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Domestic Taxes and International Trade: Some Evidence

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Abstract

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The effects on trade performance of corporate taxes and the value-added tax (VAT) continue to excite controversy but have received little empirical attention. This paper uses panel data for OECD countries from 1967 to 2003 to examine the effects of these taxes on export performance, paying particular attention to the potentially complex dynamic effects to which theory points. It finds that increased reliance on VAT revenue tends to be associated with a sharp reduction in net exports, which quickly fades. This may reflect unrelated movements in consumption, and our preferred specifications point to no trade effects of the VAT in either the short or the long run. Our results also point, however, to powerful and complex effects from the corporate tax, the pattern of which is as theory would predict from a source-based tax of this kind. Increases in corporate taxation—whether measured by revenues or the statutory rate—are associated with sharp short-run increases in net exports (consistent with induced capital flows abroad); these are then subsequently and quickly reversed (consistent with increased income from investments abroad), leaving an increase in net exports that converges to zero.

JEL Classification Numbers: H2, F1

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I. INTRODUCTION

As explicit taxes on international trade have diminished, so the potential effects of domestic taxes on international trade have become more apparent and controversial. In the early days of the European Union, for example, the elimination of internal customs barriers led to sharp disagreements, especially between France and Germany, as to the trade impact of the differing forms and levels of, and balance between, direct and indirect taxes in the various member states (Sinn, 1990). That same debate has rumbled on for many years in the United States, where it is quite commonly argued that the remission of VAT on exports places foreign countries at an unfair competitive advantage in world markets relative to those (notably, of course, the United States) more reliant on the corporate income tax. This view underlay the long-running dispute at the World Trade Organization (WTO) over the Foreign Sales Corporation (and predecessor DISC and successor EITI) legislation of the United States. Although (perhaps because) this scheme and its successors have now been removed, the same concern continues to be expressed, and indeed has left its mark on the current tax reform debate. A recent example is the argument of Hartman (2004) that the United States suffers strongly from the lack of border tax adjustment to the corporate tax, relative to firms located in countries heavily reliant on the border-adjusted VAT.

These arguments are commonly treated with some contempt by theorists, who point to the trade-neutrality of a destination-based VAT levied at a uniform rate and downplay the potential impact of reliance on origin-based taxes by invoking equivalence results between source and origin-based taxes: see for example the response to Hartman by Viard (2004). But (as indeed Viard stresses, and will be seen below), the scope of these results is limited, so that at a theoretical level the issue remains unresolved. Perhaps even more fundamentally, it seems clear, after fifty years or so of this debate, that many (perhaps mainly non-economists) simply find these arguments of principle unpersuasive, and continue to believe that the structure of the domestic tax system, particularly in relation to corporate taxes and the VAT, affects export performance.

Against this background of strongly held views and some theoretical ambiguity, this paper seeks to establish some stylized empirical facts. Using panel data for 27 OECD member countries over the period 1967–2003 (somewhat less, for some regressions, given data limitations), we ask: do countries that rely more on value added taxes, and/or less on corporate taxation, tend to have higher (or lower) net exports? The focus here is on net exports, it should be noted, rather than on export or trade intensity (meaning exports or the sum of exports and imports relative to GDP)—which have been the focus of the few previous studies in this area—because one key route by which the corporate tax may affect trade is through the capital account. This then requires an inherently dynamic analysis, because of the intertemporal budget constraints linking net exports over time.²

² Having said this, we should note too that we obtain broadly similar results using instead export intensity as the dependent variable, as reported in the Appendix.

Surprisingly, given the heat of the debate, these questions have received almost no empirical attention. The impact of the VAT on export and trade intensity has recently been considered by Desai and Hines (2005), who find, for high-income countries, somewhat mixed results: in the presence of fixed effects, a simple dummy representing the presence or absence of a VAT has no effect on either export or trade intensity; the share of VAT in total tax revenue in 2000,³ however, is significantly and negatively related to both.⁴ On the trade impact of the corporate tax, closest to the concerns here is a recent result of Slemrod (2004). Investigating (for about 100 countries at different income levels, observed in four years) not the impact but the determinants of the corporate tax, he finds a significant positive association between corporate tax revenues relative to GDP and trade intensity. This paper takes a different tack from these in focusing on net exports and on the potential dynamics of tax effects, in using a full panel of data for VAT revenues and rates, and in addressing the tax mix argument directly by including both corporate tax and the VAT.

The plan of the paper is as follows. Section II provides a simple framework that brings out some key theoretical considerations and guides the empirics. A preliminary investigation of the properties of our sample is presented in Section III. Section IV then describes our empirical strategy and reports results. Section V concludes. An appendix describes the dataset and variables used in the estimation, and presents some robustness results.

II. TAX STRUCTURE AND NET EXPORTS: ANALYTICS

This section considers the ways in which tax structure might affect exports, using as framework for this a simple model that will also guide the empirical analysis below.

A. Simple Model

The analysis focuses on a small, open, two-period economy. This “home” country is inhabited by a representative consumer with preferences $U(C_1, C_2)$ defined over consumption in the two periods. There is a single produced good, which can be used either for consumption or investment; all nominal prices, including the exchange rate in both periods, are normalized at unity.⁵ In the first period, there is an endowment Y —which can be thought of as the sum of current production and accumulated assets, both fixed by past decisions—

³ With revenue data available to them only for a single year, note that this is a country-specific constant throughout the post-VAT introduction period of the panel. Observations in which no VAT is present, so that VAT revenue is necessarily zero, are also included in these regressions.

⁴ For the full set of countries in their sample, in contrast, both the VAT dummy and reliance on VAT revenue are significantly and negatively associated with trade intensity as well as with export share.

⁵ Thus any movements in the general price level or exchange rate are effectively absorbed into the interest rate, and the interest arbitrage condition below implicitly encompasses an exchange parity condition.

that can be supplemented by borrowing an amount b from the rest of the world, with these resources then either consumed, invested in amount K in domestic production, or lent abroad in amount B . Thus, in the absence of tax, $C_1 = Y + b - B$. In period 2 the investment yields output $F(K)$, with F assumed strictly concave, and interest is paid at the gross rate R on amounts invested at home and received at the rate r (gross of home country taxes) on loans to the rest of the world. Capital does not depreciate, so that, still in the absence of tax, $C_2 = K + F(K) - (1 + R)b + (1 + r)B$. There is assumed to be no cross-ownership of domestic fixed factors, so that all rents accrue to the home country (the implications of relaxing this are, however, discussed informally below).

To capture the issues raised in the introduction, allowance is made for four types of tax.⁶ The home country taxes consumption on a destination-basis (that is, irrespective of whether domestically-produced or imported) at the (tax-exclusive) ad valorem rate T_v —this corresponds to a single-rate broad-based VAT—and on an origin basis (on all consumed commodities, whether the consumption is at home or abroad) at the (tax-inclusive) ad valorem rate T_o . Both of these taxes are assumed to be levied at the same rate in each period (with the implications of time-varying rates also being discussed informally later). There is also a source-based tax on the return $(1 - T_o)F(K)$ to home investment at the rate of T_s , and a residence-based tax on all the home resident's savings, whether left at home or put abroad, at the rate T_r (both rates tax-inclusive, and any production tax paid assumed to be deductible). There is no explicit taxation of rents to the domestic fixed factor, a point to which we return later. All tax revenue in period i is returned to the consumer as a lump sum amount \bar{T}_i which they take as given in their own decision-making.

The budget constraint in period 1 is thus

$$(1 + T_v)C_1 = (1 - T_o)(Y - K) + b - B + \bar{T}_1, \quad (1)$$

where $\bar{T}_1 = T_v C_1 + T_o(Y - K)$, while in period 2 it is

$$(1 + T_v)C_2 = (1 - T_o)(K + (1 - T_s)(1 - T_r)F(K)) - (1 + R)b + (1 + r(1 - T_r))B + \bar{T}_2, \quad (2)$$

where $\bar{T}_2 = T_v C_2 + T_o K + [1 - (1 - T_s)(1 - T_r)(1 - T_o)]F(K) + T_s Rb + T_r rB$. Since the home investor can either invest at home for a net return of $R(1 - T_s)(1 - T_r)$ or abroad for a net

⁶ Allowing for all four to be levied simultaneously is a matter of brevity rather than realism. While the model implies, for example, that capital may be subject to both source and residence-based taxes, this is to capture conveniently situations in which only one or the other is levied.

return of $r(1 - T_r)$ (and similarly the foreign investor can take either r or $R(1 - T_s)$, before paying foreign taxes), arbitrage ensures that in equilibrium:

$$R(1 - T_s) = r. \quad (3)$$

Combining (1)-(3) and using the definition of \bar{T}_i , gives:

$$C_1 + \frac{C_2}{1+r} = Y + \frac{F(K) - RK}{1+r} \equiv Y^*, \quad (4)$$

which equates the present value of consumption to that of the endowment and rents (the latter denoted by Y^*). This, it should be stressed, is the intertemporal budget constraint of the overall economy, not that perceived by the representative citizen (which will reflect the various taxes and transfers in operation, though these wash out in aggregate).

As a final preliminary, note that net exports, on which interest here focuses, are

$$E_1 \equiv Y - C_1 = B - b \quad (5)$$

in period 1 (the equality coming from (1) and the definition of \bar{T}_1), while in period 2 they are (from (2) and the definition of \bar{T}_2)

$$E_2 \equiv K + F(K) - C_2 = (1+r)b - (1+R(1-T_s))B. \quad (6)$$

In present value, combining (5) and (6) and using (3) gives

$$E_1 + \frac{E_2}{1+r} = 0, \quad (7)$$

so that the present value of net exports is zero.

Substituting from (1) and (2) for consumption in each period, the problem solved by the consumer is to choose K and B to maximize

$$U \left(\frac{(1-T_o)(Y-K)+b-B+\bar{T}_1}{1+T_v}, \frac{(1-T_o)(K+(1-T_s)(1-T_r)F(K))-(1+R)b+(1+(1-T_r)r)B+\bar{T}_2}{1+T_v} \right) \quad (8)$$

with r being taken as given (the small country assumption) and borrowing from abroad b correspondingly determined as a residual, given the infinitely elastic supply of funds from the rest of the world, and with the \bar{T}_i also taken as parametric. The necessary conditions for this are:

$$B: \quad -U_1(C_1, C_2) + U_2(C_1, C_2)(1 + (1 - T_R)r) = 0 \quad (9)$$

$$K: \quad -U_1(C_1, C_1) + U_2(C_1, C_2)(1 + (1 - T_S)(1 - T_R)F'(K)) = 0 \quad (10)$$

where derivatives are indicated by primes, except that U_i denotes $\partial U / \partial C_i$.

B. Trade and Indirect Taxation

Consider first the impact of the commodity taxes, T_v and T_o . This is simple: each cancels out of the necessary conditions and so neither has any effect on the real equilibrium, an irrelevance result related to but distinct from the equivalence results on which much has been written.⁷ In particular, neither commodity tax has any effect on the level of exports in any period. The reason for this irrelevance is straightforward. Neither tax affects production decisions, since both bear only on items of final consumption. Thus the present value of lifetime consumption, being equal to the present value of lifetime income, is also unaffected; and thus each tax is effectively lump sum, being levied on the consumption side in the case of the destination-based tax and the income side in the case of the origin-based tax.

This irrelevance of both destination- and origin-based consumption taxes to export behavior rests on a number of assumptions. The first, evident from the analysis above, is that the rates at which they are applied do not change over time. A fully anticipated increase in the rate of VAT, for example, has effects akin to those of an increase in the rate of residence-based taxation (discussed below), since it lowers the real return to saving. Consumers would be expected to bring consumption forward to avoid the higher tax in the second period, so that net exports decrease in the first period and increase in the second. Second, with only one consumption good in each period, the model above cannot capture the important feature of reality that effective rates of taxation commonly vary quite widely across commodities. In terms of the destination-based VAT commonly deployed, in particular, nontradables are often subject to a relatively low tax rate—nontraded foodstuffs, in particular, are often exempted on equity grounds, and the coverage of services is commonly incomplete. In this case the VAT will tend to decrease the size of the tradable sector and hence export intensity, with production and consumption shifting to nontradables (Feldstein and Krugman, 1990). Quite how this effect would manifest itself in the pattern of net exports over time, however, is not clear. Third, another important feature of VAT reality is imperfect refunding of VAT paid on inputs used by exporters: controlling such refunds is a major administrative challenge in many countries, especially in the developing world but also in the OECD countries

⁷ The equivalence result in the present context is the observation that if $T_o = T_v / (1 + T_v)$ then the two taxes raise the same present value of tax revenue; so long as the government is freely able to borrow or lend, they thus lead to the same real allocation even if revenue is not returned to the consumer as a lump sum. For a general statement of equivalence results, see de Meza, Lockwood and Myles (1994) and, in an explicitly intertemporal context similar to that here, Genser, Haufler, and Sørensen (1995).

examined in the empirical analysis below. If such refunds are not properly paid, the VAT acts in part as an export tax. As is noted by Desai and Hines (2005), this too would be expected to reduce the size of the tradables sector and to reduce export intensity. One other point should be noted. This is that the effects of the origin-based tax are quite different from those of the source-based corporate tax, T_s . Thus, one cannot argue for irrelevance of the corporate tax by asserting that it is analogous to an origin tax and then invoking irrelevance or equivalence results on the latter. The key point here is that the origin tax to which these results apply is a tax only on final consumption goods, whereas a source-based tax applies to all output. The latter thus has distorting effects on production more akin to those of a production tax levied on all stages of production—and for which, given the distortion of production choices, the irrelevance and equivalence results do not apply.

C. Trade and Corporate Taxation

Turning to the impact of corporate taxes, note first that (9) and (10) together imply that

$$F'(K) = \frac{r}{1-T_s} \quad (11)$$

For simplicity, we now also suppose $U(C_1, C_2) = u(C_1) + \beta u(C_2)$, with $u(C)$ strictly concave,⁸ so that (9) becomes:

$$\frac{u'(C_1)}{u'(C_2)} = \beta(1 + (1-T_R)r). \quad (12)$$

Consider first the effects of the source-based tax, T_s (with the residence-based tax T_R set to zero). Using (3), the right of (4) can be written as:

$$Y^*(T_s) \equiv Y + \frac{F[K(T_s)] - \left(\frac{r}{1-T_s}\right)K(T_s)}{1+r} \quad (13)$$

which, using (11), is readily shown to be decreasing in T_s . Thus the present value of consumption falls. To derive the impact on net exports, note that since in this case the right of (12) is simply $\beta(1+r)$, and so remains unchanged, maintaining the equality on the left requires that C_1 and C_2 both fall. This fall in C_1 in turn means, from (5), that first period net exports rise; and since the present value of net exports is zero, this in turn means that net exports in the second period must fall.

⁸ This is stronger than is needed for the results below.

The intuition is straightforward. A source-based tax on corporate income reduces investment at home, meaning greater capital exports (or less capital imports) in the first period, which is financed by running a greater trade surplus (or smaller deficit);⁹ one can think of the increased capital exports leading to an exchange rate depreciation. In the second period, net income from abroad is higher as a consequence of the increased capital exports in the first, enabling a smaller trade surplus.

For the residence-based tax, note first from (11) that domestic investment is unchanged and hence so too, using also (3) in (4) (with T_s set to zero), is the present value of lifetime consumption Y^* . But then from (12) it is readily verified that C_1 increases.¹⁰ Hence net exports fall in the first period and rise in the second—the opposite pattern to that of an increase in the source tax. The reason is again straightforward. A residence-based tax has no effect on the level of investment at home, since it does not affect the return required by non-resident investors. It does, however, lower the net return on savings faced by the home consumer, which—given our assumption on preferences—leads to lower savings. This means less investment abroad in period 1, which implies a lower trade surplus. This again reverses itself in period 2, when the reduction in income from abroad implies a higher trade surplus.

Source- and residence-based corporate taxes thus have very different effects on the pattern of net exports. There is some reason to suppose, however, that—point for point—the former are likely to be stronger in practice. This is because the impact of source-based taxation arises from the tax-sensitivity of the location of real investment, which is now thought to be quite marked,¹¹ while that of residence-based taxation arises from the interest-sensitivity of aggregate savings, the significance of which remains less clear.

Several issues arise in extracting empirical guidance from these results. A first—given that it leads to quite different conclusions—is whether corporate taxation is best seen as source- or residence-based. In practice, corporate tax systems often have a significant element of source taxation. This may be explicit, with outright exemption of corporations' earnings from

⁹ Sinn (1985) argues that an effect of this kind explains the high level of capital imports into the US following a cut in effective marginal corporate tax rates in 1981.

¹⁰ Using (4) in (12) defines $C_1(T_R)$ implicitly by

$$\frac{u'[C_1(T_R)]}{u'[(1+r)(Y^* - C_1(T_R))]} = \beta(1 + (1 - T_R)r)$$

where, by the argument in the text, Y^* is independent of T_R . Differentiating with respect to T_R , the result follows from concavity of $u(C)$.

¹¹ See for example the surveys in Hines (1999) and de Mooij and Ederveen (2003).

abroad: this is the case, for example, in the Netherlands. Or it may be implicit. For while many countries—including the United States and United Kingdom—in principle apply the residence principle (allowing a nonrefundable credit against their own taxes for those paid abroad), their taxes typically only apply when a multinational's subsidiary abroad pays dividends to the parent, so that those taxes can be deferred (and, hence, reduced in present value) by delaying that repatriation. While most OECD countries now have controlled foreign corporation rules, under which profits of subsidiaries earned abroad—typically in low-tax jurisdictions—may be brought into tax even if not repatriated to the parent, the scope of their application remains limited. All this brings many countries' corporate tax systems close to ones of *de facto* source taxation.

Second, the corporate taxes in the model above bear only on the marginal return to investment and savings, leaving the return to the fixed factor untaxed. The closest empirical analogue to T_s , for example, is the marginal effective tax rate, not the statutory or any measure of the average effective rate. In practice, however, corporate taxes are likely to bear also on intra-marginal returns, and so the question arises as to how the taxation of rents would affect the analysis above. So long as the fixed factors themselves are internationally immobile—so that the rents are location-specific—such taxation will have no effect on the level of real investment, so that the impact can only be in the form of income effects operating through the raising of tax revenue itself. And to the extent that the home country levies tax on rents that would otherwise accrue to its own residents, there will be no effect at all in the model above, given the assumption that revenue is returned to the consumer as a lump sum.

Thus, it is only to the extent that the fixed factor is owned by nonresidents that even income effects will arise. A home country tax on rents accruing to foreigners, for example, allows an increase in the present value of lifetime consumption. Given the assumption on preferences above, this will be taken entirely as an increase in C_1 ; with production unchanged, period 1 exports will thus fall, with a reduced trade surplus reflecting increased borrowing from abroad in anticipation of the greater receipts in period 2. This effect will be weakened under alternative assumptions on preferences, but will not be reversed so long as any of the anticipated increase in revenue is reflected in present consumption.

Further effects will arise if the fixed factor is internationally mobile, as in the recent literature on the concept and impact of average effective tax rates (as in Devereux and Griffith (2003), for example). In this respect, an increase in the corporate tax will tend to drive real investment abroad, so that the effects will be closely akin to those of the source-based tax analyzed above.

A third set of issues relates to the limits and interpretation of the model itself. In an overlapping generations or Blanchard-Yaari framework, for example, the condition that the present value of net exports be zero—of which heavy use was made above—does not apply. The essence of the intertemporal optimization would remain the same, however, so that the effects shown above are again likely to leave their mark. The question also arises as to how

to interpret, for practical purposes, the two periods into which the model divides the future. To the extent that reaction to tax changes may take the form of stock adjustment, the first period is naturally thought of as corresponding to fairly brief, short-run effects. Sluggish adjustment of real investment, on the other hand, is likely to slow the response to changes in source taxes. The natural empirical course, pursued below, is to recognize the potential complexity of dynamic effects and leave the rest to the data.

One last limitation—which applies also to the analysis of indirect taxation above—deserves emphasis. This is the assumption that all tax revenue is returned to the consumer as a lump sum. In the more plausible case in which it is not, the path of public expenditure may be affected by either a change in the present value of tax receipts or, if the government is constrained in its ability to borrow, by a change in their time path. And changes in public expenditure may themselves affect export performance. If government expenditure is concentrated on non-tradables, for example, a tax change that enables an increase in government expenditure may also lead to reduced exports by this route.

III. THE DATA: A FIRST LOOK

The sample—summary statistics for which are provided in the appendix—is an unbalanced panel of 27 OECD countries, covering the period after VAT introduction in each country. The estimation period is from 1967 to 2003, and the total number of observations is 573.

Figures 1 and 2 present scatter plots depicting the relationship between the trade balance (net exports relative to GDP) and reliance on VAT and corporate taxes, respectively. The correlation coefficient between the trade balance and VAT reliance is positive but only marginally significant at 0.07. That between trade balance and corporate tax reliance is also positive, but in this case it is highly significant, at 0.35. These simple plots thus suggest that net exports are positively associated with both VAT reliance and corporate tax reliance, albeit only weakly so in the case of the former.

Figures 3 and 4 depict the time series behavior of these variables by plotting the unweighted annual averages of the trade balance and the degree of revenue reliance on VAT and corporate taxes in our sample. There is again a suggestion of a positive association between net exports and both VAT and corporate tax reliance in our sample, though the correlations are not significant.

Little can be safely concluded from these simple correlations, however, since they abstract from the impact on net exports of other factors, may be contaminated by various biases, and do not address the dynamics of interest here. These considerations call for a closer econometric analysis, to which we now turn.

Figure 1. Trade Balance Against VAT/GDP

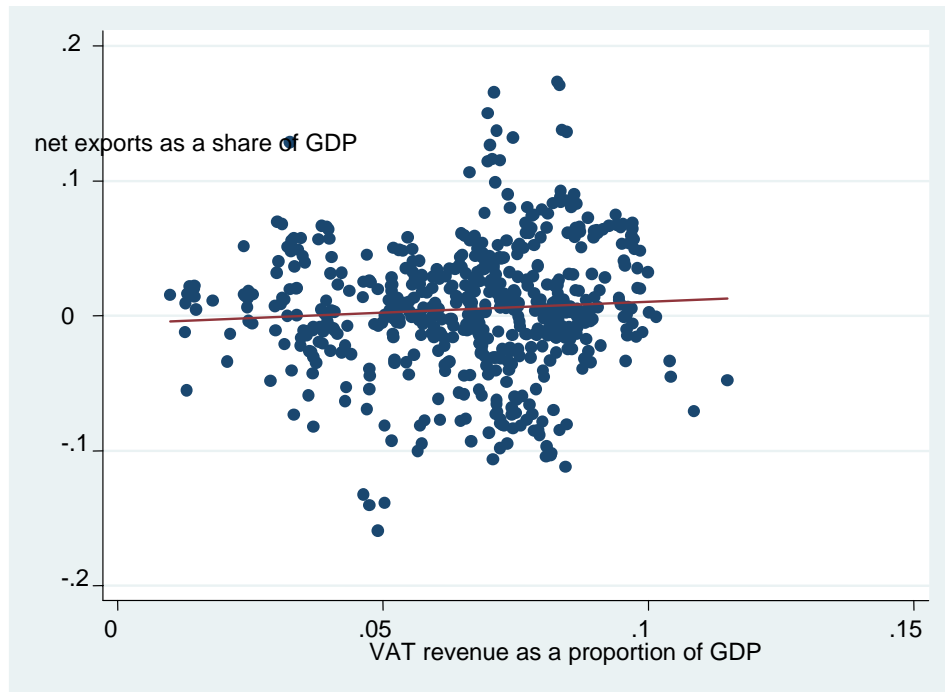


Figure 2. Trade Balance Against CIT/GDP

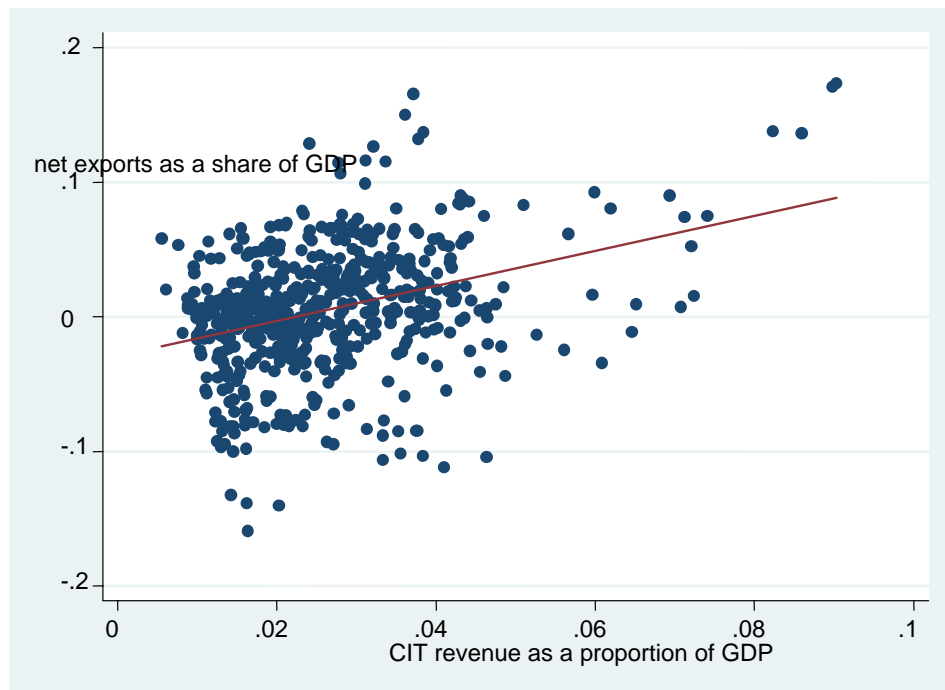


Figure 3. Trade Balance and VAT Reliance, Unweighted Yearly Average

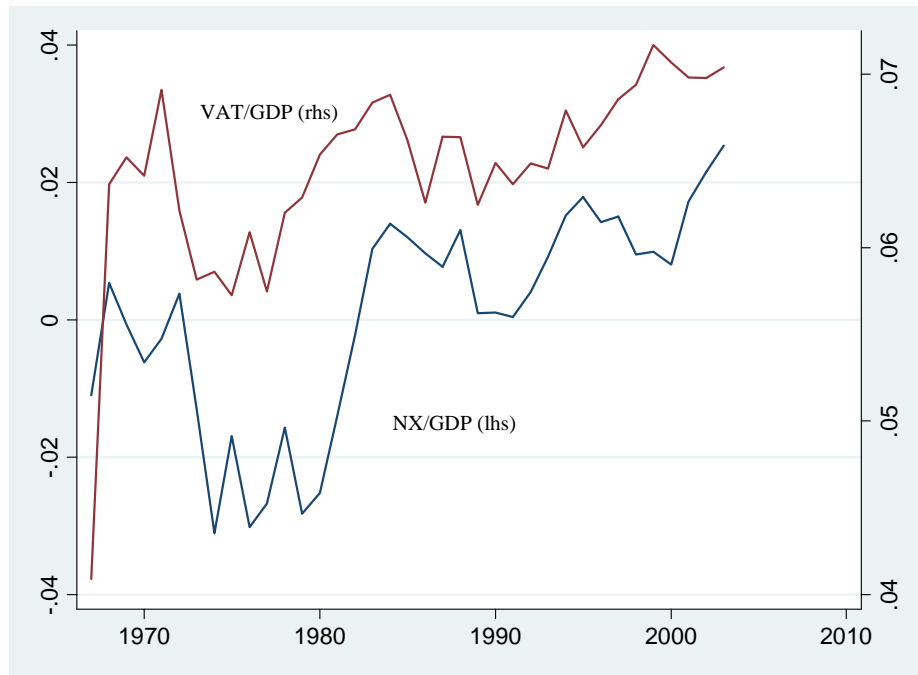
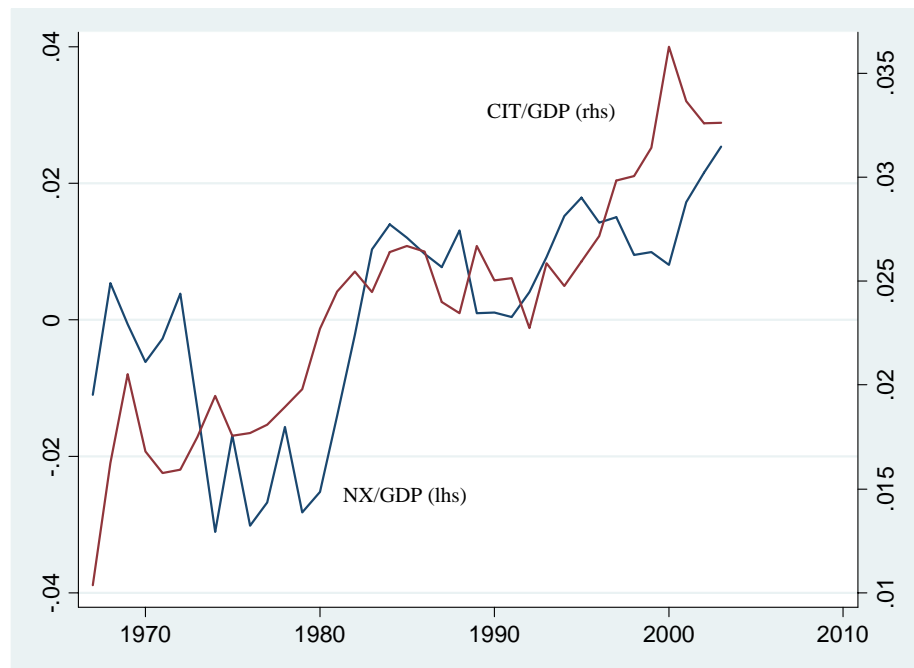


Figure 4. Trade Balance and Corporate Tax Reliance, Unweighted Yearly Average



IV. EMPIRICAL ANALYSIS

After outlining the empirical strategy, this section reports results for both static and, our main focus, dynamic specifications.

A. Econometric Specification and Issues

The basic form of the equation that we estimate is, for country i at time t :

$$NX_{it} = \alpha_i + \mu_t + \phi NX_{i,t-1} + \sum_{k=0}^2 \beta_k (VAT_{i,t-k}) + \sum_{k=0}^2 \gamma_k (CIT_{i,t-k}) + \sum_{k=0}^2 \delta_k (TAX_{i,t-k}) + \theta'X_{it} + \varepsilon_{it} \quad (14)$$

where NX denotes net exports of goods and services (relative to GDP), CIT and VAT are variables relating to the corporate tax and VAT respectively—we use several variants— TAX denotes the sum of all tax revenues (relative to GDP), the vector X denotes other conditioning variables (including GDP per capita and various geographic controls, described in the Appendix), α_i and μ_t are country- and time-specific effects respectively, and ε_{it} is an idiosyncratic error term. We allow for up to two lags in the variables of interest: at least one lag is required in order to pick up the potential sign reversals of the impact of corporate tax changes suggested by the theory above. The inclusion of the overall tax ratio TAX/GDP , allows for the possibility that net exports are affected by taxes in general rather than by the VAT and corporate tax in particular.

The coefficients on the current values of the corporate tax and VAT reliance variables (γ_0 and β_0 , respectively) capture their short-run impacts on the trade balance, while the long-run effects are given by:¹²

$$\Delta_{CIT} = \frac{\gamma_0 + \gamma_1 + \gamma_2}{1 - \phi}, \quad \Delta_{VAT} = \frac{\beta_0 + \beta_1 + \beta_2}{1 - \phi}. \quad (15)$$

The theory predicts that, insofar as the corporate tax approximates to a source-based tax, its short-run impact should be an increase in net exports, $\gamma_0 > 0$, with a subsequent reduction and consequent sign reversal of the effect, picked up in γ_1 and/or γ_2 (if it occurs within two years), and, ultimately, a permanent reduction in net exports. To the extent that these changes sum in present value to zero, one might expect the long run effect to be small: this leads one to focus on the hypothesis of no long run effect: $\Delta_{CIT} = 0$. Insofar as the corporate tax approximates a residence-based tax, the expectation is of the opposite sign pattern of effects: a short run reduction in net exports followed by an increase. For an idealized single rate VAT, the theory predicts no effect in either short or long runs ($\beta_k = \Delta_{VAT} = 0, \forall k$), at least if

¹² Note that when TAX/GDP is included in these regressions, these coefficients are to be interpreted as relating to changes in VAT or CIT whose revenue impact is offset by changes in other tax instruments.

changes in the tax rate are unanticipated. But VATs are rarely so perfect, and changes are sometimes preannounced, so the expected pattern of effects is less clear.

The corporate tax and VAT variables are likely to be endogenous, not least since they share a common denominator with the dependent variable. For this reason, we also report results using the basic rates of the two taxes, though these are conceptually imperfect and reduce the sample size. In addition, we need to control for biases arising from the presence of the lagged dependent variable. Hence, our preferred empirical strategy is to rely on instrumental variables (IV) or generalized method of moments (GMM) procedures that control for biases due to unobserved country-specific effects and lagged endogenous variables.¹³ For this we use as instruments suitably lagged values of the regressors. In the absence of higher order-serial correlation in the residuals, and provided the instruments are correlated with the endogenous variables but not with the error term, the GMM estimator consistently estimates the parameters of our model. This is so even when we include the lagged dependent variable and other endogenous variables as regressors in our model.

B. Results

This section reports a range of empirical equations estimated along the lines described above. Though not reported, all specifications include year dummies to control for any unobserved common time-specific effects. All standard errors are heteroskedasticity-robust.

Static results

To fix ideas, and relate our results to those in the previous contributions noted in the introduction, we begin by presenting results using a static specification, constraining the coefficients on all the lagged variables in (14) to be zero and so relating the trade balance to only the current values of the corporate tax and VAT reliance variables.

Table 1 investigates the effect of the VAT. Column 1 is a very simple specification, including only VAT reliance (that is, VAT revenue relative to GDP). Column 2 adds the log of GDP per capita, to control for income differences, and geographic controls (area of the country and dummies for landlocked and island economies). In both cases, the coefficient on VAT reliance is insignificant. In column 3, however—with country-specific fixed effects added, capturing the effect on exports of time-invariant country-specific features—the coefficient on VAT reliance becomes significantly negative. This suggests that the previous results may have been biased by correlations between omitted country-specific variables and

¹³ See Arellano and Bond (1991) for the form of this one-step GMM estimator, which exploits overidentifying restrictions.

Table 1. The VAT and Net Exports

	1	2	3	4
(VAT/GDP) _t	0.070 (0.078)	0.106 (0.092)	-0.575** (0.245)	-0.544** (0.245)
(TAX/GDP) _t				-0.194*** (0.067)
Constant	0.001 (0.013)	-0.005 (0.017)		
Observations	573	573	573	573
R-squared	0.09	0.11	0.62	0.63
F-statistic	1.48	1.67	12.67	12.88

Notes:

1/ Robust standard errors in parentheses.

2/ * means significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

3/ Col 1: Year effects only; Col 2: Year effects, GDP controls and geographic controls;

Cols 3 and 4: Year effects, country effects, GDP controls and geographic controls.

the VAT variable. Column 4 adds as an additional regressor the overall tax revenue as a share of GDP. This enters with a significantly negative coefficient, while that on the VAT variable remains significantly negative and of similar magnitude to that in column 3. These results are reminiscent of those of Desai and Hines (2005), though they focus on gross rather than net exports; and indeed we found a similar pattern of effects for the former.

Table 2 turns to the impact of the corporate tax. Columns 1 to 4 use the same specifications as in Table 1,¹⁴ but replace the VAT variable with corporate tax reliance (corporate tax revenue as a proportion of GDP). In all cases, there is a significant, robust, large, and *positive* association between corporate taxes and export performance. Broadly speaking, a one percentage point increase in corporate tax revenue relative to GDP, compensated by increases in other taxes, increases net exports by rather more than one percentage point. Adding basic controls thus confirms the loose visual impression from Figure 2: contrary to what appears to be a widespread view, increased reliance on corporate tax revenues tends to be associated with a *stronger* net export position.

¹⁴ The sample comprises only observations for which a VAT is in place (so as to clearly identify the effects of moving to consider the two jointly); broadly similar results are obtained using all observations for which the corporate tax variable is available.

The final column of Table 2 investigates the combined effects of both the corporate tax and the VAT. VAT reliance emerges in column 5 as insignificant in the presence of corporate tax reliance, suggesting that in Table 1 the VAT variable may have been proxying for the omitted corporate tax variable. Finally, column 6 of Table 2 controls for the endogeneity of our tax variables by instrumenting their current values with their first lags. This does not change the conclusion from column 5: export performance is unrelated to reliance on VAT, but positively related to reliance on corporate taxes.

Table 2. Corporate Taxes and Net Exports

	1	2	3	4	5	6
$(CIT/GDP)_t$	1.182*** (0.183)	1.219*** (0.180)	1.291*** (0.167)	1.479*** (0.169)	1.441*** (0.172)	1.270*** (0.244)
$(TAX/GDP)_t$				-0.317*** (0.064)	-0.309*** (0.064)	-0.233*** (0.077)
$(VAT/GDP)_t$					-0.300 (0.215)	-0.182 (0.327)
Constant	-0.014 (0.009)	-0.021 (0.012)				-0.072*** (0.020)
Observations	573	573	573	573	573	546
R-squared	0.17	0.20	0.66	0.68	0.68	0.68
F-statistic	3.05	3.17	15.00	16.15	16.01	14.67

Notes:

1/ Robust standard errors in parentheses.

2/ * means significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

3/ Column 1: Year effects only; Col 2: Year effects, GDP controls and geographic controls; Cols 3 to 6: Year effects, country effects, GDP controls and geographic controls; Col 6 uses first lags of VAT, corporate tax and total tax variables to instrument their current values.

Dynamic results

Our main interest, however, is in the dynamic specification (14), since it is this that allows for the more complex effects, especially in relation to the corporate tax, that are suggested by the theory. Estimation is by GMM, as discussed above, using as instruments lagged values of net exports and the regressors. For this, we proceed, as is standard, by first-differencing (14)

to eliminate the country-specific fixed effects and capture the time-specific fixed components by including time dummies. Thus the model actually estimated relates the first-differenced trade balance in period t to its own lag, the first-differenced measures of VAT_t and CIT_t in periods t , $(t-1)$ and $(t-2)$, and differences in controls. Though not shown, all specifications include time dummies and log GDP per capita to control for income differences; time invariant characteristics (such as the geographic controls) drop out in the differencing. Instrument validity is evaluated reporting the p-value of the Sargan Statistic (Hansen's J statistic), which is a test of overidentifying restrictions under the joint null that the model is correctly specified and the instruments are valid. The properties of the residuals are described by the p-values of the m1 test to detect first-order serial correlation (which we expect to find if the presumed specification is correct) and of the m2 test proposed by Arellano and Bond (1991) to detect second-order serial correlation in the first-differenced residuals (which we wish to reject). Results are reported in Table 3.

Column 1 reports the basic specification given in (14), using VAT and corporate tax reliance as the tax variables of interest. The coefficient on the lagged dependent variable is significantly positive, as one would expect, and all the diagnostics are satisfactory—the same is true of all reported results, and so this is not commented on further. Our main interest attaches, of course, to the tax variables. And here the results are both striking and in some respects surprising.

Beginning with the corporate tax, the coefficient on the current value of reliance is significantly positive, while those on the first lag and second lags are negative (albeit individually insignificant in the latter case). This pattern of sign reversal is exactly as the theory above predicts for a source-based corporate tax. The point estimates imply that a one point increase in reliance on the corporate tax is associated with an increase in net exports of 0.83 percent of GDP in the first year, reflecting—in terms of the theory above—the movement of capital away from the reduced net returns at home. In the following year, net exports decline by 0.84 percent of GDP, leaving them¹⁵ 0.23 points lower than prior to the tax change. The overall impact on net exports remains negative thereafter—consistent with increased income from abroad as a consequence of the initial reallocation of capital abroad—and converges to zero. After 10 years, net exports are a little under 0.02 percentage points lower than prior to the tax increase.¹⁶ In the long run, the effect converges to zero: formally, the null that $\Delta_{CIT} = 0$ cannot be rejected.¹⁷

¹⁵ Taking account of the effect through the lagged dependent variable.

¹⁶ This calculation ignores the insignificant coefficient on the second lag of the corporate tax variable.

¹⁷ The p-value on this hypothesis test is 0.91.

Table 3. Dynamic Specifications

	1	2	3	4	5	6
NX_{t-1}	0.732*** (0.090)	0.404*** (0.066)	0.715*** (0.077)	0.661*** (0.103)	0.781*** (0.045)	0.772*** (0.047)
(CIT variable) _t	0.831** (0.397)	1.307** (0.526)	1.000** (0.507)	1.006* (0.538)	0.057** (0.029)	0.059** (0.029)
(CIT variable) _{t-1}	-0.838** (0.410)	-0.757* (0.457)	-0.935* (0.489)	-0.955** (0.453)	-0.066** (0.032)	-0.061* (0.033)
(CIT variable) _{t-2}	-0.013 (0.168)	-0.230 (0.202)	-0.122 (0.210)	-0.170 (0.189)		
(VAT variable) _t	-1.371*** (0.521)	0.001 (0.001)	0.008 (0.335)		-0.049 (0.325)	
(VAT variable) _{t-1}	0.974** (0.427)	-0.003** (0.001)	0.105 (0.290)		0.029 (0.254)	
(VAT variable) _{t-2}	0.273 (0.308)	0.000 (0.002)	0.162 (0.234)			
(TAX/GDP) _t	-0.197** (0.100)	-0.499*** (0.188)	-0.335*** (0.147)	-0.376** (0.163)	-0.261*** (0.086)	-0.282*** (0.108)
(TAX/GDP) _{t-1}	0.256** (0.110)	0.173 (0.126)	0.352** (0.124)	0.347*** (0.116)	0.204*** (0.061)	0.209*** (0.074)
(TAX/GDP) _{t-2}	-0.141* (0.081)	0.072 (0.112)	-0.078 (0.074)	-0.048 (0.077)		
Constant	0.001 (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.010 (0.010)	0.010 (0.007)
Observations	492	344	492	492	298	298
	Diagnostic Tests (p-values)					
First-order s.c.	0.006	0.022	0.007	0.011	0.004	0.003
Second-order s.c.	0.490	0.167	0.402	0.425	0.201	0.196
Sargan	1.000	1.000	1.000	1.000	1.000	1.000
CIT variable	CIT/GDP	CIT/GDP	CIT/GDP	CIT/GDP	Statutory corporate tax rate	
VAT variable	VAT/GDP	Standard VAT rate	VAT/consumption	VAT/consumption	VAT/consumption	

Notes:

1/ Robust standard errors in parentheses.

2/ * means significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

3/ Instruments consist of : (i) (t – 3) to (t – 5) values of net exports and the tax variables and (t – 1) to (t – 3) values of log GDP per capita in columns 1 to 4; and (ii) (t – 2) to (t – 4) values of net exports and the tax variables and (t – 1) to (t – 3) values of log GDP per capita in columns 5 and 6.

Strong dynamic effects also emerge for the VAT. An increase in VAT reliance reduces net exports sharply in the short run. The effect is essentially reversed, however, in the second year: the null hypothesis of no long-run VAT effect cannot be rejected.¹⁸ The absence of a long-run effect is consistent with theory. The dynamics, and their strength, are harder to rationalize. Anticipatory behavior does not seem to provide an explanation. Suppose, for example, that all increases in VAT rates are preannounced, and that consumers bring consumption forward in response, but not by so much that revenue actually falls once the increase in the VAT rate applies. Then periods of high VAT reliance would be ones of low consumption, and hence of strong net exports—not weak, as found here. Alternatively, the negative impact on net exports might reflect the working out of the Feldstein-Krugman effect, or (perhaps less plausibly for these OECD countries) less than full refunding of input VAT to exporters. Or the result might simply be an artifact of movements in consumption due to other causes: if some other shock causes consumption to be high in some period, then, all else equal, VAT revenue will also be high, and net exports will be low.

To investigate this latter possibility, columns 2 and 3 of Table 3 repeat the exercise using VAT variables intended to capture more closely the parametric features of the tax. Column 2 uses the standard rate of the VAT.¹⁹ This though will not capture the impact of the additional rates applied in many countries, or of exemptions. To provide a handle on these, column 3 uses the effective rate of VAT, defined as the ratio of VAT revenue to total consumption. With both variables, the short-run effects found for VAT reliance vanish (except for the second lag using the standard VAT rate, the coefficient on which is in any event small). Using these alternative proxies, there is thus no convincing evidence that reliance on VAT has any significant explanatory power for the trade balance in either the short or the long run, supporting the interpretation that the results in column 1 arise from the confounding effects of exogenous shocks to consumption.

Changing the VAT variable—or omitting it altogether, as in Column 4—has no impact, however, on the dynamics found for the corporate tax: there is still a short-run increase in net exports, turning into a vanishing, negative effect. And indeed the coefficients themselves are quite robust across these various specifications.

It could be, however, that the corporate tax reliance variable is subject to the same difficulties as just examined for the VAT: it might be, for example, that high net exports are associated with high export earnings that are then picked up in strong corporate tax revenues. Or it could be that high profits, associated with high corporate tax payments, lead to higher investment abroad. To address such possibilities, in columns 5 and 6 of Table 2—with and without the effective rate of VAT—we replace reliance on the corporate tax with the

¹⁸ The p-value is in this case 0.74.

¹⁹ Available data on the standard rate of VAT cover only the period 1984–2003, restricting the sample.

statutory corporate tax rate.²⁰ The coefficients naturally change, but the qualitative results do not: the VAT-related variable continues to have no short- or long-run effect, while the corporate tax is positively related to net exports in the short run, but with the effect reversed after one period and converging to zero in the long run. The finding of powerful short-run dynamics but no long-run effect from the corporate tax thus emerges as quite robust.

We also experimented with using the marginal effective rate of corporate tax (METR) as the explanatory CIT variable.²¹ This proved to be insignificant (not shown, for brevity). That may simply reflect the difficulties of constructing such a summary measure of incentives to invest, especially over a period during much of which the dispersion of METRs across assets and activities was in itself a significant policy concern. Another interpretation, combined with the results in the text, is that the effects at work arise largely from the average effective rate of corporate tax rather than the METR (the former being a weighted average of the statutory and marginal effective rates,²² and tending to be closely tracked by the statutory rate), and so reflect the impact of the corporate tax on the location of mobile projects yielding pure profits.

Two further aspects of these empirical results deserve comment. First, the finding that the sign pattern of corporate tax effects matches that predicted for source- rather than that predicted for residence-based taxation—shown in Section II.C to be the precise opposite—conforms with the view that, for the reasons also set out above, even corporate taxes that are in principle residence-based function, in practice, more like source-based ones.²³ Second, although not the focus of interest here, total tax revenue as a proportion of GDP also typically enters the estimated equations with a strong effect, with an initial increase in the tax ratio leading to a reduction in net exports followed by a reversal and, ultimately, no long-run effect. Whether this reflects a temporary impact from the size of government—and similar results are obtained replacing the tax ratio by general government expenditure relative to GDP (not shown)—or effects from other domestic taxes, such as the personal income tax, is left to future work.

²⁰ This restricts the sample to 16 countries between 1983 and 2001. There do not appear to exist good panel data on corporate profits that would enable calculation of an “effective” rate of corporation tax analogous to the VAT variable used above.

²¹ As calculated by Devereux, Griffith, and Klemm (2002), and again restricting the sample as in the previous footnote.

²² Devereux and Griffith (2003).

²³ Indeed, all of the countries in our sample are characterized in the data set used in Slemrod (2004) as having residence-based systems.

Some further results are reported in Appendix Table 5. It is shown there that broadly similar results are obtained using gross rather than net exports as the left-hand variable (columns 1 and 2), and if reliance on VAT and the corporate tax is instead measured by their shares in total tax revenue (column 3).

V. SUMMARY AND CONCLUSIONS

The experience of OECD countries over the last 35 years or so emerges from the analysis here as consistent with two sets of predictions as to the impact on the trade balance of the domestic tax system.

First, the VAT itself appears to have no impact, in either the short or the long run. Although an increase in reliance on the VAT is associated with strong dynamic effects—a sharp deterioration in net exports that quickly declines—this can be explained as an artifact of unrelated shocks to consumption. Our results thus tend to confirm the view that the VAT is inherently trade neutral.

Second, and more striking, changes in the corporate tax have powerful dynamic effects, of a kind consistent with it being an essentially source-based tax. In the short run, increased corporate taxation is associated with increased net exports, consistent with the notion that such an increase leads capital to flow abroad. This increase turns into a persistent reduction in net exports, however, consistent with an increased inflow of income from abroad associated with the initial outflow. Over the long run, however, this effect declines to zero, leaving net exports unaffected.

Some aspects of domestic tax policy, it seems, do have strong effects on trade performance. And they can be quite complex.

Data

The sample is an unbalanced panel of 27 current OECD member countries with a VAT, covering the period 1967–2003, in each case covering the period after VAT introduction in each country. The precise country (year) coverage is shown in Table 4. Luxembourg and Mexico are excluded from the sample due to lack of tax revenue data, and the United States because it does not have a VAT.

Data on GDP and exports are from the *World Economic Outlook* database, and on tax revenue from the *OECD Revenue Statistics* Database, which reports data from 1965 onwards. Data on final consumption expenditure are drawn from the World Development Indicators database. Statutory corporate tax rates are taken from Devereux, Griffith and Klemm (2002), for 16 OECD member countries during 1983–2001. Statutory rates of VAT are from the Tax Policy Division at the International Monetary Fund. The geographic controls—country size, and dummies indicating whether the country is an island or landlocked—are from Rose (2002).

Table 4. Country (Year) Coverage of Sample

Australia (2000–2002)	Japan (1989–2003)
Austria (1973–2003)	Korea (1977–2003)
Belgium (1980–2003)	Netherlands (1969–2003)
Canada (1991–2003)	New Zealand (1986–2003)
Czech Republic (1993–2003)	Norway (1970–2003)
Denmark (1967–2003)	Poland (1993–2002)
Finland (1994–2003)	Portugal (1989–2001)
France (1968–2003)	Slovak Republic (1998–2002)
Germany (1968–2003)	Spain (1986–2003)
Greece (1987–2002)	Sweden (1970–2003)
Hungary (1991–2002)	Switzerland (1995–2003)
Iceland (1990–2003)	Turkey (1985–2003)
Ireland (1972–2002)	United Kingdom (1973–2003)
Italy (1973–2003)	

Descriptive statistics of the main variables in the sample are reported in Table 5.

Table 5. Descriptive Statistics

Variable	Number of Observations	Mean	Mean	Standard Deviation
Net exports as a fraction of GDP	573	0.005	0.005	0.047
Exports as a fraction of GDP	573	0.355	0.318	0.158
Log GDP per capita	573	10.767	10.001	2.436
Total tax revenue, as a fraction of GDP	573	0.372	0.372	0.077
VAT revenue, as a fraction of GDP	573	0.066	0.070	0.020
VAT revenue, as a fraction of total consumption	573	0.082	0.088	0.036
Standard VAT rate	461	17.500	18.600	5.373
Corporate tax revenue, as a fraction of GDP	573	0.026	0.024	0.013
Statutory corporate tax rate	334	0.389	0.386	0.120

Table 6 reports the number of countries by year and Table 7 the balance of the panel.

Table 6 . Distribution of Countries Over Years

Table 7. Balance of Panel

Year	Observations	No. of Years	No. of Countries
1967	1	3	1
1968	3	5	1
1969	4	9	1
1970	6	10	2
1971	6	11	1
1972	7	12	1
1973	10	13	2
1974	10	14	1
1975	10	15	1
1976	10	16	1
1977	11	18	2
1978	11	19	1
1979	11	24	1
1980	12	27	1
1981	12	31	4
1982	12	34	2
1983	12	35	1
1984	12	36	2
1985	13	37	1
1986	15		
1987	16		
1988	16		
1989	18		
1990	19		
1991	21		
1992	21		
1993	23		
1994	24		
1995	25		
1996	25		
1997	25		
1998	26		
1999	26		
2000	27		
2001	27		
2002	26		
2003	20		

Table 8. Robustness

	1	2	3
LDV _{t-1}	0.862*** (0.064)	0.915*** (0.036)	0.729*** (0.092)
(CIT variable) _t	0.510** (0.223)	0.067** (0.028)	0.278* (0.159)
(CIT variable) _{t-1}	-0.602** (0.299)	-0.075*** (0.016)	-0.268* (0.150)
(CIT variable) _{t-2}	-0.038 (0.208)		-0.018 (0.058)
(VAT variable) _t	-0.656 (0.505)	0.307 (0.247)	-0.514*** (0.194)
(VAT variable) _{t-1}	0.808** (0.371)	-0.193 (0.189)	0.365*** (0.141)
(VAT variable) _{t-2}	0.128 (0.272)		0.105 (0.097)
(TAX/GDP) _t	-0.276*** (0.078)	-0.248** (0.090)	-0.397** (0.156)
(TAX/GDP) _{t-1}	0.230** (0.113)	0.202* (0.103)	0.394*** (0.104)
(TAX/GDP) _{t-2}	-0.050 (0.076)		-0.088 (0.063)
Constant	0.000 (0.000)	-0.001 (0.001)	0.001 (0.001)
Observations	492	298	492
	Diagnostic Tests (p-values)		
First-order s.c.	0.003	0.004	0.007
Second-order s.c.	0.203	0.207	0.225
Sargan	1.000	1.000	1.000
Dependent variable	X/GDP	X/GDP	NX/GDP
CIT variable	CIT/GDP	Statutory tax R _{tte}	CIT/TAX
VAT variable	VAT/GDP	VAT/consumption	VAT/TAX

Notes:

1/ Robust standard errors in parentheses.

2/ * means significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

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