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## Appendix A

# Retail Sales and Value-Added Taxes: Variations on the Same Theme

In the abstract world of simple algebra, it is easy to see that a uniform tax on consumption (a common way of viewing a “pure” retail sales tax [RST]) is equivalent to a uniform tax on all inputs of primary factors (a common way of viewing a “pure” value-added tax [VAT]).

### Case 1: No taxes

First, consider the case where no taxes are imposed on goods or services. Then, for any good or service, in a world of perfect competition, where all prices equal long-run marginal costs, and where there are only two factors of production, labor and capital:

$$wL_i + rK_i = p_iQ_i \tag{A.1}$$

In equation A.1,  $w$  is the wage rate,  $L_i$  is the quantity of labor used directly and indirectly (through purchased inputs) in the production of good  $i$ ,  $r$  is the rate of return on capital (in shorthand, the profit rate),  $K_i$  is the quantity of capital used directly and indirectly in the production of good  $i$ ,  $p_i$  is the price of good  $i$ , and  $Q_i$  is the quantity of good  $i$  supplied to consumers.

For the economy as a whole, value added equals total wages (returns to labor) and total profits (returns to capital) added together for all industries. This is the same as total private income:

$$\text{Total private income} = wL + rK \tag{A.2}$$

In equation A.2,  $L$  is the total quantity of labor used in the economy as a whole (total employment) and  $K$  is the total quantity of capital used in the economy.

**Case 2a: RST—Wage and profit rates are fixed in nominal terms, and demand for goods and services is not affected by the nominal price level (perfectly inelastic demand)**

Next, we apply a “pure” RST to the price of all final goods and services. We assume that no good or service produced for final consumption or investment escapes the tax, which is levied at a uniform rate  $t$  on all goods and services. The new tax drives a wedge between the price received by producers and the price paid by consumers. Denoting  $p_i$  as the producer price, the price consumers or investors must pay for goods and services is  $p_i(1+t)$ .

Since wages and profits are fixed in nominal terms,  $w$  and  $r$  are not allowed to change; hence the producer price must remain unchanged. As before:

$$wL_i + rK_i = p_iQ_i \tag{A.3}$$

If demand for good  $i$  is perfectly price inelastic, consumers will purchase the same quantity of good  $i$  regardless of the price, so they bear the entire burden of the tax. The burden of the tax on consumers, reflected in a higher price for good  $i$ , is therefore:

$$p_i(1+t)Q_i - p_iQ_i = tp_iQ_i \tag{A.4}$$

If all goods are price inelastic, total nominal private income continues to be<sup>1</sup>

$$\text{Total nominal private income} = wL + rK \tag{A.5}$$

In other words, earnings from labor and capital remain the same in nominal terms: equation A.5 is the same as equation A.2. However, when workers and capitalists spend their earnings, they discover that all prices have risen by the multiple of  $(1+t)$ . So real private incomes have fallen:

$$\text{Total real private income} = (wL + rK)/(1+t) \tag{A.6}$$

Of course, tax payments might well be used to purchase public goods that benefit everyone. Conceivably, public goods more than compensate for the decline in real private income.

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1. Nominal private income includes wages and profits earned on producing goods and services purchased by the government.

**Case 2b: A VAT on primary inputs—Wage and profit rates are fixed in nominal terms, and demand for goods and services is not affected by the nominal price level (perfectly inelastic demand)**

Now consider a VAT levied on returns to all primary inputs ( $L$  and  $K$ ) at the uniform rate  $t$ . Again we assume that wage and profit rates are fixed in nominal terms, and demand is perfectly inelastic. Because wage and profit rates are fixed, producers must raise their prices to collect money to pay the tax. The price of each good or service must therefore increase from  $p_i$  to  $p_i(1+t)$ , just enough to cover the taxes on inputs. The basic equality between costs and prices then becomes

$$w(1+t)L_i + r(1+t)K_i = p_i(1+t)Q_i \quad (\text{A.7})$$

While consumers do not pay tax at the cash register,<sup>2</sup> the prices they face are the same as they are in the retail sales tax case. This is because producers have increased their prices. For the entire economy, when all prices react in the same manner as good  $i$ , nominal private income is unchanged:

$$\text{Total nominal private income} = wL + rK \quad (\text{A.8})$$

However, as before, prices have risen by the multiple  $(1+t)$ , so real private income has decreased:

$$\text{Total real private income} = (wL + rK)/(1+t) \quad (\text{A.9})$$

**Case 3: An RST or VAT with flexible wages and profits, and demand for goods and services is highly sensitive to price (perfectly elastic demand)**

In case 2, consumers paid the entire tax whether it was levied on retail sales or value added, either explicitly at the cash register or by a markup in prices. However, when nominal prices rise, consumers may not be willing to buy the same amount of goods and services. They may switch to cheaper substitutes (possibly from abroad), or do without. In the extreme case of perfect elastic demand, consumers will refuse to purchase good  $i$  for any nominal price above  $p_i$  (a consumer strike). Producers now have a choice: they can either lower wages and profits to continue to sell, or they can stop producing altogether. If full employment of labor and capital is to be maintained they must lower the price to:

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2. As an administrative choice, the VAT charge may be printed on register receipts. This makes no difference to the legal liability for paying tax on labor and capital earnings.

$$p_i^* = p_i/(1+t) \quad (\text{A.10})$$

This can only be achieved by cutting  $w$  and  $r$  to  $w^*$  and  $r^*$ , such that:

$$w^*L_i + r^*K_i = p_i^*Q_i = p_iQ_i/(1+t) \quad (\text{A.11})$$

Since we assume that wages and profits are equally flexible, the tax burden will be shared equally:  $w^* = w/(1+t)$  and  $r^* = r/(1+t)$ . Hence equation A.11 is the same as

$$wL_i/(1+t) + rK_i/(1+t) = p_iQ_i/(1+t) \quad (\text{A.12})$$

Under perfectly elastic demand, producers absorb the entire burden of the new tax in lower nominal returns to continue producing the prior level of output. As a result, private income generated from the production of good  $i$  falls by the multiple  $1/(1+t)$ . If demand for all goods is perfectly elastic, nominal private income for the economy as a whole will fall to

$$\text{Total nominal private income} = w^*L + r^*K = (wL + rK)/(1+t) \quad (\text{A.13})$$

Since the lower production costs perfectly offset the new tax, consumer prices are unchanged. Hence, nominal income is identical to real private income:

$$\text{Total real private income} = (wL + rK)/(1+t) \quad (\text{A.14})$$

The result is the same for an RST or VAT. Under an RST, producers, anticipating consumer revolt, lower their own costs (wages and profits) to reduce their previous price levels and offset the tax at the register. Under a VAT, producers hold their previous price levels and directly absorb the new tax as a reduction in after-tax wages and profits. In both cases, the price paid by consumers is unchanged.

To recap, if the price elasticity of demand is perfectly inelastic, consumers will continue to purchase  $Q_i$  regardless of price. So they bear the entire cost of either an RST or a VAT. The resulting increase in the price level causes real private income to fall. At the other extreme, if demand is perfectly elastic, consumers will refuse to accept any price increase. Producers are then forced to either shut down or lower  $w$  and  $r$  to receive less income for the same amount of production. If producers lower wages and profits so that consumers pay the same initial price, workers and capitalists bear the entire burden of the VAT or RST in lower after-tax earnings.

Rather than the extremes of perfectly inelastic or perfectly elastic demand, it is likely that price elasticity will fall somewhere between the two extremes, and producers and consumers will share the burden of the tax.

The price of the good will rise, but not by the full rate of tax, and wages and profits will fall to make up the difference. Both the national burden and the proportion of it paid by consumers, workers, and capitalists will be the same for either an RST or a VAT. Whether this burden falls more heavily on workers, capitalists, or consumers is determined entirely by the sensitivity of each to changes in prices, wages, and profits—not by the form of the tax.

Since pure RSTs and VATs are almost identical in their economic effects, it seems surprising that many advocates of consumption taxation object so strenuously to the form they dislike. Much of the debate can be attributed to political perceptions and questions of administration. However, another cause for disagreement is that neither VAT nor the RST will be implemented in a pure form. Both are also open to distortions, though in different ways. In particular, a key feature of our analysis is the single uniform rate  $t$ . If  $t$  differs from good to good or between goods and services, or if  $t$  differs between capital and labor—and if the differences depend on the form of the consumption tax—the theoretical equivalence between the RST and VAT will not hold. A nonuniform tax rate will introduce distortions into the economy. Too much of the tax-advantaged good will be produced, or too much of a tax-advantaged factor will be used. As a rule of thumb, the economic damage caused by these differentials will grow by the square of the difference in tax rates.<sup>3</sup> In this context, two observations are in order:

- The RST is highly susceptible to nonuniform application across goods and services. Politically preferred items—that is, merit goods—may have low tax rates or be exempted altogether. In fact, many state sales tax systems exempt nearly all services. While VAT may also be distorted in the same fashion, it is less open to differential rates because it is assessed at every level of the production chain.<sup>4</sup>
- However, VAT is more open to distortions between the rate assessed on labor and the rate assessed on capital. Special credits or deductions for the use of a particular input—“employment credits” or “investment credits”—can be used to favor one factor over another. Since the RST is assessed on the final sale, it is more immune to these manipulations.<sup>5</sup>

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3. For this reason, most economists recommend taxation on a broad base at a low rate to minimize distortions that inevitably arise when some goods or factor earnings are exempted and rates differ. The square rule is just a rule of thumb, since the level of distortion depends both on the tax rate and the degree of substitutability between products or inputs. For a complete treatment, see Jorgenson and Yun (2001).

4. However, some complex multirate VAT systems do assign lower rates to merit goods.

5. Of course, by selecting capital- or labor-intensive goods for a lower tax rate, politicians are able to affect the labor-capital balance using an RST.

In addition to concerns about economic differences between the RST and VAT as applied, the design debate largely revolves around political perceptions and potential administrative hazards. Our text addresses these in greater detail. To summarize:

- Consumers are more likely to perceive tax assessed at the register as a painful tax. Indeed, some critics label VAT a “hidden tax” because taxes and private costs are enveloped in the final price, unless the law requires sellers to print VAT charges on each sales receipt.
- RST critics note that the tax can easily be evaded by passing off sales to households as business-to-business sales. Because it is charged on each separate transaction, the RST also requires far more collection points than a subtraction-method VAT.
- In the United States, VAT critics associate it with a European-style welfare state. On the other hand, RST critics fear that a national-level RST will infringe on the traditional tax domain of US state and local governments.