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Short-Term and Long-Term Government Debt and Nonresident Interest Withholding Taxes

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Abstract

This paper examines the incidence of nonresident interest withholding taxes in the international 3-month Treasury-bill market and the international 5-year government bond market. The approach is one of pooled cross-section, time-series regressions. The evidence suggests that the yields on national Treasury-bills and on 5-year government bonds fully reflect the nonresident interest withholding taxes imposed on American or Japanese investors. Nonresident interest withholding taxes on short-term and long-term government debt thus do not appear to be borne by the international investor.

Key Words: Withholding taxation; interest parity conditions; government debt.

JEL Classification: G15, H22, H63.

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1 Introduction

In recent years, capital controls and other barriers to international capital mobility have been progressively reduced or eliminated. Many industrialized countries, however, continue to levy nonresident interest withholding taxes on interest accruing to foreign residents. The large variation in countries' withholding tax regimes in terms of rates and application suggests that countries disagree what role these taxes play or should play. To inform the debate, this paper examines how interest withholding taxes, insofar as they apply to government debt, affect government debt yields for the industrialized countries. The basic question is to what extent a withholding tax is compounded into higher pre-tax interest rates on short-term 3-month Treasury bills or T-bills and on long-term 5-year government bonds. From the estimated mark-up, we can immediately infer to what extent the nonresident withholding tax is in fact borne by the debt-issuing treasury rather than by the lender or the lender's treasury. Nonresident withholding taxes, if compounded into higher interest rates, do not reduce the cost of international public borrowing. Higher interest rates, however, raise the cost of domestic public borrowing, to the benefit of resident holders of government debt. These issues remain important as long as most governments are heavily indebted.

A priori, the relationship between nonresident withholding taxes and interest rates can be expected to reflect, first, whether these taxes are easily evaded by way of a third country, tax-exempt financial intermediaries or by coupon washing techniques. Second, the interest rate mark-up importantly depends on whether the lender expects to receive a foreign tax credit to offset the withholding tax. At one extreme, no mark-up should occur if a risk-neutral investor receives a fully offsetting tax credit, while a full mark-up is consistent with the absence of any tax credit. Given these complications, empirical estimation of the extent of mark-up is called for to provide insights into the economic working and incidence of nonresident interest withholding taxation.

The nonresident withholding tax regime tends to be a patchwork of rates and regulations. Tax treaties may stipulate different rates for different interest receiving countries, while there may be a host of exemptions based on the type of debt instrument, its maturity, and the status of interest payor or payee.[2] Many countries exempt government debt from nonresident withholding taxation altogether. Exceptions to this rule among the industrialized countries include Australia,

[2] See Gustavsson (1990) and KPMG (1988) for surveys.

Italy, Japan, Spain and Switzerland. This paper focuses on government debt markets, as they are well-defined, relatively liquid and as it is of prime interest to see how withholding taxes affect the tax-inclusive government cost of borrowing.

This paper examines the link between interest rates and withholding taxes separately for 3-month T-bills and 5-year government bonds, while the international investors in government debt are taken to be either American or Japanese. With T-bill yields, we in fact estimate a covered interest parity relationship adjusted for the withholding-tax mark-up.[3] T-bills have the advantage that they are almost free of default risk. To check whether the results also apply to longer-term debt, we further examine a closed interest parity relationship linking the government bond yield to comparable offshore swap interest rates in the same currency - but not subject to withholding taxation. The swap rate reflects the interest rate on a benchmark bond designated by major securities houses as such, and is therefore rather liquid and trading at a premium.[4]

Previously, Brean (1984) has documented a downward effect of the 1975 elimination of interest withholding taxes on interest rates for Canadian medium- and long-term corporate borrowings from foreign sources. Along these lines, Nöhrbaß and Raab (1990) find that the yield on German corporate bonds fully reflects the 10 per cent withholding tax rate in force in early 1989.[5] In contrast, Huizinga (1996) finds that commercial bank credits to private borrowers in developing countries in the 1970s reflect significantly less than the full nonresident withholding taxes. These different results suggest that the mark-up of withholding taxes into interest rates may vary with the time period, or the nature of market participants. To add to the evidence, this paper focuses

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[3] Several reasons for deviations from covered interest parity other than plain credit risk have been noted in the literature. See Officer and Willett (1970) for an early survey. Aliber (1973) specifically considers political risk, while Frenkel and Levich (1975, 1977) and Clinton (1988) focus on transaction costs. Transaction costs, specifically, create a band of deviations around covered interest parity for which no profitable arbitrage is possible. Taylor (1987, 1989) further points out the role of data imperfections, and Dooley and Isard (1980), Otani and Tiwari (1981) and Ito (1986) consider capital controls.

[4] Formally, an interest swap is an contractual agreement whereby two parties exchange a series of cash flows determined by two different interest rates on the same notional principal for a defined period of time. For a description of interest rate swaps, see Hull (1993) and Smithson, Smith and Wilford (1995).

[5] In January 1989 the German government introduced a withholding tax of 10% for all German domestic instruments held by residents and nonresidents. The tax was first announced in October 1987 and this resulted in massive capital outflows. On July 1, 1989, just six months after its inception, the withholding tax was removed (Deutsche Bundesbank, 1994).

on public debts of different maturities for a broad set of industrialized countries.[6]

The remainder of the paper is organized as follows. Section 2 derives the estimating equations from underlying interest arbitrage relationships. Section 3 presents the empirical results for the T-bill and 5-year government bond markets in two separate subsections. While the evidence differs somewhat across samples and time periods, overall it is supportive of the view that withholding taxes are compounded one-for-one into higher pre-tax government yields. As indicated, this is consistent with the view that international investors (such as American and Japanese pension funds) cannot obtain any offsetting foreign tax credits or that there is wide-spread domestic tax evasion. Section 4 evaluates the results and concludes.

2 The Estimating Equations

Tax authorities can apply withholding taxes on interest accruing to residents and nonresidents. In the first instance, the withholding taxes are commonly credited against the residents' final income taxes. No such source-country refunding, however, occurs for nonresident withholding taxes. From a source-country perspective, a nonresident withholding tax thus is a final tax. The private creditor, however, may or may not be able to obtain a foreign tax credit from his own tax authority to offset the nonresident withholding tax. The impact of nonresident withholding taxation on debt yields thus depends on the tax regimes of the foreign-source country and the investor's home country. The focus of this paper is on nonresident withholding taxes and their impact on government debt yields. This section specifically indicates how the covered and closed interest parity conditions involving these yields can be adjusted for nonresident withholding taxes.[7]

In the later empirical work, the investors in international government debts are taken to be

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[6] Demirgüç-Kunt and Huizinga (1995) examine the impact of dividend and capital gains withholding taxes as imposed by developing countries on their pre-tax equity returns. Only withholding taxes on capital gains appear to have a discernible impact on pre-tax equity returns. This is consistent with the rather limited creditability of nonresident capital gains withholding taxes in the U.S. and other capital exporting countries. In the domestic tax area, Poterba (1986) and Feenberg and Poterba (1991) examine the implied marginal tax rates and revenue losses in the market for tax exempt bonds in the United States.

[7] The covered interest parity linking offshore interbank interest rates and forward exchange rates generally holds very well. Government debt yields with different repayment prospects and subject to different tax regimes, however, may give rise to substantive deviations from covered interest parity.

American or Japanese.

$\tau_{j,t}^{w}$

[8] By 1992, Japanese and U.S. institutional investors (pension funds, life insurance funds, non-life insurance companies, and mutual funds) held assets of 2.0 and 7.2 trillion U.S. dollars, respectively. In contrast, institutional investors in Canada, Germany, and the U.K. held assets of 0.4, 0.8 and 1.4 trillion U.S. dollars. Further, Japanese and U.S. pension funds (life insurance companies) held 8.4 and 4.6 (11.4 and 3.7) percent of total assets abroad. For U.S. pension funds this translates into absolute foreign holdings of around 150 billion U.S. dollars. See International Monetary Fund (1995, Tables II.6 and II.7).

[9] See Lyon and Silverstein (1995, p. 157) for a discussion of foreign tax credits and income baskets.

including foreign exchange gains, if the investor pays any domestic tax on foreign source income. An international investor that is in an excess credit position faces a marginal tax rate on foreign source income of zero. Let γ be the probability that the international investor can obtain a tax-credit ex post. Uncertainty regarding the availability of foreign tax credits can, for instance, be due to the international investor's uncertain returns on financial assets other than government debt.

First, let us consider the tax-adjusted covered interest parity condition for a U.S. (or Japanese) investor that can invest in U.S. and non-U.S. T-bills. Let i_t and $i^*_{j,t}$ be the U.S. and foreign country *j*'s T-bill rates at time *t*, respectively. The investor can borrow freely in dollars against the U.S. T-bill interest rate. The costs of such borrowings are deductible from the investor's domestic taxable income. In particular, domestic interest expenses incurred to finance foreign financial assets are deductible from the investor's foreign source taxable income. Further, any exchange risk can be eliminated by way of forward exchange contracts. Let $F_{j,t}$ and $S_{j,t}$ be the forward and spot exchange rates, defined as amounts of foreign currency *j* per U.S. dollar. Both U.S. and non-U.S. T-bills are assumed to carry some sovereign risk. In particular, let θ be the expected credit loss per dollar invested in U.S. T-bills and θ^*_j be the expected credit loss per dollar invested in foreign T-bills issued by country *j*. In case of debt default both principal and interest are assumed to be lost, but the investor is allowed to write off the full principal investment against taxable income. A risk-neutral international investor that can freely borrow to finance any T-bill investment will then be indifferent about doing so if[10],

$$\left[1 + [\gamma\ (1-\tau) + (1-\gamma)]\, i_t\right](1-\theta) + \gamma\,\tau\,\theta\ =$$

$$\left[\gamma\left[1 + (1-\tau)[(1+i^*_{j,t})\frac{F_{j,t}}{S_{j,t}} - 1]\right] + (1-\gamma)\left[[1 + i^*_{j,t}(1-\tau^w_{j,t})]\frac{F_{j,t}}{S_{j,t}}\right]\right](1-\theta^*_j) + \gamma\,\tau\,\theta^*_j \qquad (1)$$

Equation (1) reflects that with probability γ the investor faces a positive domestic income tax rate, τ, on foreign source income. The last terms on both sides of (1) are the expected values

[10] Note that the assumption of risk neutrality implies that the demand for any asset is infinitely elastic. Even if arbitrage eq. (1) holds for a nonresident investor, there may be profitable investment opportunities for domestic residents. In practice, profitable arbitrage is limited for resident and nonresidents alike by the reality of risk aversion, and by borrowing limits and limitations on the tax deductibility of interest. Transaction costs, in part evidenced by bid-ask spreads in debt markets, further limit profitable arbitrage. The inclusion of these factors in a general equilibrium setting, so as to eliminate 'free lunches' for all market participants, is beyond the scope of this paper.

of the loss offset provision in case of debt default. In equation (1), we assume that the events θ, θ^* and γ are independent. Now define $p_{j,t}$ to be the percentage depreciation of the U.S. dollar vis-à-vis foreign country j's currency implicit in the forward exchange rate as follows,

$$p_{j,t} \equiv \frac{F_{j,t}}{S_{j,t}} - 1 \tag{2}$$

Substituting for $\frac{F_{j,t}}{S_{j,t}}$ from (2) into (1) and setting the cross terms $i^*_{j,t}\, p_{j,t}$, $\theta^*_j\, p_{j,t}$, $\theta^*_i\, i^*_{j,t}$ and $\theta\, i_t$ to zero, we get after rearranging,

$$(1-\gamma\tau)(p_{j,t} + i^*_{j,t} - i_t) = (1-\gamma\tau)(\theta^*_j - \theta) + (1-\gamma)\tau^w_{j,t}\, i^*_{j,t} \tag{3}$$

After dividing by $(1-\gamma\tau)$, we now can obtain the following tax-adjusted covered interest parity condition,

$$f_{j,t} = \hat{\theta_j} + \beta\, \tau^w_{j,t}\, i^*_{j,t} \tag{4}$$

where

$$f_{j,t} = p_{j,t} + i^*_{j,t} - i_t, \quad \hat{\theta_j} = \theta^*_j - \theta, \quad \beta = \frac{1-\gamma}{1-\gamma\tau}$$

The variable $f_{j,t}$ in (4) is the part of country j's T-bill yield in excess of covered interest parity. The variable $\hat{\theta_j}$ simply is the expected credit loss of investment in country j's T-bills relative to U.S. T-bills. The parameter β further indicates how much the foreign (non-U.S.) interest rate, $i^*_{j,t}$, rises if the withholding tax payment, $\tau^w_{j,t}\, i^*_{j,t}$, is increased by unity for given values of i_t, $p_{j,t}$ and $\hat{\theta_j}$. The parameter β, which satisfies $0 \le \beta \le 1$, thus is naturally interpreted as the share of the withholding tax borne by the foreign government itself, while 1 - β is the share of the withholding tax borne by the investor's home country Treasury.

The incidence parameter, β, is negatively related to the probability, γ, that the potential foreign tax credit is realized ex post if $\tau < 1$. At the same time, the expression for β reveals that it is positively related to the income tax rate τ, if $0 < \gamma < 1$. To see why, note that the pre-tax foreign interest rate, $i^*_{j,t}$, has to rise to compensate the international investor following an increase in

the withholding tax rate, $\tau^{w}_{j,t}$. The foreign interest payment, $i^{*}_{j,t}$, is subject to the investor's domestic income taxation. The foreign interest rate, $i^{*}_{j,t}$, thus has to rise more, the larger the income tax rate, τ. The share of the incidence of the foreign withholding tax borne by the investor's national Treasury thus decreases with the income tax rate, τ.

To obtain an alternative specification, we can divide both sides of equation (4) by the foreign interest rate, $i^{*}_{j,t}$, to give the following tax-inclusive covered interest parity relationship,

$$f'_{j,t} = \hat{\theta}'_{j} + \beta\, \tau^{w}_{j,t} \tag{5}$$

where

$$f'_{j,t} = \frac{f_{j,t}}{i^{*}_{j,t}}, \quad \hat{\theta}'_{j} = \frac{\hat{\theta}_{j}}{i^{*}_{j,t}}$$

In (5), the interpretation of β remains unchanged. In deriving equations (4) and (5), we have assumed that the investor reports his foreign source interest income to the domestic tax authority. Alternatively, the investor evades domestic taxes on foreign investment income. In that instance, we effectively have $\gamma = \tau = 0$, which implies that β in (4) and (5) equals 1. In case of tax evasion, the T-bill interest rate, $i^{*}_{j,t}$, thus rises one-for-one with the withholding tax liability, $\tau^{w}_{j,t} i^{*}_{j,t}$.

Next, let us consider the tax-adjusted closed interest parity condition for an investor who can invest in national 5-year government bonds and, alternatively, in offshore 5-year swap instruments in the same currency. Setting $p_{j,t} = 0$ in (4) and substituting the foreign-currency swap rate $i_{j,t}$ for the U.S. T-bill rate i_{t}, we get,

$$g_{j,t} = \hat{\theta}_{j} + \beta\, \tau^{w}_{j,t} i^{*}_{j,t} \tag{6}$$

where

$$g_{j,t} = i^{*}_{j,t} - i_{j,t}$$

The variable $g_{j,t}$ thus is the excess of country j's 5-year government bond yield, $i^{*}_{j,t}$, over the corresponding swap interest rate, $i_{j,t}$, while the variable $\hat{\theta}_{j}$ now reflects the expected credit loss

per dollar invested in 5-year government bonds relative to the corresponding swap instrument.

Analogously to equation (5), we can divide (6) by the 5-year government bond yield, $i^*_{j,t}$, to obtain,

$$g'_{j,t} = \hat{\theta}'_j + \beta\, \tau^w_{j,t} \tag{7}$$

where

$$g'_{j,t} = \frac{g_{j,t}}{i^*_{j,t}}$$

In practice, deviations from the tax-adjusted arbitrage relationships (4) and (6) and the tax-inclusive arbitrage relationships (5) and (7) occur for a variety of reasons, including data imperfections and transaction costs. As a result, a random component can be appended to any of these four relationships to give rise to an estimating equation.

3 Data and Empirical Results

Of the industrialized countries considered, only Australia, Germany, Italy, Japan, Spain and Switzerland have imposed interest withholding taxes on U.S. residents. The withholding tax rate data is mostly available on an annual basis (see Appendix A for all data sources), although any within-year tax rate changes are dated as accurately as possible. Australia, specifically, imposes a 10 per cent withholding tax applicable to American investors ever since 1980. Germany had a withholding tax of 10 per cent from January 1989 until July 1989. Italy increased its withholding tax on U.S. investors from zero to 6.25 per cent in September 1986 and subsequently to 12.5 per cent in October 1988. Japan and Switzerland have maintained constant withholding tax rates of 5 and 10 per cent, respectively, on American investors since 1980. Spain raised its withholding tax on government debt from 20 to 25 per cent in July 1989. All of these countries apply a roughly similar withholding tax regime to nonresident Japanese investors. Of the countries in the sample, Italy and Spain and to a lesser extent Belgium, France and Sweden have imposed capital controls in the eighties. These capital controls, however, in no instance prohibited the foreign ownership of domestic government debt securities. Below we consider how the withholding

tax regime has affected yields in, first, the national T-bill markets and, second, the 5-year government bond markets.

3.1 Withholding Taxes and 3-month T-bills

The T-bill interest rate data set consists of monthly observations from January 1980 to December 1994 for twelve industrialized countries: Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, the United Kingdom and the United States.[11] The maturity of all T-bills is 3 months. The countries in the data set vary widely among themselves and over time in their interest withholding tax regime.

As can be seen from Garbade (1982) and OECD (1990c), national T-bill markets differ widely in, for instance, market institutions and pricing conventions. The market for U.S.-Treasury debt is arguably the deepest in the world, with a near continuum of Treasury maturities and very narrow bid-ask spreads. T-bills are issued in weekly batches by tender. Contrary to the U.S., there is no active secondary market for T-bills in Germany. T-bills payable within three months are used as collateral for Lombard loans. Similarly, in Japan, a liquid secondary market in T-bills has yet to emerge. Gensaki bonds, which are repurchase agreements covering three-month transactions, are collateralized by government bonds or T-bills. Essentially, the gensaki market is a somewhat restricted private market. The Banque Nationale de Belgique subscribes to three-month Treasury certificates at par, in practice in so far as it can transfer them onto the market. In Canada, investment dealers, the chartered banks and the Bank of Canada submit tenders to the Ministry of Finance for 3-month T-bills to be issued. T-bills are sold at discount. In France, 13-week T-bills are an important element of the money market. T-bills are available to all economic agents and are sold in so-called Dutch auctions. T-bills in Italy are the government's most important source of short-term finance. They are issued by auction, in which the Banca d'Italia participates in the same way as other authorized dealers. Until recently, nearly all 3-month Treasury paper in the Netherlands was held by monetary institutions that use it as an interest-bearing and pledgeable asset to meet the liquidity requirements imposed by De Nederlandsche Bank. The banks had practically no Treasury paper freely available for sale on the market. Secondary market dealings were rare, and secondary market rates were merely indicative.[12] T-bills

[11] T-bills are promises of the Treasury to pay a stipulated amount on a stated maturity (Garbade, 1982).

[12] Note that since January 1, 1994 so-called Dutch Treasury Certificates (DTC's) exist to finance temporary cash deficits of the government (Goudswaard, De Haan, De Haan and Oort, 1996, p. 33).

in the United Kingdom are offered for tender each weak. In Sweden, Treasury discount notes are the main instrument for government short-term borrowing. Switzerland possesses only the embryo of a domestic money market. The Banque Nationale Suisse, may discount bills of exchange and cheques, "rescriptions" issued by the Confederation and by the cantons and communes, though is not obliged to. Finally, in Australia Treasury notes are issued by the Commonwealth government. They are issued at a discount by periodic tender and are redeemable at par 13 weeks from the date of issue.

Next, we turn to the results of estimating (4) for the pooled cross-country, time series data set using ordinary least squares (OLS), as reported in Table 1. The regressions in Table 1 include eleven country dummy variables, $\hat{\theta_j}$, and the nonresident withholding tax imposed on either U.S. or Japanese investors times foreign country j's interest rate, i.e. $\tau^{w}_{us,1980-1994} \cdot i^{*}_{j,t}$ or $\tau^{w}_{jap,1980-1994} \cdot i^{*}_{j,t}$.[13] A constant term is omitted. Newey-West (1987) standard errors are also reported to account for possible heteroscedasticity and autocorrelation resulting from overlapping 3-month interest rate observations. The Newey-West (1987) standard errors differ relatively little from the OLS standard errors, with relatively minor implications for significance levels.[14] The regressions 1 and 5 reflect the basic tax-adjusted covered interest parity condition in (4) for U.S. and Japanese nonresident investors, respectively. The coefficient β is estimated at 1.206 for U.S. investors (in regression 1) and at 1.233 for Japanese investors (in regression 5). In either regressions, the β's are statistically significantly different from zero, but not from unity. A country dummy can be interpreted as sovereign risk or country-specific transaction costs (in the form of, for instance, registration requirements) relative to the U.S.[15] The estimation results suggest that there is relatively high sovereign risk for Belgian, Canadian and Swedish debts.

In regressions 2 and 6, two control variables, the ratio of non-U.S. debt to GDP less the ratio of U.S. debt to GDP, DEBT-DEBT$_{US}$, and the non-U.S. inflation less U.S. inflation, INF-INF$_{US}$, are added to the basic regressions. These control variables can be seen as somewhat more specific (and obviously more time-varying) indicators of country risk than country dummies. The coefficient β is now estimated at 1.048 for the U.S. investor (in regression 2) and at 1.088 for the Japanese (in regression 6). Again, the estimates of β remain statistically indifferent from

[13] With country dummies included, identification of the tax variables stems from tax rate changes.

[14] The Newey-West (1987) correction is based on Bartlett weights and second order lags.

[15] Broadly interpreted, sovereign risk includes credit risk and policy risk stemming from, for instance, tax policy uncertainty.

unity. The regressions do not explicitly controls for the possible role of capital export restrictions in determining government debt yields in the absence of the requisite data.[16] The estimated positive β coefficients thus in principle can be biased insofar as nonresident withholding tax rates are correlated with capital export restrictions. Note that a country such as Italy imposes positive nonresident withholding tax rates, and has also restricted capital exports (of course, these restrictions have been eliminated in 1990). Withholding taxes tend to increase pre-tax interest rates, while capital export restrictions have the opposite effect. A failure to control for capital export restrictions in the regressions thus cannot explain positive β coefficients insofar as withholding taxes and capital export restrictions have been positively related.

In regressions 3 and 7, separate β coefficients are estimated for 5 consecutive three-year intervals in the basic equation (4) for U.S. and Japanese investors, respectively. In both regressions, the β estimate for the 1980-1982 interval is significantly different from zero and from unity, while the β estimates for the intervals 1983-1985, 1986-1988, 1989-1991 and 1992-1994 are significantly different from zero, but not from unity. Also note that in practice not all the estimates of β are within the zero-one range. Regressions 4 and 8, finally, add the two debt and inflation control variables to regressions 3 and 7. Otherwise, regressions 4 and 8 correspond closely to regressions 3 and 7.

The regressions reported in Table 2 are based on the tax-inclusive covered interest parity specification in equation (5).[17] Otherwise, the regressions are fully analogous to those reported in Table 1. The basic regressions 1 and 5 now reveal estimates for the coefficient β that are both not statistically different from zero and from unity. The estimated parameters for the country dummies are larger than in Table 1, as they now are roughly interpreted as the expected credit loss (relative to the U.S.) as a share of the foreign country *j*'s interest rate. Similar results are obtained if control variables are included in regressions 2 and 6. Regressions 3-7 and 4-8 show, however, that the β estimates are roughly in the neighborhood of unity for the intervals 1980-1982, 1983-1985, and 1986-1988, while they are close to zero in the subsequent intervals 1989-1991 and 1992-1994. This pattern of results is consistent with the view that key international investors did not receive offsetting foreign tax credits in the period 1980-1988, while such tax credits were available in the latter period 1989-1994.

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[16] See Lemmen and Eijffinger (1996b) for an empirical analysis of the determinants of capital controls in member states of the European Union.

[17] Note that the tax-inclusive specification excludes the possibility of spurious correlation.

Overall, the evidence suggests that withholding taxes on national T-bills were fully reflected in pre-tax yields in the earlier period till 1988. A full gross-up of pre-tax interest rates is plausible, as large institutional investors such as pension funds are tax-exempt in both the United States and Japan, and thus cannot receive foreign tax credits to offset foreign-source interest withholding taxation. As national T-bill markets differ markedly in scope and organization, it is interesting to check to what extent these conclusions continue to hold for longer-term government debt markets. To this end, we next examine the relationship between interest withholding taxation and yields in the 5-year government debt markets.

3.2 Withholding Taxes and 5-year Government Bonds

Long-term government bonds are perhaps closer substitutes in investor portfolios than national T-bills, in part because national central banks are less active in long-term government debt markets than in T-bill markets. It interesting to test the relationship between withholding taxes and yields separately for the long-term government debt market, not the least because long-term government debt markets tend to be far more liquid than, say, corporate debt markets. Also, maturity per se can have an independent effect on the extent to which interest withholding taxes are marked-up into higher pre-tax yields. This, for instance, is shown to be case in the commercial bank credit market to developing countries in the 1970s by Huizinga (1996). The evidence there suggests that pre-tax interest rates are marked-up less for short-term bank loans than for longer term bank loans on account of foreign-source interest withholding taxes. A reason for this 'withholding tax yield-curve effect' may be that banks on short notice know whether they can realize the foreign tax credits associated with any loans. They therefore value foreign tax credits associated with short-term loans relatively highly giving rise to a smaller mark-up into higher pre-tax yields for short-term credits. A second reason for a 'withholding tax yield-curve effect' may be that there is always some uncertainty about domestic tax regime changes insofar as existing financial instruments are not subject to grandfather clauses in case of policy changes. Of course, the government debt market is far more liquid than the secondary market for third world debt has even been, and a priori any maturity effect is expected to be weaker.

The data set now consists of monthly 5-year government bond yields and comparable offshore swap rates in the same currency for the period from April 1987 to December 1995. The data is for thirteen industrialized countries: Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Again, Newey-West (1987) corrected standard errors are also reported to account for possible heteroscedasticity and autocorrelation resulting from the overlapping sample problem.[18]

Table 3 first reports regressions based on the tax-adjusted closed interest parity condition in equation (6). The basic regressions 1 and 5 yield estimates of the coefficient β that are close to zero and statistically insignificant for the U.S. and Japanese investor cases. In contrast, regression 2 finds a positive and slightly significant β estimate for the U.S. case. Next, regressions 3-7 and regressions 4-8 test whether the mark-up of withholding taxation includes separate β estimates for three consecutive 3-year intervals to see whether the β estimate changes over time. The results suggest that the impact of nonresident withholding taxation on pre-tax yields on 5-year government bonds increases somewhat over time, although most of the individual β estimates are significantly indifferent from zero.

To conclude, Table 4 reports regressions based on the tax-inclusive closed interest parity specification in equation (7). The estimates of the β coefficient for the regressions 1, 2, 5 and 6 are close to zero and not significantly different from zero. In regressions 3, 4, 7 and 8, however, the β estimates are close to unity for the intervals 1990-1992 and 1993-1995, which suggests that the foreign pre-tax interest rates rise one-for-one by the interest tax withheld. There are several possible explanations of why the estimates of β are not significantly different from zero for the period 1987-1989 in regressions 3, 4, 7 and 8. First, during this period the swap market came into being, with possible pricing variability. Also, there are scattered data only for Germany, Japan, the U.K., and the U.S. during this period. Second, the U.K. (with no withholding taxation of public interest payments) at the time maintained high interest rates, as the pound was shadowing the D-mark. Third, German government bond yields shot up by about 50 basis points in October 1987 when the 10 percent withholding tax, to take effect in January 1988, was announced. During the first half year of 1988 when this withholding tax was in place, German bond yields were actually lower than before, as it became clear that the withholding tax would be repealed. These difficulties in the early period apparently are large enough to also yield insignificant withholding tax effects for the whole sample as in equations 1, 2, 5 and 6. For equations 3, 4, 7 and 8, the hypotheses of equal coefficients for the three withholding tax variables are rejected at the 5 percent level (with statistics of $F^{2}_{764} = 30.93$, $F^{2}_{763} = 30.81$, $F^{2}_{772} = 82.71$ and $F^{2}_{771} = 85.51$).

[18] The Newey-West (1987) correction is based on Bartlett weights and fifty-nine order lags.

4 Evaluation and Conclusion

This paper has tested to what extent national T-bill and 5-year government bond yields reflect the nonresident withholding tax regime. In the preferred Tables 2 and 4, the incidence parameter, where significantly different from zero, is positive, and frequently statistically insignificant from unity. These results suggest that at least during certain periods both T-bill and 5-year bond yields fully reflect the withholding tax regime. This conclusion suggests that key international investors receive few, if any, offsetting foreign tax-credits from their domestic tax authorities. This is to be expected as the marginal international investors are generally tax-exempt institutional investors such as pension funds. As a result, the net-of-tax government cost of funds may be invariant to the withholding tax rate. Nonresident withholding taxes thus appear to have few, if any, international redistributive implications.[19] At the same time, the international tax system de facto appears to be source-based, although most countries de jure tax their residents' income on a worldwide basis with offsetting tax credits for foreign source income taxes.

While nonresident withholding taxes may have little impact on net-of-tax interest rates, they of course increase pre-tax interest rates. This increase in interest rates also benefits domestic holders of government debt that are not subject to nonresident withholding taxes. Nonresident withholding taxes thus have potentially important national redistributive implications. To the extent that domestic owners of government debt benefit from higher interest rates, the overall effect of nonresident withholding taxes on the government budget may be negative. The domestic demand for government debt thus poses an constraint on the efficacy of nonresident withholding taxes as a tool to generate net government revenues. Important in this regard is the extent to which higher pre-tax government yields cause a shift in ownership from foreign to domestic investors in government debt. In practice, governments appear to have an incentive to separate the domestic and foreign demands for their securities. Capital controls, which are now out of vogue, are one way to achieve this. Alternatively, governments can issue debts denominated in domestic and foreign currencies in an attempt to achieve market separation.

The insight that nonresident withholding taxes on the public debt may raise little government revenue may be a stimulus for countries to agree to harmonize the international withholding

[19] Nonresident withholding taxes represent to some extent a direct transfer of resources from the lender's tax authority to the borrowing government.

tax system.[20] By acting together, countries may in fact restore the efficacy of interest withholding taxes to generate net tax revenues. In 1989, the European Commission proposed the introduction of a minimum withholding tax of 15% on foreign interest income. This proposal was an essential complement to the achievement of a free movement of capital. Capital flows were liberalized in the European Union by July 1, 1990 (with the exceptions of Greece, Ireland, Portugal and Spain). The elimination of restrictions on short-term capital flows, which may be most tax-sensitive, followed the earlier liberalization of long-term capital flows. The liberalization of course implies that capital now can flow freely from countries with source-level interest taxation to countries without any such taxation. Despite the obvious benefits of concerted European action, the minimum withholding tax proposal was rejected over concerns about its effects for Europe's financial centres.[21] The European Commission (1996), however, recently restated its view that introducing a minimum withholding tax along the lines of the 1989 proposal would be a valuable first step towards ensuring the effective taxation of international interest income. The European debate on withholding tax policy points out that a common withholding tax policy ideally also involves the non-European industrialized countries and financial centres.

[20] While debt pricing depends on the marginal investor in government debt, the net revenue implications of nonresident withholding taxes also depend on inframarginal holders of this debt.

[21] See Kopits (1992, pp. 66-71) and Huizinga (1994, p. 279) for more information.

Appendix

Data Sources

Description of T-bill rates

Country	Period	Description	Source
Australia	January 1980-December 1994	3-month T-bill rate in percentage per year (end-of-period)	DATASTREAM, National Government Series
Belgium	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
Canada	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
France	December 1986-December 1994	Bons du tresor, marché secondaire, 3 mois, dernière cotation (fin de mois)	Banque de France
Germany	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
Italy	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
Japan	January 1980-December 1994	3-month gensaki rate in percentages per year, i.e. repurchase agreement rate using long-term bonds and more recently using T-bills as collateral (end-of-period)	Bank of Japan
Nether-lands	January 1980-January 1991	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
Sweden	January 1981-December 1994	3-month T-bill rate in percentages per year (end-of-period)	Sveriges Riksbank
Switzer-land	January 1980-December 1994	3-month Eidgnössische Geldmarkt-buchforderungen in percentages per year (yield of last issue in month)	Schweizerische National Bank
United Kingdom	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series
United States	January 1980-December 1994	3-month T-bill rate in percentages per year (end-of-period)	DATASTREAM, National Government Series

Description of spot exchange rates vis-à-vis the U.S. dollar

End-of-period spot exchange rates over the period January 1980-December 1994 vis-à-vis the U.S. dollar are obtained from IMF, International Financial Statistics, line ae via DATASTREAM

Description of three-month forward exchange rates vis-à-vis the U.S. dollar

End-of-period three-month forward exchange rates vis-à-vis the U.S. dollar are obtained from IMF, International Financial Statistics, line b. If they are not available they are calculated from the formula for the forward premium $p_{j,t}$ on foreign country j's currency at time t in percent per annum as explained in IMF (1985):

$$p_{j,t} = \frac{(S_{j,t} - F^{(3)}_{j,t}) \times 4 \times 100}{S_{j,t}}$$

End-of-period forward premia (discounts) are obtained from the IMF, International Financial Statistics, line 60f. The annualized forward premium (discount) is based on a 360-day year, and the three-month forward exchange rate is the rate for 90 days, yielding the factor 4 that is employed in the formula. If forward exchange rates from the IMF are unavailable, end-of-period three-month forward exchange rates vis-à-vis the U.S. dollar are obtained from Barclays Bank (Canada: November 1994-December 1994 and Netherlands: November 1993-December 1994). All data are obtained via DATASTREAM.

Interest rate swaps and corresponding government bond yields

Interest rate swaps (see floating payment reset frequency)

Source of data:	Intercapital Brokers Ltd as collected by DART Ltd obtained via DATASTREAM
Time of day quotes:	End of U.K. business day, middle rate
Fixed business day convention:	All modified succeeding
Floating business day convention:	All modified succeeding
Floating resets:	All discrete
Settlement lag:	None
Frequency:	Monthly, end-of-month

Benchmark 5-year government bond indices - redemption yield (see fixed payment frequency)

Source of data:	EFFAS (European Federation of Financial Analysts Societies) obtained via DATASTREAM
Time of day quotes:	End of U.K. business day, middle rate
Frequency:	Monthly, end-of-month

Following DART's currency specifications, data are annualized, $\left[1 + \frac{annual\ \ yield}{100}\right] = \left[1 + \frac{semi - annual\ \ yield}{200}\right]^2$ and converted to a 360 day year by multiplying by $\frac{360}{365}$ if necessary (see table).

Country	Period	Fixed payment frequency	Fixed day count basis	Floating payment reset frequency	Floating day count basis
Belgium	June 1991-December 1995	Annual	Actual/365	Semi-Annual	Actual/365
Canada	June 1993-December 1995	Semi-Annual	Actual/365	Semi-Annual	Actual/360
Denmark	February 1993-December 1995	Annual	30/360	Semi-Annual	Actual/360
France	June 1991-December 1995	Annual	Actual/Actual	Semi-Annual	Actual/360
Germany	April 1987-December 1995	Annual	30/360	Semi-Annual	Actual/360
Italy	March 1991-December 1995	Annual	30/360	Semi-Annual	Actual/360
Japan	September 1989-December 1995	Semi-Annual	Actual/365	Semi-Annual	Actual/360
Netherlands	June 1991-December 1995	Annual	30/360	Semi-Annual	Actual/360
Spain	January 1991-December 1995	Annual	30/360	Semi-Annual	Actual/360
Sweden	January 1992-December 1995	Annual	30/360	Semi-Annual	Actual/360
Switzerland	January 1988-December 1995	Annual	30/360	Semi-Annual	Actual/360
United Kingdom	April 1987-December 1995	Semi-Annual	Actual/365	Semi-Annual	Actual/365
United States	January 1989-December 1995	Annual	Actual/360	Semi-Annual	Actual/360

Source: Data Analysis Risk Technology Limited, Park House, 16 Finsbury Circus, London.

Withholding tax rates

Coopers and Lybrand, *International Tax Summaries*, 1980-1995 Issues.

Interfisc, loose-leaf.

International Bureau of Fiscal Documentation, The Taxation of Private Investment Income, *Guides to European Taxation*, Vol. 3, Amsterdam.

KPMG (1988), *Withholding Taxes on Interest*, Second Edition, Frankfurt, July.

Control variables

INF: Realized change in the consumer price index (1990 = 100). Source: IMF, *International Financial Statistics*, line 64.

DEBT: General government gross debt over gross domestic product. Source: OECD (1995), Economic Outlook, No. 57, except for Switzerland, IMF, *International Financial Statistics*. Debt ratios of Australia are only available from 1987 onwards.

Table 1 - Tax-adjusted covered interest parity for 3-month Treasury bills

	1	2	3	4	5	6	7	8
$\tau^{w}_{us,1980-1994} \cdot i^{*}$	1.206 (4.88) [3.04]	1.048 (3.77) [2.21]						
$\tau^{w}_{jap,1980-1994} \cdot i^{*}$					1.223 (4.11) [2.70]	1.088 (3.23) [2.03]		
DEBT-DEBT$_{US}$		0.011 (1.46) [0.76]		0.006 (0.73) [0.37]		0.010 (1.18) [0.64]		0.001 (0.14) [0.08]
INF-INF$_{US}$		0.042 (1.56) [0.78]		0.029 (1.02) [0.48]		0.041 (1.41) [0.72]		0.029 (0.92) [0.50]
D, Australia	-0.023 (6.72) [4.46]	-0.015 (2.20) [1.06]	-0.025 (7.13) [4.92]	-0.018 (2.62) [1.23]	-0.023 (5.86) [3.98]	-0.016 (2.16) [1.08]	-0.026 (6.28) [4.40]	-0.022 (2.81) [1.64]
D, Belgium	0.008 (4.45) [6.79]	0.006 (0.96) [0.73]	0.008 (4.46) [6.78]	0.008 (1.33) [1.01]	0.008 (4.29) [6.79]	0.007 (1.11) [0.86]	0.008 (4.30) [6.78]	0.011 (1.74) [1.23]
D, Canada	0.010 (4.99) [9.15]	0.013 (3.39) [2.34]	0.010 (5.01) [9.14]	0.012 (3.05) [1.95]	0.010 (4.82) [9.15]	0.013 (3.18) [2.16]	0.010 (4.83) [9.14]	0.013 (3.02) [1.68]
D, France	0.007 (2.53) [2.67]	0.014 (2.85) [1.52]	0.007 (2.54) [2.67]	0.011 (2.25) [1.12]	0.007 (2.44) [2.67]	0.013 (2.61) [1.40]	0.007 (2.44) [2.67]	0.011 (1.96) [1.16]
D, Germany	-0.007 (3.85) [4.82]	-0.0009 (0.22) [0.11]	-0.007 (3.83) [4.80]	-0.003 (0.67) [0.33]	-0.007 (3.72) [4.82]	-0.001 (0.25) [0.13]	-0.007 (3.70) [4.80]	-0.003 (0.71) [0.40]
D, Italy	-0.021 (8.51) [3.91]	-0.019 (4.18) [2.28]	-0.021 (8.14) [3.66]	-0.019 (4.05) [2.19]	-0.020 (7.86) [3.80]	-0.017 (3.55) [2.01]	-0.020 (7.78) [3.70]	-0.017 (3.48) [2.12]
D, Japan	0.002 (0.89) [0.80]	0.006 (1.51) [0.91]	0.0007 (0.29) [0.28]	0.002 (0.51) [0.30]				
D, Netherlands	0.007 (2.96) [1.95]	0.010 (2.49) [1.47]	0.007 (2.97) [1.94]	0.009 (2.22) [1.24]	0.007 (2.86) [1.95]	0.010 (2.36) [1.39]	0.007 (2.86) [1.94]	0.010 (2.25) [1.32]
D, Sweden	0.008 (3.82) [2.62]	0.013 (3.06) [1.69]	0.008 (3.83) [2.61]	0.011 (2.62) [1.36]	0.008 (3.69) [2.62]	0.013 (2.85) [1.58]	0.008 (3.70) [2.61]	0.012 (2.52) [1.38]

D, Switzerland	0.004 (2.16) [2.79]	0.014 (2.49) [1.17]	0.004 (1.97) [2.64]	0.009 (1.58) [0.71]	0.001 (0.47) [0.46]	0.011 (1.65) [0.80]	0.00002 (0.008) [0.008]	0.002 (0.32) [0.19]
D, United Kingdom	0.004 (2.35) [1.31]	0.010 (2.53) [1.02]	0.004 (2.35) [1.31]	0.008 (1.97) [0.76]	0.004 (2.26) [1.31]	0.010 (2.32) [0.96]	0.004 (2.27) [1.31]	0.008 (1.78) [0.90]
$\tau^{w}_{us,1980-1982} \cdot i^{*}$			2.089 (5.85) [5.21]	2.585 (4.23) [3.22]				
$\tau^{w}_{us,1983-1985} \cdot i^{*}$			1.463 (3.70) [3.32]	1.715 (2.19) [3.37]				
$\tau^{w}_{us,1986-1988} \cdot i^{*}$			1.233 (3.56) [2.84]	1.339 (3.26) [2.56]				
$\tau^{w}_{us,1989-1991} \cdot i^{*}$			0.723 (2.55) [1.84]	0.659 (2.17) [1.44]				
$\tau^{w}_{us,1992-1994} \cdot i^{*}$			1.514 (4.06) [2.65]	1.461 (3.66) [2.33]				
$\tau^{w}_{jap,1980-1982} \cdot i^{*}$							2.077 (4.85) [4.38]	3.117 (3.09) [3.16]
$\tau^{w}_{jap,1983-1985} \cdot i^{*}$							1.497 (3.24) [2.82]	1.942 (1.27) [2.17]
$\tau^{w}_{jap,1986-1988} \cdot i^{*}$							1.256 (3.16) [2.58]	1.496 (3.11) [2.93]
$\tau^{w}_{jap,1989-1991} \cdot i^{*}$							0.851 (2.58) [1.97]	0.882 (2.47) [2.32]
$\tau^{w}_{jap,1992-1994} \cdot i^{*}$							1.716 (3.81) [2.67]	1.820 (3.71) [3.44]
$\bar{R}^2$	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.10
N	1826	1742	1826	1742	1646	1562	1646	1562

Note: The dependent variable is the return on the non-U.S. T-bill in excess of covered interest parity ($f_{j,t}$). Absolute t-statistics based on OLS are in parentheses and based on Newey-West (1987) are in square brackets. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom. N is the number of usable observations.

Table 2 - Tax-inclusive covered interest parity for 3-month Treasury bills

	1	2	3	4	5	6	7	8
$\tau^{w}_{us,1980-1994}$	0.334 (0.94) [0.71]	-0.043 (0.11) [0.09]						
$\tau^{w}_{jap,1980-1994}$					0.373 (0.85) [0.64]	0.033 (0.07) [0.05]		
DEBT-DEBT$_{US}$		0.266 (2.85) [2.13]		0.139 (1.44) [1.05]		0.202 (2.13) [1.60]		0.055 (0.53) [0.38]
INF-INF$_{US}$		0.359 (1.16) [0.87]		0.117 (0.35) [0.24]		0.383 (1.16) [0.85]		0.083 (0.23) [0.16]
D, Australia	-0.138 (3.26) [2.52]	-0.033 (0.40) [0.28]	-0.222 (5.07) [3.69]	-0.136 (1.60) [1.06]	-0.141 (2.88) [2.18]	-0.057 (0.64) [0.44]	-0.213 (4.19) [3.08]	-0.176 (1.87) [1.22]
D, Belgium	0.090 (3.98) [8.58]	-0.055 (0.77) [0.77]	0.090 (4.04) [8.57]	0.004 (0.06) [0.06]	0.090 (3.98) [8.58]	-0.005 (0.07) [0.08]	0.090 (4.02) [8.57]	0.061 (0.80) [0.81]
D, Canada	0.086 (3.83) [10.03]	0.087 (1.93) [1.94]	0.086 (3.88) [10.02]	0.077 (1.62) [1.49]	0.086 (3.82) [10.03]	0.102 (2.14) [2.07]	0.086 (3.86) [10.02]	0.088 (1.77) [1.60]
D, France	0.077 (2.53) [2.58]	0.160 (2.88) [2.19]	0.077 (2.56) [2.58]	0.111 (1.90) [1.35]	0.077 (2.52) [2.58]	0.154 (2.69) [1.99]	0.077 (2.55) [2.58]	0.096 (1.56) [1.07]
D, Germany	-0.151 (6.72) [5.57]	-0.081 (1.65) [1.21]	-0.150 (6.76) [5.56]	-0.123 (2.33) [1.60]	-0.151 (6.71) [5.57]	-0.084 (1.62) [1.16]	-0.151 (6.74) [5.56]	-0.135 (2.44) [1.63]
D, Italy	-0.130 (4.04) [2.68]	-0.162 (3.04) [2.61]	-0.138 (4.32) [2.85]	-0.164 (2.98) [2.52]	-0.128 (3.99) [2.63]	0.139 (2.50) [2.15]	-0.133 (4.18) [2.75]	-0.139 (2.46) [2.11]
D, Japan	0.122 (2.89) [2.27]	0.161 (2.73) [2.18]	0.037 (0.85) [0.70]	0.051 (0.78) [0.60]				
D, Netherlands	0.115 (4.39) [2.32]	0.115 (2.42) [1.62]	0.115 (4.45) [2.32]	0.105 (2.11) [1.38]	0.115 (4.39) [2.32]	0.129 (2.60) [1.75]	0.115 (4.43) [2.32]	0.116 (2.26) [1.48]
D, Sweden	0.066 (2.72) [2.38]	0.091 (1.90) [1.49]	0.066 (2.75) [2.38]	0.069 (1.35) [1.00]	0.066 (2.71) [2.38]	0.101 (1.99) [1.53]	0.066 (2.74) [2.37]	0.072 (1.36) [0.98]

D, Switzerland	0.158 (5.52) [4.36]	0.317 (4.48) [3.05]	0.116 (3.99) [3.38]	0.191 (2.48) [1.63]	0.138 (2.81) [2.13]	0.292 (3.27) [2.22]	0.067 (1.31) [1.05]	0.112 (1.08) [0.71]
D, United Kingdom	0.033 (1.46) [1.24]	0.089 (1.87) [1.18]	0.033 (1.48) [1.42]	0.053 (1.04) [0.62]	0.033 (1.46) [1.24]	0.090 (1.81) [1.13]	0.033 (1.47) [1.24]	0.046 (0.86) [0.50]
$\tau^{w}_{us,1980-1982}$			2.690 (5.14) [4.39]	2.765 (3.88) [3.14]				
$\tau^{w}_{us,1983-1985}$			1.347 (2.57) [2.35]	0.755 (1.11) [1.12]				
$\tau^{w}_{us,1986-1988}$			1.692 (3.72) [2.95]	1.503 (3.02) [2.47]				
$\tau^{w}_{us,1989-1991}$			0.050 (0.13) [0.10]	-0.134 (0.32) [0.25]				
$\tau^{w}_{us,1992-1994}$			0.121 (0.30) [0.22]	-0.094 (0.21) [0.16]				
$\tau^{w}_{jap,1980-1982}$							2.601 (4.36) [3.69]	2.889 (3.35) [2.64]
$\tau^{w}_{jap,1983-1985}$							1.039 (1.74) [1.49]	0.267 (0.34) [0.30]
$\tau^{w}_{jap,1986-1988}$							1.476 (2.76) [2.21]	1.404 (2.39) [1.96]
$\tau^{w}_{jap,1989-1991}$							0.164 (0.35) [0.27]	0.071 (0.14) [0.11]
$\tau^{w}_{jap,1992-1994}$							0.144 (0.29) [0.21]	0.044 (0.08) [0.06]
$\bar{R}^2$	0.11	0.12	0.13	0.15	0.11	0.11	0.12	0.13
N	1826	1742	1826	1742	1646	1562	1646	1562

Note: The dependent variable is the return on the non-U.S. T-bill in excess of covered interest parity per dollar invested in the foreign country j's asset ($f^{/}_{j,t}$). Absolute t-statistics based on OLS are in parentheses and based on Newey-West (1987) are in square brackets. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom. N is the number of usable observations.

Table 3 - Tax-adjusted closed interest parity for 5-year government bonds

	1	2	3	4	5	6	7	8
$\tau^{w}_{us,1987-1995} \cdot i^{*}$	-0.024 (0.37) [0.16]	0.136 (1.99) [0.75]						
$\tau^{w}_{jap,1987-1995} \cdot i^{*}$					-0.200 (1.93) [0.53]	-0.019 (0.18) [0.06]		
DEBT		0.011 (6.39) [1.89]		0.012 (6.25) [1.83]		0.011 (5.60) [1.84]		0.009 (4.43) [1.50]
D, Belgium	-0.002 (4.91) [2.68]	-0.018 (7.05) [2.08]	-0.002 (4.95) [2.68]	-0.018 (6.87) [2.01]	-0.002 (4.82) [2.68]	-0.016 (6.23) [2.04]	-0.002 (4.90) [2.68]	-0.015 (5.01) [1.69]
D, Canada	-0.004 (7.88) [19.30]	-0.015 (8.34) [2.56]	0.004 (7.94) [19.27]	-0.015 (8.11) [2.45]	-0.004 (7.73) [19.30]	-0.014 (7.46) [2.54]	-0.004 (7.86) [19.28]	-0.013 (6.17) [2.15]
D, Denmark	-0.004 (9.60) [12.93]	-0.012 (9.39) [2.93]	-0.004 (9.68) [12.91]	-0.013 (9.12) [2.80]	-0.004 (9.43) [12.93]	-0.012 (8.48) [2.93]	-0.004 (9.58) [12.92]	-0.011 (7.14) [2.51]
D, France	-0.004 (11.29) [8.34]	-0.010 (10.10) [3.17]	-0.003 (11.38) [8.33]	-0.010 (9.80) [3.02]	-0.004 (11.08) [8.34]	-0.010 (9.15) [3.17]	-0.004 (11.27) [8.33]	-0.009 (7.76) [2.73]
D, Germany	-0.004 (13.60) [8.54]	-0.009 (10.10) [3.24]	-0.003 (13.00) [7.35]	-0.009 (9.62) [3.17]	-0.004 (13.01) [7.29]	-0.009 (9.04) [3.36]	-0.003 (12.82) [7.01]	-0.008 (7.55) [2.93]
D, Italy	0.005 (4.80) [2.07]	-0.011 (4.02) [1.29]	0.003 (2.31) [0.87]	-0.012 (4.34) [1.37]	0.007 (5.42) [1.54]	-0.008 (2.59) [1.15]	0.003 (1.73) [0.55]	-0.008 (2.79) [1.19]
D, Japan	-0.005 (11.01) [6.11]	-0.014 (9.28) [2.93]	-0.005 (10.98) [4.98]	-0.015 (9.33) [2.92]				
D, Netherlands	-0.004 (12.17) [27.23]	-0.013 (9.33) [2.85]	-0.004 (12.27) [27.19]	-0.014 (9.03) [2.72]	-0.004 (11.95) [27.23]	-0.013 (8.39) [2.84]	-0.004 (12.15) [27.20]	-0.012 (7.00) [2.43]
D, Spain	-0.003 (1.59) [0.69]	-0.014 (5.62) [2.10]	-0.007 (2.81) [1.03]	-0.015 (5.64) [1.94]	-0.001 (1.14) [0.33]	-0.010 (5.09) [2.55]	-0.005 (3.65) [1.17]	-0.011 (5.69) [2.57]
D, Sweden	-0.008 (20.68) [13.12]	-0.017 (11.82) [3.66]	-0.008 (20.84) [13.10]	-0.017 (11.40) [3.46]	-0.008 (20.29) [13.12]	-0.016 (10.74) [3.68]	-0.008 (20.63) [13.10]	-0.015 (9.14) [3.17]

D, Switzerland	-0.008 (24.54) [4.15]	-0.010 (21.16) [5.06]	-0.008 (23.71) [4.49]	-0.010 (21.01) [5.29]	-0.007 (11.51) [2.67]	-0.010 (12.60) [4.61]	-0.008 (12.14) [3.80]	-0.010 (12.80) [5.36]
D, United Kingdom	-0.005 (19.77) [5.07]	-0.010 (12.45) [3.53]	-0.005 (19.92) [5.07]	-0.010 (12.02) [3.38]	-0.005 (19.40) [5.07]	-0.010 (11.36) [3.48]	-0.005 (19.73) [5.07]	-0.009 (9.74) [3.07]
D, United States					-0.010 (33.10) [12.82]	-0.016 (13.86) [4.73]	-0.010 (33.65) [12.80]	-0.016 (11.96) [4.20]
$\tau^{w}_{us,1987-1989} \cdot i^{*}$			-0.386 (3.02) [1.33]	-0.234 (1.84) [1.07]				
$\tau^{w}_{Us,1990-1992} \cdot i^{*}$			0.090 (1.18) [0.42]	0.173 (2.30) [0.83]				
$\tau^{w}_{us,1993-1995} \cdot i^{*}$			0.122 (1.35) [0.50]	0.144 (1.63) [0.55]				
$\tau^{w}_{jap,1987-1989} \cdot i^{*}$							-0.405 (2.99) [1.01]	-0.310 (2.29) [0.86]
$\tau^{w}_{jap,1990-1992} \cdot i^{*}$							0.073 (0.63) [0.18]	0.130 (1.13) [0.33]
$\tau^{w}_{jap,1993-1995} \cdot i^{*}$							0.222 (1.59) [0.53]	0.175 (1.26) [0.40]
$\bar{R}^2$	0.78	0.79	0.79	0.80	0.81	0.83	0.83	0.83
N	779	779	779	779	787	787	787	787

Note: The dependent variable is the return on the 5-year benchmark government bond index in excess of the swap rate ($g_{j,t}$). Absolute t-statistics based on OLS are in parentheses and based on Newey-West (1987) are in square brackets. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom. N is the number of usable observations.

Table 4 - Tax-inclusive closed interest parity for 5-year government bonds

	1	2	3	4	5	6	7	8
$\tau^{w}_{us,1987-1995}$	-0.003 (0.02) [0.04]	-0.017 (0.10) [0.20]						
$\tau^{w}_{jap,1987-1995}$					-0.003 (0.02) [0.04]	0.019 (0.11) [0.20]		
DEBT		-0.024 (0.92) [0.25]		-0.025 (0.82) [0.30]		0.039 (1.51) [0.45]		-0.073 (2.66) (1.05)
D, Belgium	-0.027 (4.83) [2.66]	0.006 (0.16) [0.05]	-0.027 (5.01) [2.65]	0.007 (0.17) [0.06]	-0.027 (5.22) [2.66]	-0.082 (2.24) [0.67]	-0.027 (5.74) [2.65]	0.073 (1.92) [0.75]
D, Canada	-0.052 (6.89) [13.43]	-0.029 (1.11) [0.32]	-0.052 (7.16) [13.41]	-0.029 (0.96) [0.36]	-0.052 (7.45) [13.43]	-0.090 (3.48) [1.08]	-0.052 (8.20) [13.41]	0.017 (0.64) [0.26]
D, Denmark	-0.060 (8.41) [15.35]	-0.043 (2.22) [0.65]	-0.060 (8.74) [15.33]	-0.043 (1.96) [0.74]	-0.060 (9.09) [15.35]	-0.087 (4.56) [1.44]	-0.060 (10.01) [15.33]	-0.010 (0.50) [0.20]
D, France	-0.055 (9.72) [14.04]	-0.043 (2.83) [0.83]	-0.055 (10.09) [14.02]	-0.042 (2.51) [0.94]	-0.055 (10.50) [14.04]	-0.076 (5.17) [1.64]	-0.055 (11.56) [14.02]	-0.017 (1.11) [0.45]
D, Germany	-0.053 (12.59) [6.36]	-0.042 (3.05) [0.89]	-0.053 (13.07) [6.36]	-0.041 (2.69) [1.04]	-0.053 (13.61) [6.36]	-0.073 (5.45) [1.76]	-0.053 (14.97) [6.36]	-0.018 (1.27) [0.55]
D, Italy	0.038 (1.65) [3.78]	0.068 (1.70) [0.57]	-0.094 (3.32) [1.31]	-0.065 (1.46) [0.46]	0.038 (2.19) [4.56]	-0.010 (0.29) [0.10]	-0.065 (3.65) [3.11]	0.021 (0.57) [0.26]
D, Japan	-0.124 (6.76) [5.41]	-0.104 (3.68) [1.31]	-0.225 (10.13) [3.39]	-0.206 (6.50) [2.01]				
D, Netherlands	-0.065 (11.45) [25.74]	-0.046 (2.19) [0.61]	-0.065 (11.89) [25.71]	-0.046 (1.91) [0.70]	-0.065 (12.37) [25.74]	-0.095 (4.59) [1.41]	-0.065 (13.62) [25.71]	-0.009 (0.40) [0.16]
D, Spain	-0.031 (0.70) [1.48]	-0.014 (0.28) [0.19]	-0.295 (5.30) [2.04]	-0.281 (4.85) [1.67]	-0.032 (1.86) [3.62]	-0.057 (2.38) [1.04]	-0.134 (7.55) [6.16]	-0.090 (3.77) [2.17]
D, Sweden	-0.087 (14.21) [15.41]	0.068 (3.16) [0.91]	-0.087 (14.76) [15.39]	-0.067 (2.78) [1.05]	-0.087 (15.36) [15.41]	-0.117 (5.58) [1.75]	-0.087 (16.91) [15.40]	-0.030 (1.36) [0.55]

D, Switzerland	-0.152 (15.42) [4.63]	-0.147 (13.12) [3.78]	-0.192 (17.65) [6.04]	-0.187 (15.49) [4.75]	-0.152 (8.99) [4.52]	-0.161 (8.99) [4.19]	-0.226 (13.65) [19.46]	-0.212 (12.19) [15.10]
D, United King-dom	-0.055 (13.34) [8.33]	-0.044 (3.61) [1.02]	-0.055 (13.86) [8.32]	-0.044 (3.19) [1.16]	-0.055 (14.42) [8.33]	-0.072 (6.01) [1.80]	-0.055 (15.87) [8.32]	-0.023 (1.84) [0.69]
D, United States					-0.149 (34.96) [10.86]	-0.173 (10.57) [3.28]	-0.149 (38.48) [10.99]	-0.105 (6.13) [2.67]
$\tau^{w}_{us,1987-1989}$			-0.003 (0.02) [0.04]	-0.018 (0.10) [0.23]				
$\tau^{w}_{us,1990-1992}$			1.098 (4.94) [2.02]	1.092 (4.91) [1.97]				
$\tau^{w}_{us,1993-1995}$			1.017 (4.58) [1.69]	1.029 (4.62) [1.75]				
$\tau^{w}_{jap,1987-1989}$							-0.003 (0.23) [0.04]	-0.045 (0.30) [0.76]
$\tau^{w}_{jap,1990-1992}$							0.859 (4.97) [3.65]	0.809 (4.67) [3.77]
$\tau^{w}_{jap,1993-1995}$							1.118 (6.47) [5.30]	1.148 (6.65) [5.51]
$\bar{R}^2$	0.79	0.79	0.80	0.80	0.83	0.83	0.86	0.86
N	779	779	779	779	787	787	787	787

Note: The dependent variable is the return on the 5-year benchmark government bond index in excess of the swap rate per dollar invested in the foreign country j's asset ($g'_{j,t}$). Absolute t-statistics based on OLS are in parentheses and based on Newey-West (1987) are in square brackets. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom. N is the number of usable observations.

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