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ABSTRACT

Ignoring tax avoidance possibilities, a value-added tax and a cash-flow income tax have identical behavioral and distributional consequences. Yet the available means of tax avoidance under each are very different. Under a VAT, avoidance occurs through cross-border shopping, whereas under an income tax it occurs through shifting taxable income abroad. Given avoidance, we show that a country would make use of both taxes in order to minimize the efficiency costs of avoidance activity, relying relatively more on that tax that is harder to avoid. We then make use of aggregate Danish tax and accounting data from 1992 to measure the amount of avoidance that occurred under the two taxes. While the estimates of avoidance activity are small, the figures imply that Denmark could reduce the real costs of avoidance activity by putting more weight on income rather than value-added taxes.

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Given the increasing economic interdependence among developed countries, tax competition between countries has become a growing concern. Multinationals can quickly shift substantial amounts of taxable income out of countries with high corporate tax rates into countries with low rates, while individuals can readily escape domestic taxation of their income from financial assets through shifting their savings abroad into countries providing them anonymity and low tax rates. Given these pressures from transfer pricing and capital flight, countries have the incentive to lower their income tax rates relative to those in competing countries so that taxable income is shifted into rather than out of their jurisdiction. The extra tax base they attract by lowering their tax bases, however, will in large part result from a relocation of activity, causing a drop in the tax base abroad and thereby generating a fiscal externality and inducing destructive tax competition among countries. The lower effective tax rate on foreign–source activity also creates costly distortions to the financial structure of firms and the portfolio choice of individuals. What options do countries face to lessen the efficiency costs generated by income taxes in an open economy?

In theory there certainly do exist tax systems that are free from these locational distortions and fiscal externalities. As noted for example by Razin and Sadka (1991a) or Mintz and Tulkens (forthcoming), if individuals are immobile[1] across countries then residence–based income taxes in a small open economy do not impose externalities on other countries that use the same type of tax, and the Nash equilibrium residence–based tax rates cannot be improved on through tax coordination. However, in practice, such pure residence–based taxes have not been feasible. The basic problem is the difficulty of monitoring earnings and expenditures of domestic residents that occur abroad. While a government has the power to collect information from domestic firms and domestic financial intermediaries in order to enforce taxes on the earnings and expenditures of domestic residents, it has no ability to collect comparable information from foreign sources. Even if a country by statute has a residence–based tax, foreign–source earnings and expenditures will frequently escape tax, resulting in a very different tax structure in practice.

Taxes on the return to capital income are particularly vulnerable to avoidance and evasion, given financial arbitrage, transfer pricing, and capital flight. Razin and Sadka (1991b), for example, forecast that these combined threats will lower effective capital income tax rates to zero in equilibrium. In fact, Gordon and Slemrod (1988) find that the U.S. loses tax revenue on net from its attempt to tax the return to capital.[2] But if capital income taxes both lose revenue and generate particularly large efficiency losses, then they have lost their role as an effective tax instrument. In this paper, we instead will focus on the possible tax treatment of income from labor in an open economy.

What if new real investment can be expensed and the returns to financial assets and liabilities are tax exempt, thereby eliminating any distortions to capital investments? These

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[1] When individuals are mobile, only benefit taxes are not vulnerable to tax competition, as argued by Buchanan and Goetz (1972). Otherwise, individual locational decisions impose first–order welfare effects on jurisdictions, generating fiscal externalities.

[2] Sorensen (1988) reports similar findings for Denmark. The loss of revenue results only in part from income shifting across borders — domestic portfolio arbitrage also generates substantial revenue losses, as high income investors borrow heavily from tax exempt entities to invest in lightly taxed assets, generating tax losses in the process.

changes by no means eliminate the problems generated by transfer pricing and a government's inability to monitor foreign–source earnings. Entrepreneurs, for example, can still avoid tax on their earnings from foreign subsidiaries, in which case they can make use of transfer pricing to avoid tax as well on domestic–source earnings.

Given the inability of governments to monitor foreign–source earnings, tax evasion is an inherent part of an income tax system in an open economy. The basic choice governments face in practice is between the use of income taxes and some other tax instruments. The specific alternative we examine is a destination–based value–added tax. Ignoring evasion a labor income tax has the same economic incidence and efficiency cost as a value–added tax, assuming appropriate transition rules.[3] Once evasion is taken into account, however, the incidence and efficiency consequences of the two taxes can be very different. A government's inability to monitor transfer pricing used by multinationals has no effect on the value–added tax base, for example, since the only price that matters for the value–added tax is the price paid by the final consumer. Similarly the inability to monitor foreign–source earnings is of no consequence for a VAT as long as the government can monitor consumption expenditures. Monitoring consumption expenditures, however, generates its own and very different enforcement problems. In particular, destination–based value–added taxes require rebates of taxes paid in the origin country and imposition of taxes in the destination country when any goods cross borders. Yet it is very difficult to detect all imports at the border — the EU has found doing so sufficiently costly that it has abandoned altogether the attempt to monitor cross–border shopping by individuals. Both income taxes and value–added taxes are therefore subject to evasion, but the level and nature of the evasion opportunities are very different in the two cases.

In section 2, we explore theoretically the optimal use of labor income vs. destination–based value–added taxes in order to minimize the overall excess burden of imposing a tax on labor income. Given that the sources of evasion are very different under labor vs. consumption taxes, we find that both should be used in practice — the less vulnerable one of these taxes is to evasion, the larger its tax rate should be relative to the other tax rate.[4]

The key issue then in the design of the overall tax system is the relative vulnerability of labor vs. consumption taxes to evasion. In section 3, we attempt to measure this empirically through a close examination of the reported income vs. value–added tax bases in Denmark in 1992. Based on the reported data, we construct the tax base for both a uniform–rate value–added tax and a labor income tax. If both are measured accurately, then reported

[3] Since the present value of lifetime labor earnings equals the present value of lifetime consumption expenditures, ignoring gifts and bequests, the two taxes differ only in the timing of payments. Note, however, that if a tax is first imposed in the middle of an individual's life, the equivalence breaks down (without appropriate transition rules) since the present value of consumption during the rest of the individual's life differs from the present value of remaining labor income by the amount of the individual's accumulated savings to date. To avoid complications from gifts and bequests, we will assume that neither tax system attempts to impose a separate layer of tax when funds are transferred between individuals.

[4] In a recent study examining the same question, Boadway, Marchand, and Pestieau (1994) assume in contrast that only income taxes are vulnerable to evasion. Offsetting this advantage to consumption taxes, they assume that only income taxes can have a nonproportional rate structure. In our model, in contrast, both taxes can be evaded but for simplicity both taxes are proportional.

labor income should equal reported expenditures plus net asset accumulation. To the degree to which the amount of evasion differs under the two taxes, however, the tax base that is more subject to evasion will be smaller than would be forecast using this aggregate budget constraint, given the observed value for the other tax base. The difference between the forecasted and the actual tax base equals the difference in the amounts of evasion under the two taxes. Since the Danish government has measured the evasion rate under the value–added tax directly, we then infer the absolute amount of evasion under each tax.

In particular, given the information the Danish government reported on consumption abroad by Danes, we estimate that 4 billion Danish kroner of value–added escaped taxation in 1992 because of cross–border shopping. Using this figure together with our results on relative evasion rates, we infer that 4.1 billion kroner of labor income were unreported for tax purposes. While both numbers are small (the total labor income tax base was 545.4 kroner), our theoretical results imply given these figures that less weight should be put on the value–added tax relative to current law in order to minimize the efficiency losses that arise due to evasion activity. Intuitively, evasion activity under the value–added tax appears to be particularly sensitive to tax rates since the observed evasion of the VAT results from the difference in value–added tax rates between Denmark and Germany rather than the overall level of the VAT rate. In future work, we hope to examine comparable data in other countries, to see to what degree these results vary internationally.

1. Implied efficiency costs from evasion and implications for tax design

In order to focus on the effects of evasion on the relative attractiveness of labor income vs. value–added taxes, we examine a setting in which the two taxes are otherwise equivalent. In particular, we assume that the two taxes are imposed throughout an individual's life, so ignore the transition issues emphasized by Auerbach and Kotlikoff (1983). In addition, we assume that both taxes are proportional and comprehensive, so ignore both differential value–added tax rates by commodity and any nonlinear rate structure under the income tax.[5] The key difference between the two tax bases that we focus on is the difference in their vulnerability to evasion. We use a very simple model to measure the efficiency losses from evasion. Assume that the utility of domestic residents depends on their consumption, C, labor supply, L, and the supply of government services, G, yielding utility of $U(C,L)+V(G)$.[6] By statute, assume that the value–added tax rate is τ while the labor income tax rate is t. The individuals' collective budget constraint is then $C(1+\tau)=L(1-t)$, ignoring evasion, where we have assumed that the wage rate equals one.[7] The government's budget constraint, ignoring evasion, would be $G=\tau C+tL$.

To account for tax evasion, assume that evasion of the value–added tax takes the form of cross–border shopping. By purchasing the fraction f_C of one's consumption abroad, tax

[5] See the end of this section for further discussion of this issue.

[6] The assumed separability in the utility function simplifies some of the steps below, but should have no fundamental effect on the results. Note that the model is atemporal — since neither tax distorts savings decisions, we omit savings decisions from the model.

[7] We do not include any initial assets in this budget constraint, to avoid the transition issues emphasized by Auerbach and Kotlikoff (1983).

payments fall by $f_C C(\tau - \tau_f)$, where τ_f is the value–added tax rate across the border. (By constraint, $f_C > 0$.) This cross–border shopping generates nontax costs of $N_C(f_C)C$, arising e.g. from extra travel expenses. When labor income taxes are evaded, we assume for simplicity that no offsetting tax liabilities are incurred abroad, e.g. income is shifted into a tax haven. Assume that evading the fraction f_L of labor income taxes generates nontax costs of $N_L(f_L)L$.[8] In addition, assume that each of these cost functions is quadratic, so that $N_C(f_C) = .5Cf_C^2/c$ and $N_L(f_L) = .5Lf_L^2/d$, where c and d are parameters measuring the ease of evasion. The extra expenses incurred in evading value–added taxes we presume take the form of transportation and other expenditures abroad, which would be taxable at rate τ_f, while the costs incurred from evading labor income taxes we presume simply result from a lower return to labor supplied abroad. As a result the budget constraint becomes:

$$C(1+\tau) - f_C C(\tau - \tau_f) + .5C(1+\tau_f)f_C^2/c = L(1-t)(1-f_L) + f_L L - .5Lf_L^2/d, \quad (1)$$

whereas the government's budget constraint becomes[9]

$$G = \tau C(1-f_C) + tL(1-f_L).$$

Under these assumptions, it immediately follows that the utility–maximizing levels of evasion for individuals are $f_L = dt$ and $f_C = \max(c'(\tau - \tau_f), 0)$, where $c' = c/(1+\tau_f)$. In addition, the individual chooses how much to work. The first–order condition for L equals

$$\frac{U_L}{U_C} = -\frac{1 - t(1 - .5dt)}{1 + \tau - .5c'(\tau - \tau_f)^2}. \quad (2)$$

In designing its tax policy, the government chooses the two tax rates in order to maximize individual utility, taking as given how individuals respond to these tax rates. At the optimal policies, any minor perturbations in tax rates must leave individual utility unaffected. In particular, consider the implications of a marginal increase in τ accompanied by a marginal decrease in t chosen to leave the right–hand side of equation (2) unaffected, so that

$$\partial t/\partial \tau = -\left(\frac{1 - t(1 - .5dt)}{1 + \tau - .5c'(\tau - \tau_f)^2}\right)\left(\frac{1 - c'(\tau - \tau_f)}{1 - dt}\right). \quad (3)$$

By design, this policy change will have no effect on individual labor supply decisions or on individual consumption levels, so will affect utility only through its implications for G. Maximizing G with respect to τ and allowing t to respond according to equation (3), we find after a bit of simplification that

$$c'\tau = \max\big(dt(1 + c'\tau_f), c'\tau_f\big). \quad (4)$$

[8] We assume here that these evasion costs consist of lost real resources rather than fines. When fines do exist, we redefine t and τ to represent all payments to the government, while f_C and f_L represent successful evasion.

[9] For simplicity, we ignore any tax revenue generated from cross–border activity undertaken by foreign residents. For an attempt to model explicitly the simultaneous choice of value–added taxes by two neighboring countries, see Kanbur–Keen (1993).

When, for example, income taxes become more costly to evade, d is smaller implying that t rises relative to τ. Similarly, when τ_f rises, τ also rises since evasion has become less of a threat. Note that if the VAT cannot be evaded then the optimal income tax rate is zero, while if evasion of the income tax is costly enough (i.e. $d < c'\tau_f/[t(1+c'\tau_f)]$) then the optimal VAT rate equals τ_f.[10]

If in the empirical work, we can estimate the fraction of each tax base that is lost due to evasion, then we can infer the values of c' and d knowing the statutory tax rates. This information, when combined with equation (4), in principle gives us information about the optimal tax structure. In particular, if the current tax rates are τ and t and the observed evasion rates are $\hat{f}_C$ and $\hat{f}_L$, then the optimal tax rates τ^* and t^* satisfy

$$\frac{\tau^*}{t^*} = \left(\frac{\hat{f}_L}{\hat{f}_C}\right)\left(\frac{\tau - \tau_f(1-\hat{f}_C)}{t}\right), \tag{5}$$

assuming $\tau^* > \tau_f$ — otherwise $\tau^* = \tau_f$ and t is set to achieve the desired revenue.

This derivation makes a number of simplifying assumptions which deserve mention. For one, the functional form used to describe the nontax costs of evasion imposes a tight link between the total amount of evasion, which we hope to measure, and the marginal change in this amount as tax rates increase, which is what matters in the optimal tax rate calculation. A general functional form for N_C and N_L would lead to a more complicated link between observed amounts of evasion and optimal tax rates and a more complex optimal tax formula. More limited generalizations are possible, however. For example, unreported consumer expenditures abroad consist in part of cross–border shopping, which is motivated primarily by tax differences, and in part of tourist expenditures which are likely to be much less responsive to tax differences. Below we report data on both cross–border shopping and tourist expenditures. For purposes of discussion in this paper, we will assume that the fraction of pretax consumption expenditures allocated to foreign tourism is entirely unaffected by τ, while the amount of cross–border shopping is proportional to the value–added tax savings.[11] It is easy to show that this modification to our assumptions has no effect on optimal tax policies — optimal policies still satisfy equation (4).

In addition, the above model ignores the underground economy, where the use of cash transactions facilitates the evasion of both income and value–added taxes.[12] Since the incentives for underground activity depend on the total tax burden and not the relative use of income vs. value–added taxes, the presence of underground activity does not affect the optimal relative use of the two taxes. A formal demonstration is in the Appendix.

The above model also ignores a variety of other complications that may make one tax or the other more attractive. For example, both taxes allow for redistribution based on

[10] This latter results would change if we took account of tax evasion by foreign residents, as in Kanbur–Keen (1993).

[11] In particular, if tourist expenditures abroad equal αC for some exogenous value α, then value–added tax payments would now equal $\tau(1-\alpha)C(1-f_C)$, while the costs of tax evasion would be measured by $.5(1-\alpha)Cf_C^2/c'$.

[12] To avoid detection, these activities would normally not file for a rebate of value–added taxes paid on any inputs they purchase. As a result, this evasion reduces each tax base by the same amount.

aggregate income or expenditures, but only the consumption tax allows for redistribution as well based on the relative amounts that individuals consume of different goods. While Sandmo (1974) demonstrated conditions under which this variation in tax rates by good would not be desired, these conditions may or may not hold.[13]

In contrast, a labor income tax can much more easily accommodate a progressive rate structure. However, this progressivity need not be affected by a shift towards more use of value–added taxes. For example, McLure (1991) proposes a modified value–added tax in which wage and salary payments are deductible from the VAT base but in which each individual's wage and salary income is then taxed separately using a progressive rate structure with a maximum rate equal to the VAT rate.[14] This approach to adding progressivity to a destination–based VAT is equivalent to supplementing a proportional VAT with a wage subsidy with declining subsidy rates as an individual's income rises.[15]

Changes in tax rates over time in response to changes in the desired level of government expenditures introduces very different types of intertemporal distortions in the two cases. Changing labor tax rates distort the relative wage rates at different dates and so the timing of work effort, whereas changing consumption tax rates distort the desired timing of consumer purchases and therefore of desired savings.

If the entry of new firms generates positive externalities by providing information to others about the potential viability of new products, new forms of organization, or even just new locations, then a labor tax can be used to help correct this externality. For example, new owners may face a reduced effective tax rate because they can easily convert their labor income into capital gains through leaving profits within the firm and later selling their ownership rights in the firm, generating capital gains rather than ordinary income. Such subsidies to new firms are not so easily arranged under a consumption tax.[16]

One further factor is the desired tax treatment of nonresidents. If a country is small relative to world markets so that it is a price taker in the relevant market, then it is easy to show that the optimal tax rate on activity by foreign residents is zero. When the country is not a price taker, however, e.g. it has unique tourist attractions, then it does have an incentive to set tax policy to take advantage of this market power. The extent of market power can easily differ with respect to consumer markets and labor markets.

For these reasons and others, any conclusions about the nature of optimal tax policy

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[13] Being able to vary the consumption tax rate by good also provides an indirect means of introducing tariffs, particularly if production taxes can be introduced that vary by good, as noted for example by Gordon and Levinsohn (1990). Use of a labor tax, in contrast, provides a means of precommitting not to make use of indirect tariffs.

[14] Given the specific design of this proposal, however, existing GATT rules would likely prevent border corrections when goods are exported and imported, so the proposal does not include such corrections. If GATT rules allowed it, however, border corrections could easily be appended to the proposal by allowing a deduction at the top rate when goods are exported and imposing a tax at the top rate when goods are imported.

[15] For example, a nonlinear income tax function $T(L)$ can replaced by $T(L) - L\Delta t$ when a "proportional" labor income tax is reduced in favor of more use of a value–added tax.

[16] Differential tax rates across forms of compensation under a labor tax may not be the most closely targeted form of corrective subsidy either, but its role as a corrective subsidy is a common rationale for these tax distortions at least in U.S. political discussions.

must be subject to qualifications. But evidence on the relative vulnerability of consumption vs. income taxes to evasion remains a major consideration in the relative attractiveness of the two taxes.

2. Evidence on the extent of evasion of VAT vs. labor income taxes

Conceptual Approach

To judge the optimal use of value–added taxes vs. labor income taxes, we need to measure the vulnerability of each tax to evasion. The nature of the evasion opportunities under a value–added tax are very different from those under an income tax. Individuals can avoid domestic value–added taxes by buying goods abroad and bringing them back into the country, whereas such cross–border shopping has no effect on their income tax liabilities. They can avoid domestic income taxes by opening up foreign subsidiaries and shifting accounting profits abroad, but value–added taxes would still be owed when the resulting earnings are consumed.

To measure the relative amounts of evasion under the two taxes, we will make use of the aggregate cash–flow constraint for the country, linking current earnings, current expenditures, and the current accumulation of assets. If we had accurate accounting data, then the accounting earnings would just equal the value forecast based on the accounting expenditures and asset accumulation. Using tax data, however, the figures for both earnings and expenditures will be understated due to evasion. If evasion of the income tax is relatively larger, then the observed earnings reported for tax purposes will be smaller than the value forecast based on observed expenditures reported for tax purposes and accounting information on asset accumulation. This difference then gives us a measure of the *relative* amounts of evasion under the two tax bases. We will implement this approach using detailed tax and accounting data for Denmark for the calendar year 1992.

In addition, we have estimates from a Danish research institute on the extent of evasion under the existing value–added tax due to cross–border shopping, based on monitoring they have done at the border. We then combine the government's estimate of the amount of evasion under the value–added tax with our estimate of the relative amounts of evasion under the two taxes to infer the absolute amount of evasion under the income tax.

To facilitate this estimation of the relative amounts of evasion under the two tax bases, we define the income tax base and the value–added tax base to minimize the differences between the two other than differences in timing of payments and in evasion rates. To begin with, we compare a value–added tax not with the current income tax but with a proportional cash–flow tax on business earnings from real assets along with a personal tax at the same rate on labor income.[17]

Such a cash–flow tax does not distort investment decisions, and ignoring evasion and transition issues should have the same incidence as a comprehensive value–added tax. The current value–added tax in Denmark, in contrast, exempts or imposes a zero rate on expenditures in a number of sectors. In many cases, this more favorable tax treatment

[17] Our procedure for modifying the existing income tax data to estimate the tax base for this cash–flow tax follows closely the procedure described in Gordon–Slemrod (1988).

seems to be justified by distributional considerations.[18] While distributional considerations are normally pursued in different ways under a VAT vs. a labor income tax, in order to minimize the differences between the two tax bases we standardize for distributional characteristics by examining a uniform-rate value-added tax. We estimated the value added that would be reported under such a uniform VAT by adding to the observed tax base an accounting measure of the value-added in each of the exempt sectors and consumption in each of the zero-rated sectors. In so doing, we ignore any potential evasion in these sectors.[19] We decided to make one exception, however, for the financial services sector. The exemption here we viewed to exist not because of any distributional considerations but because of administrative difficulties in enforcing a value-added tax on this sector. Individuals can easily make use of banks and insurance companies in foreign countries, even foreign branches of domestic firms, when prices are cheaper abroad, so the amount of cross-border shopping should be particularly sensitive to the tax treatment of this sector. As a result, we decided to operate under the assumption that no value-added taxes on this sector are feasible. To maintain consistency with this assumption, we also eliminated any cash-flow income or wage payments from the financial services sector in our measure of labor income.

Given these definitions of the alternative tax bases, we need to make careful use of the country's aggregate cash-flow constraint to forecast how the two should compare if they were reported accurately. Given the special treatment of the financial sector in our analysis, we keep explicit track of this sector in the following derivation. We start with the cash-flow constraint of the household sector, where

$$(W + W_e + W_f) + S_h + rA_h + r_d D_h + (\pi + \pi_e) = (C + C_f + H) + F_h + T_h + \dot{A}_h + \dot{E}. \quad (6)$$

Here, W, W_e, and W_f equal wage income from the taxed sector, from the tax-exempt (financial) sector, and from abroad, respectively. S_h equals government subsidies to households, while T_h equals all personal income tax and value-added tax payments by the household sector. The terms C, C_f, and H consist of nondurable consumption expenditures in Denmark, nondurable expenditures abroad, and durable (primarily housing) expenditures; F_h represents consumption expenditures in the exempt financial sector. $(\pi + \pi_e)$ equals the residual cash-flow of both the taxed and the tax-exempt sectors — by convention, all earnings net of real investment expenditures are paid out to households. D_h equals the household sector's deposits in the financial sector, earning a monetary rate of return of r_d plus perhaps various noncash service benefits. A_h in contrast represents holdings of domestic government bonds, B_h^d, and foreign financial securities, B_h^f, net of loans from the financial sector, L_h: $A_h = B_h^d + B_h^f - L_h$ — these holdings earn an average pre-tax rate of

[18] The specific exempt sectors at issue are education, medical care, personal transportation, social services (e.g. nursing homes), rental housing, and financial services, while the zero-rated sectors are sales of ships, airplanes, and newspapers.

[19] Of these exempt or zero-rated sectors, other than financial services, the only one where cross-border shopping seemed plausible was sales of ships and airplanes. However, given the conspicuous nature of ships and airplanes, enforcing domestic taxes at import of these goods should be straight-forward, so we proceeded under the assumption that the amount of evasion would not change if these sectors were not exempt or zero-rated.

return of r. Finally, $\dot{E}$ represents net purchases from foreigners of corporate equity issued by domestic firms.[20]

The cash–flow of the taxable domestic business sector can be represented by:

$$Q + r_d D + S = (W + W_d) + F + rL + I + T + (\pi + \pi_d + p_d - \pi_f). \tag{7}$$

Here, Q represents cash sales, S measures government subsidies to firms, while $r_d D$ equals earnings on bank deposits. The payroll, $W + W_d$, consists of wage and royalty payments, W, to domestic residents and payments W_d to foreign residents. As before, F represents expenditures on financial services, L equals loans from the financial sector, and T equals cash–flow and other business tax payments. I represents all real investments made that period. The residual profits, $\pi + \pi_d + p_d - \pi_f$, consists of the profits accruing to the domestic household sector, π, the profits going to foreign owners due to their direct investment, π_d, payments to foreigners on their portfolio investment in domestic firms, p_d, minus the profits received by domestic firms on their subsidiaries abroad, π_f.

The cash–flow of the financial sector equals:[21]

$$r(B_e^d + B_e^f + L + L_h) + (F + F_h) = r_d(D + D_h) + W_e + R_e + T_e + I_e + (\pi_e + \pi_{de} - \pi_{fe}). \tag{8}$$

Here, R_e and I_e equal nondurable and durable purchases of real inputs from the taxable sector, while T_e refers to unrebated value–added taxes paid on these purchases. The definitions of the other variables correspond to those above, with the subscript e referring to the exempt sector.

Finally, the cash–flow constraint of the government equals:

$$T_h + T + T_e + T_d - T_f + \dot{B} = (S + S_h) + r(B_h^d + B_e^d + B_d) + G + I_g. \tag{9}$$

As defined above, $T_h + T + T_e$ equals all tax payments by domestic households and firms. But some of these tax payments, T_f go to foreign governments, while some foreign firms and individuals make tax payments, T_d, to the domestic government. Similarly, B_d represents foreign holdings of domestic government bonds. Finally $G + I_g$ equals current government expenditures on nondurables and investment goods.

Combining all of these cash–flow constraints, we find that

$$(Q - I + \pi_f + \pi_{fe} + W_f) - (\pi_d + \pi_{de} + W_d) = (C + C_f + H + R_e + I_e + G + I_g) \tag{10}$$

$$-[r(B_h^f + B_e^f - B_d) - p_d] + (T_f - T_d) + (\dot{B}_h^f + \dot{E} - \dot{B}_d).$$

The first term in parentheses on the left–hand side of equation (10) in theory equals the tax base under a cash–flow income tax on firms combined with a personal tax on payments deductible under the cash–flow tax (e.g. wage and royalty payments). Note that

[20] Corporate bonds are virtually unknown in Denmark.

[21] For notational simplicity, new purchases/sales of financial assets are all listed in the household sector, and foreign portfolio investment in the domestic financial sector is ignored.

foreign–source as well as domestic–source earnings accruing to domestic residents should in principle be included in this tax base.

The second term on the left–hand side is a correction term for reported taxable earnings going to foreigners due to their direct investment in the domestic economy — these funds are not available to finance domestic consumption. There is some question, though, ›w to interpret the observed cash flow of the domestic subsidiaries of foreign multinationals. This cash flow can in principle include not only the earnings of foreign owners but also the nonwage compensation of domestic employees that is retained within the firm and paid out later in deferred compensation or stock options. Only the former component is unavailable to finance domestic consumption. In most of our calculations, we will assume that the observed cash–flow of domestic subsidiaries of foreign firms results entirely from the nonwage compensation of domestic employees, in which case any earnings of foreign residents has been paid out in a deductible form, e.g. through royalty payments or through transfer pricing.[22]

The first term on the right–hand side of equation (10) should approximate the tax base under a destination–based value–added tax.[23] Some purchases of domestic consumer goods will be done by nonresidents, however, and are not financed by the income flows included in this equation. We will subtract off estimates of the size of these purchases by nonresidents, in order to focus on the activity of domestic residents. In theory, the observed value–added tax base should include purchases abroad by domestic residents, C_f. Since the financial sector is assumed to be exempt, inputs it purchases from other sectors ($R_e + I_e$) remain subject to tax. Government expenditures, $G + I_g$, in Denmark are sometimes subject to VAT and sometimes not. Where such expenditures are not included in the observed tax base, they will be added in separately.

Ignoring evasion, the tax base for an income tax and a destination–based VAT differ because of the three residual terms. First, consumption expenditures can be financed in part from the return to financial assets owned abroad by domestic residents, whereas part of the return taxable under an income tax is income accruing to foreign portfolio investors in domestic business and government financial assets so is not available to finance domestic consumption. Second, earnings of domestic individuals can be used in part to finance increased ownership of foreign assets or the purchase of domestic assets currently owned by foreigners, rather than for current consumption. Finally, some domestic earnings are lost through tax payments to foreign governments so are no longer available to finance domestic consumption, while some government revenue arises from domestic taxes paid by foreign residents.

Evasion activity will imply, however, that equation (10) will not be satisfied in the data. To begin with, the observed cash–flow tax base will likely be smaller than the theoretically

[22] To the extent that the reported cash–flow of foreign subsidiaries does include income accruing to foreign residents, we overestimate the reported amount of labor income and so underestimate the relative amount of evasion under the income tax.

[23] Note that housing and consumer durables can be treated in either of two ways under such a tax. Either consumption services arising from use of these goods can be taxed period by period or else expenditures on the purchase of these goods can be taxed at the purchase date. In present value, the two methods are equivalent. Denmark uses the latter method.

correct measure due to avoidance of taxes particularly on foreign–source income. Similarly, the observed tax base for the destination–based VAT will be smaller than the theoretically correct measure due primarily to cross–border shopping. While the cross–border shopping between Denmark and Germany likely arises in large part because of tax considerations, and would be responsive to relative tax rates, the shopping abroad by Danish tourists would not be affected to the same extent by relative tax rates. As noted above, we assume that tourist expenditures are unresponsive to relative tax rates. The Danish Institute for Border Region Research has estimated the amount of revenue lost from cross–border shopping by imposing spot checks at the border.

Note that activity in the underground economy reduces both tax bases equally, so will not be detectable given our figures. As shown in the Appendix, information about the size of the underground economy is not needed to calculate the optimal relative tax rates on income vs. value–added, though it is certainly needed to judge the efficiency costs of expanding the size of the public sector.

Measurement of the income tax base

The tax base described above for the income tax consists of taxable wage and salary income from all but the financial sector plus a measure of the cash–flow of Danish nonfinancial firms (measured net of wage and salary payments). Consider first the problem of measuring wage and salary income. The Ministry of Taxation reports the following figures for personal incomes for 1992:[24]

Net wages, transfers, and pension benefits	579.5
Other labor income	10.0
Minus employee pension contributions	-14.1
Wages plus transfers and net pension receipts	575.4

The intended measure of wage income includes as wage income the same figure reported by firms that year as a wage deduction. As a result, the deferral of reported personal income that occurs through pension plans needs to be undone. We therefore add to the above figure the total pension contributions (by employers as well as by employees), compiled from various financial institutions:

Employee and employer pension contributions	29.7
and subtract	
Total pension benefits	14.8
to give	
Wages plus transfers	590.3

To measure wage income alone, we exclude taxable government transfers. The resulting correction is

[24] All figures represent billions of 1992 Danish kroner.

Minus transfers	-137.7

In order to impose the same tax treatment of the financial sector under both the income tax and the value–added tax, we also need to subtract off the wage income from the financial sector:

Minus wages in the financial sector	-24.7

to yield a measure of total taxable wage income.

Taxable wages	427.9

We next measured the real cash–flow of Danish firms. In principle, we start with the reported taxable profits of firms, and first eliminate all deductions/income from financial assets.[25] Next, we replace depreciation deductions and deductions for the cost of goods taken out of inventory with a deduction for new purchases of investment goods and goods added to inventories.

Given the available Danish data, however, this process turned out to be somewhat complicated. The central source of data comes from the "company form" which is issued by the Department of Taxation, Central Customs, and Tax Administration, and is filled out by about 78,000 Danish firms. These forms are not filed by firms traded on the Danish stock exchange,[26] by firms with low enough revenue, or by firms in several selected industries.[27] Within each of seventy different sectors among the covered industries, we used data on the ratio of aggregate accounting depreciation in that sector to accounting depreciation among the 78,000 firms within that sector to forecast the cash–flow figures for the covered industries as a whole. The first column reports the resulting figures for corporations and partnerships, whereas the last column reports equivalent figures for personally owned firms:

	Corp+Part	Other
Taxable income	30.2	34.0
Plus net financial expenditures	16.5	15.3
Plus depreciation deductions	26.2	12.7
Plus inventory depreciation	2.8	0.6
Cash flow +I (covered)	75.8	62.3

These figures measure the cash–flow only from the industries covered by the "company form." For the remaining industries, we used accounting data to measure accounting surplus (or gross operating surplus) before depreciation deductions, yielding an estimate for the cash–flow of these uncovered industries of:[28]

[25] As a result, though, we do eliminate the return to some forms of labor income, e.g. sales of ideas to foreigners, that show up in the data as capital gains on financial assets.

[26] Only 240 firms had shares traded on the Danish stock exchange and the vast majority of these firms were small or medium–sized.

[27] The main uncovered sectors are agriculture, nursery gardens, fur farming, agricultural services, forestry, fishing, fish farming, lignite/oil/natural gas production, electric and gas supply, district heating, water supply, mail services, and telecommunications.

[28] This figure includes a correction for value–added taxes paid on purchases of intermediate inputs, amounting to 2.3 billion kroner.

Cash flow +I (uncovered)	52.2

A correction is needed for services purchased from the financial sector. While observed cash flow will be net of expenditures on financial services, the tax base appearing in equation (10) does not include a deduction for F. Undoing this deduction adds 7.0 to taxable cash–flow.

One complication is that these reported cash–flow figures are net of production taxes of 12.6, labor market contributions of 1.9, and include production subsidies of 23.7. Yet as seen in equation (10) the desired measure of labor income is before any taxes and subsidies. We therefore include the following correction:

Minus net government subsidies	-9.2

Finally, we need to subtract off new investment expenditures in the nonfinancial business sector. According to the National Accounts, fixed gross investment in the private nonfinancial sector equals 71.6, while inventory net investment equals -1.0:

Minus new investment	-70.6

Combining the above figures we find that aggregate business cash flow equals

Cash flow	117.5

while aggregate taxable labor income equals

Taxable labor income	545.4

This measure should in principle include the cash–flow of foreign subsidiaries of domestic firms. However, Denmark by law generally exempts this foreign–source income. While in theory the law could instead attempt to include foreign–source earnings in the tax base, we know from evidence in Hines and Hubbard (1990) that the U.S. collects little if any tax revenue from foreign–source earnings in spite of careful statutory attempts to include foreign–source income in the tax base. We therefore assume that the current Danish law realistically approximates best feasible practice for foreign–source income.

Measurement of the value–added tax base

To measure the potential tax base under a comprehensive value–added tax, we started with the information that revenue from the existing value–added tax in Denmark in 1992 amounted to 81.1 billion Danish kroner. Given the 25% VAT rate prevailing in that year, this implies a value–added tax base under existing law of 324.4. However, under current Danish law this figure is measured gross of excise taxes (amounting to 32.6 billion Danish kroner), yet the desired figure would be before any taxes. Our initial estimate of the VAT base is therefore

Current VAT base	291.8

This figure omits, however, the value–added in the sectors that are currently tax exempt and omits consumption expenditures in sectors that are currently zero–rated. Based on

Ministry of Taxation data, we estimate that including all of these sectors other than the financial sector in the tax base would result in an increase in the base of

Value–added in exempt + output in zero-rated sectors	21.3

The initial figure for the value–added tax base includes 57.1 billion kroner of expenditures on goods and services by the government, but only a few selected units of the government are subject to value–added tax under current law. In order to include appropriately all government expenditures on goods and services, we measured total government expenditures on goods and services and then added to the value–added tax base the difference between this figure and 57.1. Available data report the following figures for government expenditures:

Wages	158.0
Purchases of intermediate goods	67.3
Gross investment	13.8
Transfers abroad (net of subsidies from the EU)	9.9
Minus included government expenditures	-57.1
Correction for exempt government expenditures	191.9

The initial value–added figure also includes some expenditures by foreigners in Denmark. According to the Central Bureau of Statistics, foreigners spent 22.9 billion kroner on goods and services in Denmark, expenditures that include value–added and excise tax payments. Given an average effective VAT and excise tax rate of 51%, foreign consumption expenditures net of tax payments equaled 15.1 billion kroner. Since our desired measure would include only expenditures by domestic residents, we need the following correction:

Minus consumer purchases by foreigners	-15.1

Collecting terms, we find that the base for a comprehensive value–added tax would equal:

Value–Added	489.9

Measurement of the three correction terms

According to equation (10), labor income will differ from value–added because of three separate correction terms. To begin with, individuals can finance consumption not only from their current labor income and cash–flow from domestic firms, but also from the income from their holdings of assets abroad, net of the financial payments they need to make to foreigners on their holdings of domestic assets. According to the current account statistics provided by the Danish Central Bank, net interest and dividends receipts in Denmark in 1992 equaled -34.2 billion kroner.

In addition, current income can be spent not only on current consumption and investment in productive assets but also on the acquisition of financial assets abroad, while consumption can be financed in part by the sale of financial assets to foreigners. This leads to the second correction term in equation (10). According to data from the Danish Central Bank, in 1992 there was a net capital outflow (ignoring net foreign direct investment, which is included in other terms in equation (10)) of 10.2 billion kroner.

Finally, we need to measure the tax payments made by foreigners to the domestic government minus the taxes paid abroad by domestic residents. We calculated above that foreign consumers paid about 7.8 billion kroner in VAT and excise taxes in Denmark. In 1992 Danish consumption expenditures (gross of VAT) abroad equaled 23.0 billion kroner. Taking a weighted average of the VAT and excise tax rates in those countries that are destinations for Danish tourists and cross–border shoppers, we estimate that they faced an average VAT rate of 29%, implying tax payments abroad equivalent to 5.2 billion kroner. On net, therefore, Danes receive an extra 2.6 billion kroner due to cross–border tax payments.

Danish subsidiaries abroad and foreign subsidiaries in Denmark will also be paying some taxes. As noted earlier, however, their reported taxable income could include income accruing but not yet paid out to domestic employees as well as income accruing to foreign residents. We have presumed that the bulk of the income accruing to foreign residents has been paid out in a tax–deductible form, e.g. through transfer pricing, so make no further correction for taxes paid by these firms.[29]

Taken together, the three correction terms imply that the accounting figure for labor income should exceed that for value–added by 41.8 billion kroner.

Implications for evasion of income vs. value–added taxes

What then have we learned about the relative amounts of evasion under the Danish income vs. value–added taxes? As shown above, the value–added that would be reported for tax purposes under a comprehensive value–added tax, net of sales to foreigners, would have equaled 489.9 billion kroner in 1992. Given this figure and given the data on the three correction terms in equation (10), ignoring evasion the reported labor income should have equaled $489.9 + 41.8 = 531.7$ billion kroner. In contrast, the actual figure for labor income that we calculate would have been reported for tax purposes under a cash–flow tax equaled 545.4 billion kroner. The difference between these two figures is 13.7 billion kroner, so evasion under the income tax is estimated to be 13.7 billion kroner less than evasion under the value–added tax.

In addition, from figures presented above we observe that Danes spent 17.8 billion kroner abroad on consumer goods in 1992 (net of value–added taxes), expenditures that were unreported for purposes of domestic value–added taxes. Given this figure, we then conclude that reported labor income was reduced by 4.1 billion kroner due to tax evasion.[30] Of the 17.8 billion kroner spent abroad by Danes in 1992 on consumer goods and services, however, only about 4.0 billion kroner was estimated to have been spent (net of value–added taxes) as a result of cross–border shopping at the German/Danish border, while the

[29] We did attempt to calculate the difference in the size of the corporate and withholding tax payments by foreign subs in Denmark relative to those paid by Danish subs abroad, to see how important this assumption was. The difference in the two figures was essentially zero, eliminating any ambiguity from this source.

[30] Recall that this figure does not include evasion in the underground economy. Since the underground economy evades both income and value–added taxes, its size does not affect the desired relative use of income vs. value–added taxes.

remaining 13.8 billion kroner consisted of other (primarily tourist) consumer expenditures abroad.

As a result, the amount of evasion that has occurred in response to current tax rates was almost identical (4.1 vs. 4.0 billion kroner) under the two taxes. However, the observed evasion of the income tax was the response to a tax savings of t per kroner unreported for tax purposes whereas the tax savings from not reporting a kroner of consumer expenditures was only $\tau - \tau_f$. Since there is less gain from evading the VAT, yet the same amount of evasion occurs as under the income tax, we infer that the costs of evading the VAT must be much lower. As a result, we inevitably will conclude that raising extra revenue at the margin through the value–added tax resulting in more additional evasion than raising revenue through the income tax, implying too much reliance on the value–added tax in Denmark.

To see this formally, we need to estimate f_C and f_L from the available data. One complication that must be faced in doing so is how to interpret the evasion costs $N_C(f_C)$ and $N_L(f_L)$. We presume that the extra costs incurred to evade domestic value–added taxes largely take the form of transportation expenditures abroad. Using the notation from equation (1), expenditures abroad net of foreign value–added taxes therefore equal $f_C C + .5Cf_C^2/c = 4.0$, while reported domestic expenditures equal $(1 - f_C)C = 489.9$. Given the forecast from the theory that $f_C = c'(\tau - \tau_f)$, and given the observation that the value–added tax rates in 1992 equaled 25% and 14% in Denmark and Germany, respectively, we conclude after a bit of calculation that $\hat{f}_C = .0077$, implying that .77% of domestic consumption evaded domestic value–added taxes.

Similarly, we presume that the 4.1 billion kroner in labor income that evaded tax is largely foreign–source income, which according to the theory in section (1) equals $f_L L - .5Lf_L^2/d$, while the reported labor income of 545.4 equals $L(1 - f_L)$. Given the forecast that $f_L = dt$ and setting $t = .7$ under the assumption that evasion is largely driven by the maximum prevailing tax rate under the income tax in Denmark that year, we conclude after a bit of algebra that $\hat{f}_L = .0114$, implying that 1.14% of potential labor income was shifted abroad to evade tax.

Given these estimates for $\hat{f}_C$ and $\hat{f}_L$ and the observation that $\tau_f = .14$, we then conclude from equation (5) that

$$\frac{\tau^*}{t^*} = .66\left(\frac{\tau}{t}\right),$$

suggesting that less weight should be put on the value–added tax relative to the income tax given the existing evasion opportunities in Denmark. Since Denmark currently has one of the highest value–added tax rates in the E.U., perhaps this is not surprising. This result is driven solely by the implications of the tax structure for evasion, and does not take into account many other considerations affecting the choice of income vs. value–added taxes.

3. Conclusions

In recent years, there has been substantial concern about increasing income tax evasion as economies become more open, due in particular to the greater ease of capital flight and transfer pricing. Similarly, use of the value–added tax has been limited by fears that domestic consumers will evade the tax by shopping abroad. The main objective

of this paper has been to measure the amounts of evasion that occur under each tax using detailed data from Denmark for 1992. The analysis is based on comparing the observed income tax base with the figure that would be forecast based on the economy's aggregate cash–flow constraint given observed consumption expenditures under the VAT and observed accounting figures for asset accumulation. While true accounting data on income and consumption would satisfy this accounting identity precisely, the figures on income and consumption reported for tax purposes will each be too small due to evasion. This procedure allows us to measure the difference in the amounts of evasion under the two taxes. The Danish government has measured the amount of evasion of the value–added tax directly, allowing us to combine their figure with our estimate to infer the amount of evasion under the income tax.

The data suggest that evasion rates under each tax have been surprisingly small — only .77% of potential VAT revenue appears to have been lost due to cross–border shopping, while only 1.14% of potential income tax revenue is unreported.[31]

In the paper, we develop a theoretical model to examine the choice of income vs. value–added tax rates that would minimize the excess burden resulting from evasion activities. Based on this theory, we forecast that evasion costs could be reduced by lowering the VAT rate relative to the income tax rate, at least given the situation prevailing in 1992 in Denmark. Denmark certainly had one of the highest VAT rates in the world at that date, so this result is perhaps not surprising. In future work we hope to examine the same question in other countries, to see how general this result is.

[31] Neither figure includes evasion in the underground economy, however.

APPENDIX

Optimal Taxes in the Presence of Underground Activity

In the underground economy, the use of cash transactions facilitates the evasion of both income and value–added taxes. Without such evasion, as seen in equation (2) a dollar of pretax labor income enables individuals to purchase only $[1-t(1-.5dt)]/[1+\tau-.5c'(\tau-\tau_f)^2]$ dollars of consumption goods. Denote this ratio by A. Because of underground activity, however, assume that both labor and value–added taxes are evaded on the fraction f of all pretax labor income. This evasion imposes real costs on evaders, however, of $.5Lf^2/e$. As a result, the individuals' budget constraint now equals

$$C = AL(1-f) + fL - .5f^2L/e. \tag{1a}$$

The individuals' optimal value of f equals $(1-A)e$, while the optimal values of f_C and f_L remain the same as before.

As seen from collecting the tax payments in equation (1a), the government's budget constraint now equals

$$G = \tau(1-f_C)C + t(1-f_L)L(1-f) - \tau(1-f_C)(f-.5f^2/e)L.$$

The term $\tau f(1-f_C)L$ measures the evasion due to underground activity of the value–added taxes that would otherwise have been paid — the tax base ignoring evasion is L rather than C since the underground economy cannot receive a rebate for any value–added taxes paid on inputs that it purchases and still evade detection. The additional term $\tau(.5f^2/e)L$ measures the value–added taxes paid on the real expenditures needed to successfully evade detection of underground activity.

As before, consider the effects of an increase in τ and a decrease in t chosen so as to leave the individuals' tradeoff between C and L unchanged. Substituting the optimal value of f into equation (1a), we see that the individuals' tradeoff depends solely on A. The combined tax change is therefore designed to leave A unchanged on net, so the drop in t needed to offset a rise in τ continues to satisfy equation (3). At the optimal tax rates, this combined change in tax rates should leave government revenue unchanged. Differentiating revenue with respect to τ, and allowing t to adjust appropriately, we find that

$$(1-2c'\tau+c'\tau_f)[C-L(f-.5f^2/e)] + (1-2dt)L(1-f)\frac{\partial t}{\partial \tau} = 0.$$

Substituting for C from equation (1a), for $\partial t/\partial\tau$ from equation (3), using the equilibrium condition that $f=(1-A)e$, and simplifying we find that the optimal tax rates continue to satisfy equation (4).

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