. If these two goods were perfect substitutes, then any price difference between "e-tail" and local retail prices (inclusive of taxes and shipping) would lead to an all-or-nothing behavior, where all consumers would purchase from the cheaper source.

One way to allow for the coexistence of both e-commerce and local retail despite price differences may be to acknowledge the importance of shopping behavior: some consumers may enjoy a drive to the mall and the associated window-browsing; they may also value the service and personal assistance of a sales associate; others yet may prefer to spend their time elsewhere and shop quickly and conveniently from their homes, waiting for doorstep delivery. While these shopping preferences could be modeled explicitly, such a framework would be demanding in terms of marketing data. The simple fact remains that, in the aggregate, the two goods are not perfect substitutes and

Occam's razor leaves us with the mere specification of a finite Armington elasticity of substitution between a good purchased at a local store and an identical good purchased online. Because we have no hard data on the magnitude of this elasticity, we will report results for a wide range of plausible magnitudes in Section 5 dedicated to robustness.

3.2. The GE Specification

The economy consists of three regions: state A, state B, and RoW, the Rest of the World. The RoW is simply a perfectly elastic supplier of an export good (thus at a fixed price) and its import behavior is set by balance of trade considerations. The economies of states A and B, on the other hand, are modeled in more depth. Each is composed of four sectors: a government sector, which imposes sales and income taxes, buys household labor services, and produces a publicly provided good; a household final consumption sector; an industrial sector producing an export good, a nontraded good, and a nontraded service; and, finally, a retail sector selling an *import* good through two alternative channels, either traditional retail or online.[5]

Our model thus aims at isolating the direct impact of various tax regimes on the retail sector from their indirect impact on factor allocation in production by (1) restricting e-commerce to a good imported from the RoW (which may include any of the other 48 states) and (2) assuming that the industrial sector does not produce an intermediate good for use by the retail sector. The first assumption, in particular, also guarantees a "level playing field" for the retail sectors of the two competing states to the extent that the wholesale price of the imported good is the numéraire and thus identical for all retailers.

Thus, the retail sector of state i ($i = A, B$) uses labor (but no capital) and a (wholesale) input h_i imported from RoW to produce a retail good, x_i, distributed either through the local retail channel ($x_{\ell i}$) or through e-commerce (x_{ej}). State i's other sectors use capital and labor to produce an export good y_i (to pay for h_i), a nontraded good m_i, and a nontraded service n_i.[6] The representative profit-maximizing firms have CES technology, while labor is assumed to be fully mobile across sectors.

While the RoW simply imports y_A and y_B and considers them perfect substitutes to one another, state i's consumers value $x_{\ell i}$, x_{ei}, m_i, n_i, as well as a nontraded publicly provided good g_i and leisure f_i. We specify multilevel preferences for state consumers: at the highest level, *non-*

[5] Since A and B are assumed to be small regions relative to the "rest of the world," most retail goods would indeed be imported from elsewhere.

[6] We distinguish between nontraded goods and nontraded services because sales taxes are imposed on goods, but not on services.

separable preferences over the aggregate private good, the publicly provided good and leisure in a *constant elasticity of substitution* (CES) framework allow, in particular, for varying degrees of complementarity or substitutability between private and public consumption. At the second level, private consumption is a CES aggregate of retail good, the nontraded good, and the nontraded service. At the lowest level, finally, the retail good purchased locally, $x_{\ell i}$, and the retail good purchased from out-of-state, x_{ei}, are assumed to be imperfect substitutes, as discussed in the previous section.[7]

Public sector behavior is limited to satisfying the budget constraint: spending on public good must equal government revenue (sales tax plus income tax, i.e., tax on factor incomes).

3.2.1. Consumption

We specify *nonseparable* preferences over private goods c, public goods g, and leisure f in a four-level utility framework. Let c_i represent aggregate private consumption and let g_i be the quantity of public good provided in region i. Let $k = 0, 1, 2, 3$ index the four levels of the nested CES utility function. Then denote σ_{ki} the CES and ϕ_{kij} the weight parameter for the jth good in the kth nest for state i's representative consumer. Furthermore, let

$$\rho_{ki} = (\sigma_{ki} - 1)/\sigma_{ki}.$$

The representative consumer has the following nested-CES preferences:

$$U_i = \left(\phi_{0i1}\, u_i^{\rho_{0i}} + \phi_{0i2}\, g_i^{\rho_{0i}}\right)^{1/\rho_{0i}},$$

with aggregate private consumption

$$u_i = \left(\phi_{1i1}\, c_i^{\rho_{1i}} + \phi_{1i2}\, f_i^{\rho_{1i}}\right)^{1/\rho_{1i}},$$

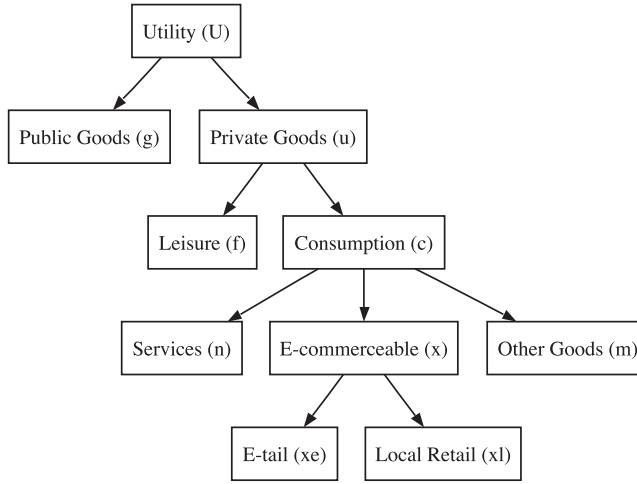
and nonleisure consumption

$$c_i = \left(\phi_{2i1}\, x_i^{\rho_{2i}} + \phi_{2i2}\, m_i^{\rho_{2i}} + \phi_{2i3}\, n_i^{\rho_{2i}}\right)^{1/\rho_{2i}},$$

where x_i is the utility gained from consuming either $x_{\ell i}$ or x_{ei}:

$$x_i = \left(\phi_{3i1}\, x_{\ell i}^{\rho_{3i}} + \phi_{3i2}\, x_{ei}^{\rho_{3i}}\right)^{1/\rho_{3i}}.$$

[7] A representative consumer's (cardinal) CES utility corresponds to her real income, that is, her nominal income divided by her state's price index. We therefore use the terms welfare, utility, and real income interchangeably.



The representative consumer maximizes U_i subject to the budget constraint

$$p_{x\ell i}(1+\tau_{\ell i})\,x_{\ell i} + (p_{xei}(1+\tau_{ei}) + p_{si}s)\,x_{ei} + p_{mi}(1+\tau_{\ell i})\,m_i + p_{ni}n_i = (1-t_i)\,(I_i - w_i f_i),$$

where w_i is the wage rate (and $(1-t_i)\,w_i$ the opportunity cost of leisure), t_i is the income tax rate, $p_{x\ell i}$, p_{xei}, p_{mi}, p_{ni}, and p_{si} are the prices for $x_{\ell i}$, x_{ei}, m_i, n_i, and shipping s_i, respectively, $\tau_{\ell i}$ and τ_{ei} are the *de facto* (i.e., enforceable) sales tax rates on local retail and "e-tail" goods, respectively. We assume that the quantity of shipping service[8] s_i is simply proportional to x_{ei}, that is, $s_i = s\,x_{ei}$.

To simplify notation, let

$$p_{ei} = p_{xei}(1+\tau_{ei}) + p_{si}s,$$
$$p_{\ell i} = p_{x\ell i}(1+\tau_{\ell i}).$$

3.2.2. Production

The representative firm of state i, sector $\psi \in \{y, m, n\}$, owns capital $K_{\psi i}$ and employs labor $L_{\psi i}$. The total factor amount is fixed, for example, $\bar{L}_i = \sum_\psi L_{\psi i}$; p is the import price for good x. Output supplies for $\psi \in \{y, m, n\}$ result from maximizing profit

$$\Pi_{\psi i} = p_{\psi i}s_i - w_i L_{\psi i} \text{ subject to } \Pi_{\psi i} \geq 0.$$

[8] These are to be interpreted as the *additional* shipping costs associated with home delivery as opposed to bulk delivery from producer to retailer.

Similarly, the retail sector maximizes

$$\Pi_{xi} = p_{xi}x_i - p_i x_i - w_i L_{xi} \text{ subject to } \Pi_{xi} \geq 0.$$

The technology for y, m, and n is CES:

$$\psi_i = \left(\beta_{K\psi i} \bar{K}_i^{\frac{\sigma_{\psi i}-1}{\sigma_{\psi i}}} + \beta_{L\psi i} L_i^{\frac{\sigma_{\psi i}-1}{\sigma_i}} \right)^{\frac{\sigma_{\psi i}}{\sigma_{\psi i}-1}},$$

where $\beta_{K\psi i}$ and $\beta_{L\psi i}$ are the share parameters and $\sigma_{\psi i}$ is the CES. The wage rate in region i is represented by w_i and $L_{\psi i}$ is the amount of labor hired.

For the retail good, we specify a Leontieff production function

$$x_i = \max\{h_i, \gamma_{xi} L_{xi}\},$$

so that at equilibrium $x_i = h_i = \gamma_{xi} L_{xi}$. Region i's pretax factor income is thus

$$I_i = w_i \bar{L}_i + \Pi_{xi} + \sum_{\psi} \Pi_{\psi i}.$$

3.2.3. Public sector

Government spending, which in our model is simply the labor bill associated with the provision of the public good, must equal tax revenue:

$$w_i L_{gi} = \tau_{\ell i} p_{zi} z_i + \tau_{\ell i} p_{\ell i} x_{\ell i} + \tau_{ei} p_{ei} x_{ei} + t_i (I_i - w_i L_{fi}).$$

3.2.4. Social accounting

Leisure enters the welfare function so that total income consists of both leisure and nonleisure income. The latter corresponds to the classical definition of national income. Subtracting income taxes from nonleisure income yields disposable income, which is spent on goods and services inclusive of their sales taxes. Leisure, goods, and services net of sales taxes define utility from private consumption. Sales taxes plus income taxes define state revenue, which is spent on publicly provided goods. Looking at the source of total income, it stems from capital income (profit) and time endowment. Time not spent on leisure is spent earning a wage. Figure 2 offers a synoptic view.

3.3. Key Abstractions and Limitations

It is important to point to the key abstractions embodied in our model. For instance, our static, single-period model does not allow for savings; as a consequence, income and *uniform* sales taxes are equivalent. Furthermore, the

Time		Profit	
Leisure	Labor	Profit	
Total Income			
Leisure	Non-Leisure INC		
Leisure	Disposable Income		Income Taxes
Leisure	Consumption	Sales Taxes	Income Taxes
Private Utility		Public Good	

Figure 2: Social accounting.

use of a representative consumer precludes consideration of any distributional issues.

Neither do we have a fully specified intermediate production level; we therefore do not deal with issues related to taxation of below-retail transactions and focus solely on B2C commerce. As such, our model does not take into account changes in tax revenue from cascading and we must treat the missing tax revenue (needed to balance our budget) *as if* it were a *separate* tax on final goods. This stand-in tax is computed in the "SSTP" scenario so as to satisfy the government budget constraint; it is then held fixed at that level for all other scenarios. The assumption of an implicit and constant sales tax should only have a negligible effect on our simulations and comparative statics.

3.4. Calibration of Preference and Technology Parameters

Forty percent of time endowment is allocated to work and the other 60% to leisure.[9] In the base case, we assume that the elasticity of substitution between aggregate private and public good is an inelastic 0.5; the elasticity of substitution among e-marketable, other retail goods and services is 2.0; and the elasticity between the e-tail and local retail version of e-marketable goods is a relatively high 4.0. To check for robustness, we also ran simulations under alternative elasticities specifications, which are reported in Section 5.

4. Simulations and Main Results

Our starting point is a true second-best benchmark economy ("INC") with two identical states, where each state's public sector's sole source of revenue is a state income tax.[10] Here, public good provision is optimal and corresponds to that of a benevolent planner (see column 1 in Tables 7 and 8).

[9] Assuming a 50-hour work-week and 6 hours of sleep per night.

[10] Note, again, that in our model, an income tax is equivalent to a consumption tax on all goods and services and should be interpreted as such. In particular, our income tax is not a tax on savings since savings is not modeled.

Table 7: Coordinated fiscal adjustments

		1 INC	2 SSTP	3 ST	4 IT	5 PG
1	T Fed Inc.	**8.33%**	**8.33%**	**8.33%**	**8.33%**	**8.33%**
2	T S&L Inc.	**14.63%**	**9.60%**	**9.60%**	9.94%	**9.60%**
3	T Retail	**0%**	**6.80%**	8.12%	**6.80%**	**6.80%**
4	T Online	**0%**	**6.80%**	**0%**	**0%**	**0%**
5	T Cascading	**0%**	3.65%	**3.65%**	**3.65%**	**3.65%**
6	Q Public Gd (g)	22.96	**22.96**	**22.96**	**22.96**	22.56
7	Q Leisure (f)	100.000	105.387	105.127	104.685	104.850
8	Q Services (n)	50.700	47.180	47.392	47.665	47.842
9	Q NE Goods (m)	15.240	13.772	13.760	13.921	13.975
10	Q ER Goods (x_e)	8.880	8.192	7.578	7.754	7.777
11	Q EE Goods (x_l)	2.109	2.020	2.685	2.585	2.591
12	Q Shipping (s)	0.111	0.106	0.141	0.136	0.136
13	Q Export good	5.495	5.106	5.132	5.170	5.184
14	Real income (U)	200.000	194.662	194.624	195.032	195.090
15	Δ% Public Gd	0	0	0	0	−1.73
16	Δ% Leisure	0	+5.39	+5.13	+4.68	+4.85
17	Δ% Services	0	−6.94	−6.52	−5.99	−5.64
18	Δ% NE Gds	0	−9.63	−9.71	−8.66	−8.30
19	Δ% ER Gds	0	−7.75	−14.66	−12.68	−12.42
20	Δ% EE Gds	0	−4.22	+27.31	+22.57	+22.87
21	Δ% Shipping	0	−4.22	+27.31	+22.57	+22.87
22	Δ% Export Gd	0	−7.08	−6.61	−5.91	−5.65
23	Δ% Real Inc.	0	−2.67	−2.69	−2.48	−2.46

We then introduce sales taxes on all goods, including those purchased via e-commerce, to create the so-called "SSTP" economy (see column 2 of Tables 7 and 8). Since the new sales tax generates public revenue, it is combined with a corresponding reduction in income tax so as to preserve the original level of public good provision.[11]

From there, we move to a situation where the two states can no longer collect taxes on out-of-state purchases and must therefore consider three potential policies to balance their budgets:

- (ST) maintain the original public good provision by increasing the sales tax rate $\tau_{\ell i}$ on the *de facto* taxable goods (see column 3 of Table 7);

[11] Note that once sales taxes are introduced, the original provision of public good may no longer be optimal since a slight reduction in its provision would also imply lower distortionary sales taxes.

- (IT) do so by increasing the income tax t_i instead (see column 4 of Table 7); or
- (PG) leave tax rates unchanged, but cut public good provision g_i (see column 5 of Table 7).

While we assume identical initial fiscal structures for both states at the benchmark, we will distinguish between *coordinated* fiscal policy adjustments and *unilateral* adjustments. In the *unilateral* case, only state A changes its tax structure to restore the original level of public good provision while state B allows its public good provision to be driven by the new, lower level of pubic revenue.

4.1. Coordinated Responses by Both States

The first six lines in Table 7 show the policy figures of interest: public good provision (line 6) as well as income tax (lines 1 and 2), sales tax on local purchases (line 3), *de facto* sales tax on out-of-state purchases (line 4), and cascading (line 5). For each scenario, five parameters are fixed (shown in bold) and the sixth one (framed) is endogenous and computed so as to satisfy the governments' budget constraint. Note that the endogenous variable that solves the CGE system varies by policy proposal.

Our simulations start out with the second-best scenario of income taxes only INC, where the optimal provision of public good, g_i, is established at 22.96 (see column 1 of Table 7). This second-best scenario is also our benchmark for purposes of comparison against the other four scenarios shown in columns 2–5 of Table 7.

Under the SSTP scenario, we are moving away from the second-best scenario and toward one that corresponds to the observed policy of combined income and sales taxes, with the proviso that the original supply of public good is maintained by enforcing the ability to tax out-of-state commerce at the prevailing sales tax rate of 6.8%. Here we also establish the implicit tax rate of 3.65% that mimics cascading; this rate is then held at that level for all remaining simulations (see line 5).

For the next three simulations, the ability to tax out-of-state commerce is lost. Under scenario ST, the states' budgets are balanced through an increase of the sales tax rate from 6.80% to 8.12%, almost a 20% increase. Under scenario IT, the budgets are balanced through an increase of state income taxes from 9.60% to 9.94%, a 3.4% increase. Under scenario PG, finally, state and local governments in both states do not seek remedies to the shrinking tax base, but simply provide a smaller amount of public good, the supply of which falls from 22.96 to 22.56 units, a 1.73% decline.

The welfare (or real income) effects are striking:

(1) The departure from the true second-best, income taxes only scenario INC to one partially based on sales taxes (or equivalently, the

abolition of a consumption tax on services) leads to a significant static real income drop of 2.67%;

(2) An increase in the income tax rate (scenario IT) has virtually the same impact on welfare as a reduction in public good provision (scenario PG);

(3) The proposed SSTP agreement fares about as poorly as a simple increase in the sales tax on goods purchased through traditional brick and mortar retail (scenario ST), both causing an additional loss of about a quarter percent in real income compared to PG or IT.

In other words, it does not make much of a difference whether states lower public good provision or whether they increase their income tax, since we are indeed close to optimal provision where the marginal benefit of public good provision equals the marginal cost of income taxation.[12] A reduction of sales taxes, on the other hand, even if only on a restricted category of goods, is much preferable to a decrease in the income tax. Thus, while it is good to have a uniform sales tax, it's even better to have a low *average* sales tax.

Restricting our attention to the four scenarios SSTP, IT, ST, and PG, that is, working on the assumption that services are exempt from consumption taxes, we close this subsection with the following observations from Table 7:

(1) Regardless of how states respond to lost revenue, real income changes associated with the rise of e-commerce are *extremely* small. That is, compare columns 3–5 of Table 7 with column 2 of Table 7.

(2) The best response to the shrinking sales tax base, due to a rise in sales tax exempt e-commerce, is to compensate with a combination of higher income taxes and a lower public good provision.

(3) A streamlined sales tax agreement is about as ineffective as a simple increase of the sales tax rate on *de facto* taxable goods: either leads to a loss of real income when compared to the higher income tax/lower public good provision alternatives.

(4) Removing the tax advantage currently enjoyed by e-tail relative to local retail would shrink e-commerce by over 22%. These results are consistent with Goolsbee's prediction of a 24% decline.

[12] The very small advantage of scenario PG is simply due the slight suboptimal provision of public goods at the SSTP benchmark: recall that public good provision was only optimal under scenario INC, the source benchmark with income taxes only.

Table 8: Unilateral fiscal adjustments by state A

		1	2	3	4	5	6
		INC	**SSTP**	**(ST,PG)**		**(IT,PG)**	
		A/B	**A/B**	**A**	**B**	**A**	**B**
1	T Fed Inc.	**8.33%**	**8.33%**	**8.33%**	**8.33%**	**8.33%**	**8.33%**
2	T S&L Inc.	**14.63%**	**9.60%**	**9.60%**	**9.60%**	10.04%	**9.60%**
3	T Retail	**0%**	**6.80%**	8.50%	**6.80%**	**6.80%**	**6.80%**
4	T Online	**0%**	**6.80%**	**0%**	**0%**	**0%**	**0%**
5	T Cascading	**0%**	3.65%	**3.65%**	**3.65%**	**3.65%**	**3.65%**
6	Q Public Gd (g)	22.96	**22.96**	**22.96**	22.67	**22.96**	22.67
7	Q Leisure (f)	100.000	105.387	104.941	105.114	104.375	105.107
8	Q Services (n)	50.700	47.180	47.634	47.478	47.964	47.498
9	Q NE goods (m)	15.240	13.772	13.812	13.864	14.013	13.869
10	Q ER goods (x_e)	8.880	8.192	7.487	7.814	7.675	7.850
11	Q EE goods (x_l)	2.109	2.020	2.718	2.585	2.654	2.522
12	Q shipping (s)	0.111	0.106	0.143	0.136	0.140	0.133
13	Q Export good	5.495	5.106	5.158	5.144	5.204	5.146
14	Real income (U)	200.000	194.662	194.646	194.945	195.167	194.936
15	Δ% Public Gd	0	0	0	−1.26	0	−1.26
16	Δ% Leisure	0	5.39	4.94	5.11	4.37	5.11
17	Δ% Services	0	−6.94	−6.05	−6.35	−5.40	−6.32
18	Δ% NE Gds	0	−9.63	−9.37	−9.03	−8.05	−8.99
19	Δ% ER Gds	0	−7.75	−15.69	−12.01	−13.58	−11.60
20	Δ% EE Gds	0	−4.22	28.88	22.56	25.84	19.57
21	Δ% Shipping	0	−4.22	28.88	22.56	25.84	19.57
22	Δ% Export Gd	0	−7.08	−6.13	−6.38	−5.28	−6.35
23	Δ% Real Inc.	0	−2.67	−2.68	−2.53	−2.42	−2.53

4.2. Unilateral Response by State A

We now turn to the case of a unilateral response by state A while state B preserves its initial tax structure and simply adjusts public good provision to match fiscal revenue. The results are shown in Table 8.

As before, the outcomes are compared to our initial benchmark of a true second-best scenario with no sales taxes in either state. Scenario SSTP (which, by definition, is bilateral) is listed again for ease of comparison. As in the previous set of simulations, the first six lines in Table 8 represent the policy parameters, the five in bold being set and the framed one calculated so as to satisfy the public budget constraint. (We now list separate columns for each state when the figures are no longer identical.)

Under scenario (ST,PG), state A preserves its public good provision at 22.96 units by increasing the sales tax rate from 6.80% to 8.50% (column 3 in Table 8) and state B only adjusts its provision of public good (column 4 in

Table 9: Coordinated versus unilateral fiscal adjustments

SCENARIO	SSTP	ST	IT
Coordinated	−0.22%	−0.24%	−0.03%
Unilateral by A	—	−0.23%	0.04%

Table 8); under scenario (IT,PG), state A preserves its public good provision by increasing the income tax rate from 9.60% to 10.04% (column 5) and state B only adjusts its provision of public good (column 6 in Table 8). As before, the impacts on A's real income relative to the SSTP scenario are all very small, indeed almost nil in the (ST,PG) case, while there is a slight, 0.26% welfare gain under (IT,PG). In both cases, a passive state B sees real income grow ever so slightly by about 0.15%; as small as it is, the impact on B can be considered a good outcome under (ST,PG) (column 4) to the extent that B does not imitate A's counterproductive policy, and a poor outcome under (IT,PG) (column 6) to the extent that B could do even better by also increasing its income tax.

4.3. Coordinated versus Unilateral Measures

The welfare or real income effects in state A, relative to doing nothing (PG), for both the unilateral and coordinated policy responses to a sudden inability to tax out-of-state commerce are compared in Table 9.

Thus doing nothing, that is, simply reducing the provision of public goods, is on par with an income tax increase (IT). Both trump an increase in the sales tax rate (ST) and the SSTP, although the changes, in relative terms are rather small.

We conclude this section with the following bottom line: whether we are looking at a coordinated or a unilateral policy adjustment to make up for revenue lost to e-commerce, the welfare effects are extremely small. The very small size of these effects is, to a large extent, a consequence of the small size of the affected market; it is also explained by corrective substitution effects which the CGE framework captures, even when private and public goods are poor substitutes. The impact on consumption patterns may be large, but the ultimate utility impact is small, indeed effectively minimized by optimizing consumers and producers in both states.

5. Robustness

We calibrated our computational model on the basis of data reported in Section 2. We do not, however, have reliable estimates for the various elasticities of substitution used to specify the representative consumers' utility functions, namely: σ_1, the elasticity of substitution between public and private goods; σ_2, the elasticity of substitution among private goods; σ_3, the

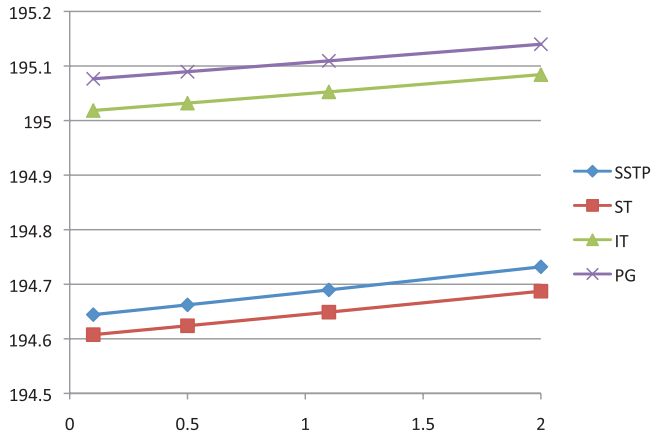


Figure 3: Welfare as function of σ_1.

elasticity of substitution between e-tail and retail goods; and σ_L, the elasticity of substitution between leisure and consumption.

Below we check the robustness of our results over the entire range of alternative reasonable elasticity values.

As shown in Figure 3, our results are robust over alternative elasticity specifications with respect to public versus private consumption. We have so far assumed that these two classes of goods are complements (elasticity of substitution equal to 0.5), but if we specify a higher degree of substitutability with an elasticity of substitution equal to 2, our policy implications remain unaffected: the SSTP still fares best among solutions involving the taxation of sales with 11 thousandths of a percent increase in cardinal utility; increasing the income tax rate leads to a 3 thousandths percent improvement; and an increase in the sales tax on *de facto* taxable goods leads to 8 thousandths of a percent *decline* in welfare. A move to a pure income-based taxation, finally, would raise real income by 0.123%. Intuitively, when private consumption is a better substitute for public goods, a reduction in revenue collection is less costly in terms of welfare loss; thus, a policy aimed at raising revenue by increasing the distortionary sales tax is more likely to have a net negative impact.

The same robustness with respect to welfare is observed when σ_2, the elasticity of substitution among private goods, and σ_3, the elasticity of substitution between e-tail and retail goods, whose benchmark values are both 2.0, are varied from 0.5 to 10.0, as shown by the plots in Figure 4.

A different choice for σ_3 should, however, have a much stronger effect on the willingness of consumers to switch from traditional to online retail and the shares of e-tail and retail, as confirmed by the plots in Figure 5.

Clearly, when σ_3, the elasticity of substitution between e-tail and retail, is zero, tax structure does not affect the relative sizes of the two sectors.

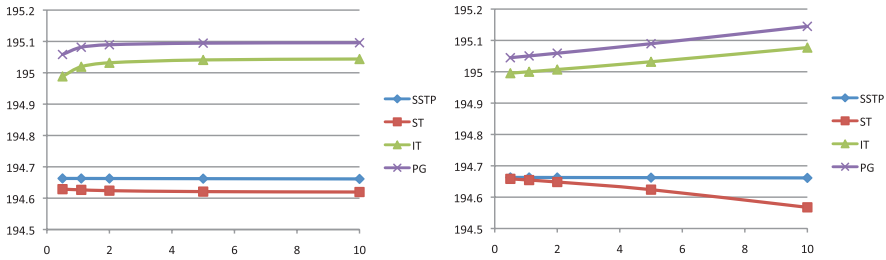


Figure 4: Welfare as function of σ_2 (left) and σ_3 (right).

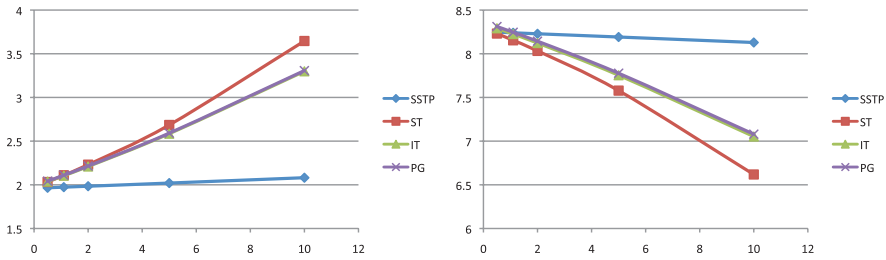


Figure 5: E-tail (left) and traditional retail (right) as functions of σ_3.

Moreover, under the SSTP regime, the relative sizes remain largely constant regardless of σ_3. On the other hand, the higher the elasticity, the greater the discrepancy of market shares under, say, the SSTP and PG regimes. At the benchmark elasticity of substitution of 4.0, a shift from PG to SSTP implies a 22% reduction of e-commerce, which, as mentioned in Section 4.1 is comparable to Goolsbee's 24% prediction. Alm and Melnik's prediction of a 6% decline, on the other hand, can only be obtained with an elasticity of substitution σ_3 well under 1.0; in other words, e-tail and retail would have to be complements rather than substitutes.

6. Implications of Growing Internet Adoption

As the Internet continues to be adopted by more households, and becomes increasingly ingrained into our cultures, we can expect the share of online purchases to keep growing. On the basis of our model, as this share doubles from 10% to 20% of retail, we expect about three quarters of a 1% increase in total private consumption along with an almost 1% decrease in public good provision; simultaneously, our consumption of leisure drops by about one quarter of 1%, as households decide to work more. Cardinal utility, finally, increases ever so slightly.

Under the extreme assumption of e-commerce capturing 80% of all retail, *ceteris paribus* (!), the aforementioned trends are amplified with total private consumption increasing by 5% and public good provision dropping

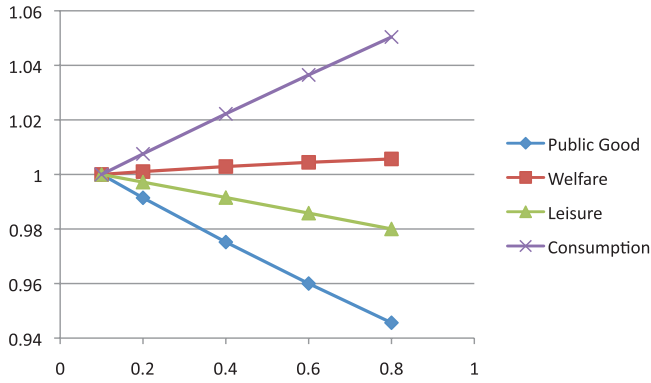


Figure 6: Impact of growing adoption.

by 5%. Consumption of leisure drops by 2%, while welfare increases by just over one half of 1%. The results are summarized in Figure 6.

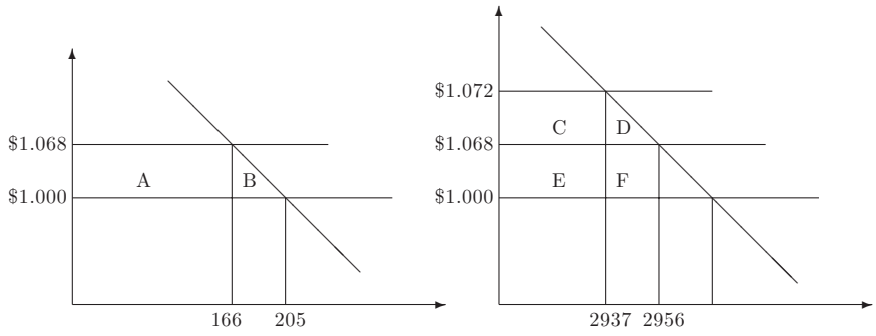
7. How Important Are the GE Effects?

Our results suggest that the rise of e-commerce can only have small consequences on tax revenue and thus public good provision, and that those have an even smaller impact on consumer welfare. Much of the argument is driven by the fact that e-commerceable goods only make up a modest share of our consumption and generate an even smaller share of our welfare. In addition, our GE approach allows for substitution in consumption, thereby further alleviating any welfare losses associated with the nontaxation of select goods, but simultaneously increasing the burden on other markets.

To see to what extent our results are driven by GE considerations, we repeat our analysis using a partial equilibrium approach, that is, a standard welfare analysis based on changes in consumer surplus and tax revenue. A quick, back-of-the-envelope way of translating our assumptions on preferences into locally defined demand curves is to use the fact that the own-price elasticities of demand η in the case of nested CES utility is given by $\eta = \sigma - s(1 + \sigma)$, where s is the expenditure share for that good (within its nest) and σ is the elasticity of substitution.

In particular, within the class of e-commerceable goods, our base calibration specified an elasticity of substitution of -4 between goods sold online and goods sold through brick-and-mortar retail. The market share of goods sold online was about 10% with a sales volume of \$166 billion. This corresponds to an own-price elasticity of demand of -3.7 for online retail goods. A sudden inability to levy the 6.8% sales tax would lead to an increase of the sales volume by \$39–\$205 billion, lead to a loss of tax revenue of \$11.3 billion

(see area A in the graph), and cause a net welfare *gain*[13] of $1.33 billion (see area B in the graph).



To make up the lost revenue, we must increase the sales tax rate on goods that can indeed be taxed. These make up a sales volume of $2956 billion and an expenditure share among goods and services of about 32.7%. Given an elasticity of substitution between goods and service of −2, we obtain an own-price elasticity of −1.67. We find that the sales tax rate would have to be raised from 6.8% to about 7.2%, causing the sales volume to fall from $2956 to $2937.5, while the new tax revenue (areas E+C) grows to $211.5 billion, compared to the old tax revenue (areas E+F) of $201 billion. The additional welfare loss (areas D+F), finally, equals $1.34 billion.

Overall, then, the $1.33 billion gain is offset by a $1.34 billion loss, for a net $10 million welfare loss, this in a $9.7 trillion economy. Just as in the GE approach, the partial equilibrium welfare effect of not imposing sales taxes on e-commerce is extremely small. Indeed, it is smaller by a factor of 10, which is in line with the Goulder–Williams argument that a partial equilibrium analysis would underestimate the magnitude of welfare effects, since it does not capture excess burden in other markets.

8. Conclusion

Because theory does not provide unambiguous answers about the pros and cons of a potential Streamlined Sales Tax Agreement among the states, we resorted to computer-based simulations to shed some light on the various fiscal responses to e-commerce. A closer look at the data shows that currently at most 3.1% of the tax base is *potentially* at stake. How much of it is actually lost depends on consumers' elasticity of substitution between identical goods from alternative channels. How much such a reduction in public revenue, in turn, affects real income depends on consumers' elasticity of substitution between public and private goods.

[13] Recall that we are now in a first-best framework.

Our main finding is that any tax agreement or policy guaranteeing the continued provision of the original amount of public good, including a Streamlined Sales Tax Agreement, would only have a negligible impact on consumers' welfare. We established this result even though we used a GE approach designed to capture excess burden of taxation in all markets. In particular, our model includes preferences for leisure, so that total labor supply varies with the burden of taxation.

It is important to point out that our results do not necessarily contradict Zodrow's (2006) finding that the optimal tax on internet sales is close to the optimal tax on other goods; second-best considerations, however, suggest that even significant deviations from the optimum still only lead to small losses in welfare terms.

Among the studied alternative tax policies, the superior solution consists of a complete abolishment of all sales taxes with a tax on income (or equivalently, a broadening of the sales tax base to all consumption, including that of services) the sole source of state government revenue. The latter interpretation confirms Russo's finding (2005), although one must be careful to note that his dynamic Ramsey-type growth model with savings breaks the equivalence between an income tax and a broader sales tax. Of course, such leveling of the playing field would eliminate the fiscal advantage currently enjoyed by the e-tail sector.

E-commerce clearly benefits from the sales tax advantage. Depending on the elasticity of substitution between goods purchased in local stores and identical goods purchased online, e-commerce could shrink anywhere from 20% to 40% if the sales tax differential were to be eliminated. The resistance of mail order companies and now e-commerce companies to sales taxes is thus not surprising, and they have so far been very effective in blocking legislation.

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