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Implications for Cross-Border Investment

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ABSTRACT

The economic significance of the tax on cross-border dividends depends on the limits to dividend arbitrage. In the case of Canadian payments to the U.S. we observe these limits exactly because we see the actual pricing of the dividend-arbitrage transactions. These transactions recover only some withholding, so that Canadian and non-tax U.S. accounts perceive different expected returns from Canadian stocks, where the difference increases with dividend yield. The resulting difference in expected utility of wealth is small but the difference in efficient portfolio weights is potentially large and increasing in yield, and the actual difference between Canadian and U.S. holdings of Canadian stocks is large and increasing in yield. Governments may thus take advantage of robust financial markets to boost domestic governance of domestic firms at a low utility cost, though this may be more preferable for zero-dividend firms, whose governance moves abroad.

How do cross-border dividend taxes affect cross-border investment? We focus on investment across the U.S./Canada border and address this question, which is really two: what tax remains net of dividend arbitrage, and how does this *net* tax affect cross-border investment? Identifying the net tax presents a major empirical challenge, because the usual spot-market data cannot show it. Bid/ask spreads are too large, relative to the potential gains from trade, for such data to show what, if anything, is gained by selling shares cum-dividend and later buying them back. We turn instead to the *lending* market, for which our data show directly the actual pricing of dividend-arbitrage transactions by U.S. investors. We find that arbitrage recovers only some of the tax, which implies a large volume of tax-disadvantaged investment that includes all U.S. retirement money in international-equity mutual funds.

How does this net tax affect U.S. investment in Canada? The net tax is small so it might seem that the effect should be small too, but the robustness of our financial markets suggests otherwise. It is well-known (e.g. Jobson and Korkie, 1980) that efficient portfolio weights are highly sensitive to expected return. Because there is so much error in observations of expected returns, this is usually viewed as a normative problem with the Markowitz (1952, 1959) model, i.e., as a reduction in its ability to tell people how to invest. But we can also view this as a strong *positive prediction* of the model: small differences in expected returns can imply big differences in weights, where the magnification depends on the covariances of the affected assets with everything else. For a given taxed asset our markets offer tens of thousands of alternatives, with many potential sources of commonality in returns, so the magnification is likely to be high.

Because the magnification is an emergent property of wide choices, the usual optimizations over country indices do not capture it. We can see some of it if we *disaggregate* these indices, though for two reasons it is not feasible to see the full effect. We cannot optimize over all assets we observe because their sample covariance matrix will not invert, and even if we had their *true* covariance matrix, the absence of the assets we do *not* observe is likely to understate the effect. That is, the effect of taxing an asset is likely to grow as substitution into other assets grows easier, but removing assets from the problem makes substitution harder. What we *can* do is gauge how the sensitivity *grows* as we move toward the true problem by enlarging the investible universe a little. When we move from optimizing over a U.S. and a Canadian market index to optimizing over 53 sub-portfolios of these stocks, we find that the effect of the tax on U.S. investment in Canadian stocks grows fivefold.

Does this sensitivity of efficient weights translate to sensitivity of actual weights? We take this question to the portfolio weights of Canadian and U.S. institutions. In both the 13f disclosures by major institutions and also the statutory disclosures by mutual funds we find that U.S. weights on Canadian shares decline significantly as dividend yield increases. We do not find this sensitivity in Canadian weights on U.S. shares, which is consistent with the very different structure of retirement investing in Canada.

A potentially useful perspective on these results is that the large effect on holdings of the small tax on dividends could be a policy goal. The withholding tax repatriates governance of domestic firms at the cost of a small reduction of expected utility of wealth. This could be attractive to domestic authorities, though the relation to yield may be unfortunate since zero-dividend firms may be the ones whose voters should be closer.

The rest of the paper is in six sections: Section I covers the relevant background, Section II describes the data, Section III covers dividend arbitrage, Section IV infers portfolio-weight sensitivity from portfolio theory, Section V relates actual portfolio weights to yields, and Section VI summarizes and concludes.

I. Background

This section covers the legislation, literature and theory relevant to our analysis. Because our data cover stocks from Canada and the U.S., we focus primarily on the background relevant to investing across their border.

I.A Overview of Dividend Withholding

Many economies withhold a portion of dividends paid to foreign accounts (see Callaghan and Barry, 2003, for a country listing and a discussion). This tax can depend on the country of the recipient; the tax applied to payments between Canada and the U.S. is 15%. Most economies, including Canada and the U.S., also grant full or nearly-full credits for foreign taxes paid, so this tax is generally of little consequence for taxable accounts. However, non-tax accounts, such as retirement accounts, have no access to the credits so to them the tax is costly. Retirement money in dedicated pension funds can be safe from some withholding because some countries, including Canada and the U.S., allow these funds to apply for exemption. But mutual funds are not eligible for exemption, so the tax is costly to their retirement accounts.[1]

To gauge the potential loss to a disadvantaged investor, consider that the benchmark MSCI World ex USA index paid 35bp more *gross* of withholding than *net* over the recent year,[2] implying ~5% loss of retirement savings over a 30-year career.[3] The largest U.S. international equity mutual fund, the $26B American Funds EuroPacific Growth Fund, reports $53M of dividend withholding for the year ended 3/31/02, indicating about 20bp (i.e. $53M/$26B) of return missed by non-tax accounts. Since retirement savings are 44% of the $358B in such funds (as of 12/31/02),[4] this is not only a large disadvantaged clientele but also nearly half the funds' money.

The disadvantaged clientele appears much smaller in Canada, due to a seemingly unrelated regulation. The regulation is the Foreign Content Rule, by which funds must invest at least 70% domestically to qualify for tax treatment as RSP (Retirement Savings Plan) funds. International RSP funds comply by investing in Canadian government bonds and, with Canadian institutions as counterparties, swapping their returns for returns of foreign firms. This qualifies as domestic investment, even if the counterparties lay off their exposure through offsetting swaps with foreigners. In other words, Canadians' cross-border retirement money lands in derivatives, rather than the spot. The motive is

[1] Withholding also reduces funds' calculated total returns, because these returns include income distributions, which are net of withholding, but do not include the tax credit passed through to taxable accounts.

[2] The MSCI World ex USA *Net* Index returned -15.643% for the year ended 4/30/03, and the *Gross* index returned -15.290%.

[3] That is, the consumer pays 35bp/year on each invested dollar, and the average dollar is invested 15 years.

[4] The Investment Company Institute's 2003 *Mutual Fund Fact Book* reports, for 12/31/02, $358B under management by international equity funds (page 68), of which $158B is retirement accounts (page 56).

not dividend-tax efficiency but as McDonald (2001) and others note, derivatives can work around the tax problem by allowing advantaged investors to hold the spot. This also means, however, that the advantaged investors get the votes, which may not be the efficient allocation of governance.

In addition to taxing outbound payments, some countries credit domestic payments. Canada has a Dividend Tax Credit that lowers the rate that taxable Canadian individual accounts pay on dividends from Canadian firms, so long as they don't hedge their economic exposure.[5] Because of this credit, taxable accounts in Canada may actively prefer dividends to capital gains from their Canadian investments, whereas non-taxable accounts in the U.S. prefer capital gains to dividends. The strength of this preference depends on what they can reclaim of withholding.

I.B Reclaiming Withholding through Arbitrage

The accounts disadvantaged by withholding are non-taxable accounts, so the goal of arbitrage is to move shares either to accounts that would not be withheld, or to taxable accounts that can get the withholding back. Because the IRS requires a 16-day holding period for the foreign tax credit, and disallows it completely when the dividend must be reimbursed (see the instructions for IRS Form 1116), arbitrage by U.S. investors concentrates on the former. The goal is to move shares from another country to investors in that country, and for this movement disadvantaged investors have two principal

[5] In our sample period, 1999 and 2000, dividend income is grossed up by 25% for tax purposes, and the credit is 13.3333% of this amount. Investors with the highest incomes pay a 5% surtax on the resulting tax. For a taxable account with the highest marginal Federal rate of 29%, the effective marginal Federal rate on most income is 30.5% and the effective rate on dividends is 20.6%. See Booth (1987) and Lakonishok and Vermaelen (1983).

options, sale/repurchase and lending. Of these, lending is likely the preferred route, for three reasons. The main reason is that selling shares cum-dividend and buying them back ex-dividend on the open market would involve roundtrip transactions likely to dwarf the tax. For example, if a stock pays a 2% yield in quarterly installments, then the tax on a payment is 15% of 50bp, or 7.5bp, miniscule for a roundtrip transaction. Also, trading out and back in misses a period of exposure to the stock. Finally, for the fund's taxable accounts, selling and buying back realizes capital gains or losses. A given dividend date is unlikely to be the best moment to do this. By contrast, a share *loan* costs little, does not affect exposure to the stock, and is not a taxable event. Therefore, the recovery of withholding tax is revealed by the pricing of record-date equity loans.[6] This pricing is what we observe for the Canadian stocks listed in the U.S.

To learn what disadvantaged investors recover we have to know only what they get for loaning their shares; the complete structure of the arbitrage is not important. However, because regulation makes the arbitrage difficult, it is worth noting how it *could* be structured. Suppose a U.S. mutual fund, call it Taxwise International Fund, has 100,000 shares of TransCanada Pipelines, due to pay C$0.27/share to shareholders of record on 6/30/03. Absent arbitrage, Taxwise will get (0.85)(C$0.27)(100000) = C$22,950 in cash and the remaining C$4,050 as a credit. Here is a structure, represented in Figure 1, by which Taxwise converts the credit into some cash:[7]

[6] For the fiscal year cited above, The EuroPacific fund could not lend due to a fundamental policy against lending (it has since altered this, by shareholder vote, to a non-fundamental policy). The Vanguard International Value Fund *can* lend, and for its fiscal year ended 10/30/02, when it had $1.085B under management, it reports $1.4M withholding, or 13bp, and $1.0M, or 9bp, security-lending revenue.

[7] Market participants tell us this is the popular structure.

- A U.S. arbitrageur shorts 100,000 shares cum-dividend to a Canadian arbitrageur, and repurchases them ex-dividend, borrowing the shares from Taxwise. The U.S. arbitrageur earns market interest on the short-sale proceeds.
- The arbitrageurs enter a swap whereby the Canadian *pays* his price return plus C$22,950, and *gets* market interest on the proceeds minus a discount *D*.
- The U.S. arbitrageur pays C$22,950 to Taxwise as reimbursement for the dividend, and also pays a lending fee *F*.

All put together, Taxwise exchanges the C$4,050 credit for *F* in cash, the U.S. arbitrageur makes *D*-*F*, and the Canadian arbitrageur makes C$4,050-*D*.[8] In our data we see the C$4,050 and the *F*, it's only the sharing *D* between the arbitrageurs we don't see.

This study introduces lending to the empirical literature on dividends (see Elton, Gruber and Blake, 2002, for an overview and bibliography). The literature was historically concerned with trading off dividends and capital gains, for which loans are not useful. More recent studies address cross-border payments, where loans play the role noted here. The theoretical value of lending for arbitrage across the German border is derived by McDonald (2001), but the results of that paper and also those of Dai and Rydqvist (2002), which addresses the Norwegian market, are from spot and derivative markets.

For measuring arbitrage profits there is an important benefit with lending data, relative to spot and derivative data, in the narrow function of loans. Because loans do not transfer economic exposure, they do not incur the bid/ask spreads associated (e.g.

[8] It might seem that Taxwise should just loan directly to the Canadian, but then the Canadian tax authority would oblige the Canadian to withhold from the dividend reimbursement just as TransCanada would withhold from the dividend. The hedge from the swap makes the Canadian ineligible for Canada's dividend tax credit (though the Canadian might evade detection by routing the swap through another party).

Bagehot, 1971) with transferring economic exposure. So even though we do not know whether the lender originated the loan transactions in our database, the pricing of the loans is still representative of what other lenders could have gotten by originating their own transactions. By contrast, with spot and derivative data it would be crucial not to pay the spread, and we would not know whether that was possible.

I.C Taxes and Optimal Portfolios

The effect of tax differences on efficient weight differences[9] is the efficient weight vector w_A of advantaged investors, those not paying the tax, minus the efficient weight vector w_D of disadvantaged investors, those paying the tax. To prepare to explore this relation between w_A-w_D to the disadvantaged investors' tax, we derive functional forms from standard results. For tractability and continuity with the literature, we take the Normal/Exponential approach to these optimizations.

Let μ and y be the vectors of expected returns and dividend yields, gross of taxes, of all investible assets, and let Σ be the assets' covariance matrix. Also, let λ be the risk-aversion parameter of all investors, and let τ be the tax that disadvantaged investors pay on dividends. From standard results we get[10]

(1) $$w_A = (1/\lambda)\mu\Sigma^{-1} \qquad \& \qquad w_D=(1/\lambda)(\mu-\tau y)\Sigma^{-1},$$

so that

(2) $$\Delta \equiv w_A - w_D = (1/\lambda)\tau y\Sigma^{-1}.$$

[9] See Black (1974) for a general treatment of the differential-tax problem, and Booth (1987) for a treatment of Canada's Dividend Tax Credit.

[10] This assumes (as in Black, 1974) that the disadvantaged investor *gets* the tax when he shorts, but the advantaged investor does not. This matches what we show above: when a U.S. investor shorts, he pays the market lending fee that we observe, which is net of the effective tax. A Canadian investor must pay the entire tax to the Canadian government if the lender would be withheld, so he does not get the effective tax.

As French and Poterba (1991) note, we can relate weight differences to expected-return differences without taking a stand on expected-return *levels*.

By clearing the market, we can also relate the departure of weights from value weights to the relative sizes of the clienteles. If the aggregate dollars invested by advantaged and disadvantaged investors are A and D, respectively, and if w_{VW} is the vector of the assets' value weights, so that $Aw_A+D(w_A-\Delta)=(A+D)w_{VW}$, we have

(3) $$w_A-w_{VW} = [D/(A+D)]\Delta \qquad \text{and} \qquad w_D-w_{VW} = [-A/(A+D)]\Delta.$$

The larger clientele departs proportionately less from value weights.

We want to learn about the relation between the tax τ and its effect Δ on holdings, but the sample covariance matrix of all assets will not invert. We cannot evade this fact by assuming some amount of asset-specific risk (e.g. by assuming a particular factor structure, or by shrinking toward a diagonal matrix); the true amount of asset-specific risk is the key quantity here, so this would amount to assuming the result.[11] What we *can* do is observe how the effect of the tax grows as the list of assets grows, while keeping the number of assets small relative to the number of observations of their returns. From this we can observe whether the true effect departs significantly from the country-index case already solved elsewhere.

I.D Empirical Results on Cross-Border Investment

Most of the studies on cross-border investment (see Lewis, 1999, for a review) are about aggregate country weights, i.e., the weights of countries in the equity holdings of

[11] Note that there could be thousands of factors relevant to covariation, such as commonalities in firms' inputs, suppliers, products, customers, lenders, retailers, strategies, locations, hedges, consultants, etc., but only a few *pervasive* factors relevant to discounting.

countries. When French and Poterba (1991) model investors as allocating across country indices, they find that the expected-return difference that rationalizes the observed weights is large, much larger than withholding taxes. We are not attempting to rationalize the entire home bias (which, judging from the Baby-Bell bias in Huberman, 2001, may be impossible) but since the tax effect could be much stronger than country-index allocations predict, it is an important question how much home bias the tax induces, and since the tax operates through dividend yield we can find out by relating the cross section of home bias to the cross section of dividend yield.

The closest antecedent to this part of our work is the analysis in Dahlquist and Robertsson (2001), which shows non-Swedish ownership of Swedish stocks to decrease as dividend yield increases. The authors conjecture that the tradeoff between capital gains and dividends outside of Sweden may be responsible, but Callaghan and Barry (2003) report a 15% Swedish withholding tax, so that too may be responsible. There is also evidence on the cross-sectional determinants of holdings in Kang and Stulz (1997), which covers Japanese equities, but the explanatory variables do not include yield.

The data of this paper cover U.S.-listed stocks. This allows us to disaggregate some of the investment across the U.S./Canadian border because a number of Canadian firms list on U.S. exchanges, not as ADRs but as the same security trading in Canada (see Eun and Sabherwal, 2003). This is not a comprehensive list of Canadian firms but it has the advantage over the Swedish study of eliminating the influence of cross-border trading frictions for U.S. investors. That is, these are all stocks that U.S. investors can trade interchangably with their domestic stocks. Another advantage of our data is that it is *all* institutional investors, so when we compare foreign to domestic ownership we are comparing institutions to institutions, rather than institutions to consumers, which Dahlquist and Robertsson (2001) ultimately conclude is the difference driving their results.

II. Data

We combine the standard databases of the prices, dividends and institutional holdings of U.S.-listed stocks with a proprietary database of loans of these stocks.

The proprietary database, which Geczy, Musto and Reed (2002) (GMR) describe in detail, reports the pricing of all loans of U.S.-listed equities from November 1998 to October 1999 by one of the world's most active lenders. This lender is a large custodian bank, lending as agent for its custodial clients. Because U.S. exchanges list some Canadian stocks, 102 listings by the end of our sample period, this database shows us the terms at which U.S. investors can loan Canadian shares on their record dates, provided at least one of the custodial clients loaned that stock on that date. From these lending terms we calculate specialness using the methodology of GMR,[12] and from specialness we calculate the lender's revenue.

Stock price and dividend information is from the CRSP data, in U.S. dollars. Institutional stock holdings come from two databases compiled by Thomson Financial. The 13f database includes both U.S. and Canadian institutions, and shows the holdings of all U.S.-listed stocks by institutions that hold at least $100M worth, and that do some business in the U.S. We use the 13f data for 12/31/2000; the SEC's *Official List of 13f Securities* for 12/31/2000 lists the stocks that institutions had to disclose. The Mutual

[12] In GMR, the specialness of a cash-collateral loan is the loan's rebate subtracted from the GC rate, the specialness of a non-cash-collateral loan is the lending fee minus 20bp, and the specialness of a stock on a given day is the value-weighted average specialness of loans of that stock that day.

Fund database includes both U.S. and Canadian mutual funds; we use the most recent disclosures as of 12/31/2000. The holdings data cover spot but not derivative holdings, so the U.S. holdings of general-purpose, but not RSP, Canadian funds are represented.

III. Dividend Arbitrage Pricing

In this section we learn from the loan-pricing data what disadvantaged investors reclaim. We find all the times our data provider loaned Canadian shares on their dividend record dates, and then relate the lending revenue to the dividend. To establish this relation we run a simple regression to separate the fixed and variable components.

We first identify all record dates of U.S.-listed Canadian stocks with observable loan pricing. Loan pricing is observable if our data provider loans the stock that day in sufficient size (there must be at least one "Medium"-sized loan; see GMR). There are 34 such record dates, so these 34 observations are the sample for this section. For observation i there are four relevant statistics: from the lending data, the specialness S_i (expressed as an annual percentage) and the number n_i of calendar days of a record-date loan (i.e. 3 for Friday record dates, and usually 1 otherwise), and from the CRSP data the dividend D_i (gross of withholding) and stock price P_i as of the day before the record date. Borrowers provide cash collateral equal to 102% of the securities' value as of the previous day's close, so the specialness cost, and therefore the lending revenue, per dollar value of securities borrowed is $1.02(S_i/100)(n_i/360) \equiv C_i$, and the dividend per dollar value of securities borrowed is $D_i/P_i \equiv Y_i$. If $C_i = 0.15Y_i$ then disadvantaged investors recover their entire disadvantage, but if C_i is lower then the shortfall is their effective tax. The 34 pairs (Y_i, C_i) are plotted in Figure 2.

In Figure 2, lending revenue is always below 15% of the dividend yield, so the lender never recovers all of withholding.[13] The average of C_i/Y_i is 3.8%, so on average about a fourth of the tax is recovered. To decompose this recovery into its fixed and variable components, as McDonald (2001) does for ex-day price drops, we regress recovery on yield (in basis points; standard errors in parentheses):

$C_i =$	-2.9	$+ 0.1026 YLD_i$	R^2=53.8%
	(0.95)	(0.017)	N(obs)=34

The intercept is significantly negative and the slope is significantly less than 15%. So the economic interpretation is that, for each dividend, the disadvantaged investor pays the arbitrageur a transactions cost, 3bp at the point estimate, and gets a fraction, 10/15 at the point estimate, of the withholding back as cash. Therefore, both the frequency and size of dividends penalize the disadvantaged investor, at approximately these magnitudes.

Our lending data show us the effective dividend tax on disadvantaged investors, which the next sections relate to the portfolio-choice problem. As an aside, it is worth noting that our results show some of the arbitrage rents accruing to capital. It might seem that lenders should get all the rents, since disadvantaged investors with shares might seem much scarcer than advantaged investors with cash, but the market clears in between. It may be that only a few advantaged investors have spare cash in the necessary quantity (n.b. the loan values we observe are typically millions of dollars). There may also be a peso problem of the sort proposed by Dai and Rydqvist (2002): arbitrageurs may need compensation for the possibility of an adverse ex-post tax ruling on the structure (which has not occurred).

[13] This also suggests that the arbitrageurs do not have access to Canada's Dividend Tax Credit because if they did, the arbitrage surplus to share would be greater than 15% of the dividend.

IV. Implications for Efficient Investment

Can the net tax have a significant effect on efficient investment? As equation (2) demonstrates, it depends on the covariance matrix. For any tax there is a Σ that delivers a big effect, so the important question is the effect of the Σ that investors actually face. We cannot observe this Σ but we *can* observe, with reasonable precision, the Σ of a small subset of available investments. The substitution among limited choices is likely to underestimate the actual substitution so this small-subset approach serves primarily as a lower bound. The investments we use are portfolios of the Canadian and U.S. stocks that trade in the U.S. To allow us to relate the effect to dividend yield we group the Canadian stocks by yield, and to provide a diversity of substitution opportunities we group the U.S. stocks by industry. We keep the number of portfolios small relative to the number of observations of their returns, and we represent the uncertainty due to sampling error by generating confidence intervals through bootstrapping. To gauge the significance of expanding the investor's substitution possibilities beyond one index per country, we also calculate one index per country and repeat the exercise using just these two assets.

IV.A Sample Construction and Estimation

We begin by identifying all U.S. and Canadian stocks trading in the U.S. from 12/31/97 to 12/31/00.[14] The dividend yield of each stock is calculated to be its 2001 dividends divided by its 12/31/00 price. The Canadian stocks are grouped by yield y into five portfolios: y=0, 0<y≤1%, 1%<y≤2%, 2%<y≤3%, and 3%<y. The U.S. stocks are grouped by SIC code into the 48 portfolios of Fama and French (1997). Portfolio returns

[14] We use three years because we want stocks with complete data for the sample period; the number of such stocks drops off rapidly as we move the start date back from 12/97.

are value-weighted daily returns and portfolio dividend yields are value-weighted dividend yields, where the value weights use market capitalizations as of 12/31/00.[15] Therefore, we have 53 assets and 753 observations of their returns. The sample covariance matrix of these observations is $\boldsymbol{\Sigma}_{53}$, and the dividend-yield vector $\boldsymbol{y}_{53}$ is 0 for the U.S. portfolios and the dividend yield of the Canadian portfolios. We also calculate from the same underlying stocks one value-weighted index for each country, and define $\boldsymbol{\Sigma}_2$ to be the sample covariance matrix of these two indices, and $\boldsymbol{y}_2$ to be 0 for the U.S. index and the dividend yield of the Canadian index. Finally, following Pastor and Stambaugh (2002) we use the value 2.75 for λ.

IV.B Effect of the tax

We want to know, what effect does a given tax on Canadian dividends have on the difference between the investments of those who do and do not pay it? For a given tax rate τ we define $\boldsymbol{\Delta}_{53}(\tau) \equiv (1/\lambda)\tau \boldsymbol{y}_{53}(\boldsymbol{\Sigma}_{53})^{-1}$ and $\boldsymbol{\Delta}_2(\tau) \equiv (1/\lambda)\tau \boldsymbol{y}_2(\boldsymbol{\Sigma}_2)^{-1}$, i.e., the advantaged investors' weights minus the disadvantaged investors' weights in the 53- and 2-asset cases, respectively, when the disadvantaged investors pay τ. To summarize the effect on investment in Canada we define $\delta_{53}(\tau)$ to be the sum of $\boldsymbol{\Delta}_{53}(\tau)$ over the five Canadian portfolios, and $\delta_2(\tau)$ to be Canadian-index element of $\boldsymbol{\Delta}_2(\tau)$, so that $\delta_{53}(\tau)$ is how much more the advantaged investor allocates to Canada, compared to the disadvantaged investor, when the tax rate is τ and the investment universe is the 53 portfolios, and $\delta_2(\tau)$ is analogous.

[15] We use static end-of-period weights because we want the covariances of the portfolios the investor is choosing between, which have those weights, and because (since we do not reference average returns) it does not matter that this imparts an upward bias to sample-period portfolio returns.

We calculate $\delta_{53}(\tau)$ and $\delta_2(\tau)$ for values of τ ranging from 0 to 15%, representing the full range of possible effective tax rates. These are the solid lines in Figure 3. The lighter dashed lines on Figure 3 are confidence intervals generated by bootstrapping, following Efron and Tibshirani (1993).[16] What we find is that the effect of the tax is much larger, five times larger at the point estimate, when we disaggregate the market indices into the portfolios, and that this difference is far outside the confidence intervals. At the full 15% tax rate the advantaged investors weight Canada 8% more, and at 5% it is 3% more. If we take Canada and the U.S. to be the entire market for these assets, then from equation (3) we can infer from the relative sizes of the economies that Canadians overweight their domestic stocks, relative to value weights, by about 90% of the weight difference, and U.S. investors underweight by the remaining 10%.

Even at the weak access to investment substitutes that we impose, the small tax moves a significant amount of ownership of domestic firms back home. This could be attractive to the domestic government, and could motivate charging the tax in the first place, but it is potentially significant that the movement is negative in dividend yield. Canada's zero-dividend stocks are not taxed, so for them ownership moves abroad, especially because they become the low-cost exposure to Canada. Looking closer at our results we find that the weight in $\mathbf{\Delta_{53}}(\tau)$ on the *low*-dividend Canadian portfolios, $y=0$ and $0<y\leq 1\%$, moves *down* 4% as τ goes to 15%, while the weight on the other Canadian portfolios moves up 12%. Because firms that distribute less are likely to need more governance by owners, and because foreign owners are likely to provide less governance, this inverse relation could be undesirable.

[16] We sample with replacement returns on the U.S. industry and Canadian stock portfolios in the sample 1,000 times, recomputing $\mathbf{\Sigma_{53}}$ and $\mathbf{\Sigma_2}$, and from them $\delta_{53}(\tau)$ and $\delta_2(\tau)$ for each τ. The solid lines show the average over the iterations, and the dashed lines show the 5% and 95% values from the empirical cdfs.

This results of this section show that the cross-border tax can put significant distance between the portfolios of advantaged and disadvantaged investors, where the distance increases with dividend yield. We cannot observe the full theoretical effect but we can observe the *actual* effect in the realized portfolio weights of institutional investors in the U.S. and Canada. This is the task of the next section.

V. Evidence from Holdings

Our data show Canadian and U.S. holdings of Canadian and U.S. stocks; the empirical question is how the difference between these holdings depends on dividend yield. For holdings of Canadian stocks, the results above predict a strong dependence. There is a large disadvantaged U.S. clientele that loses a portion of dividends, even after arbitrage, and this portion can significantly affect portfolio weights. Also, no U.S. investor gets the Dividend Tax Credit that taxable Canadian individual accounts get. For holdings of U.S. stocks, the dependence is likely to be much weaker because there is not a large disadvantaged Canadian clientele holding foreign stocks, due to the RSP structure, and because there is no Dividend Tax Credit in the U.S. We first address institutional holdings in general, as represented by 13f filings, and then we address mutual-fund holdings in particular.

The 13f data cover the same stocks as above, i.e., U.S. and non-U.S. stocks trading in the U.S, and include both U.S. and non-U.S. institutions, including several from Canada. Thus for institutional investors we can calculate the Δ of the previous section as the difference, for each U.S. listed stock, between the stock's weight in the aggregate Canadian portfolio and its weight in the aggregate U.S. portfolio.

We have 13f data as of 12/31/00 for 1149 U.S. and 12 Canadian institutions. For every U.S. and Canadian stock *i* on the *Official List of 13f Securities* published by the SEC we calculate its value weight $US13F_i$ in the aggregate portfolio of the U.S. institutions, its value weight $CDN13F_i$ in the aggregate portfolio of the Canadian institutions, and its value weight VW_i in this universe. Stock *i*'s dividend yield y_i is defined as above, and CDN_i is 1 if stock *i* is Canadian, and 0 otherwise. To test whether U.S. investors, compared to Canadian investors, are relatively averse to Canadian dividends, we first regress $CDN13F_i$-$US13F_i$ on CDN_i, y_i and CDN_i*y_i. The virtue of this regression model is that CDN_i picks up non-dividend sources of home bias and y_i picks up dividend preference across stocks in general, leaving the interaction term to pick up the preference for Canadian dividends in particular. The regression result is in the first row of Table I, Panel A.

The coefficient on the interaction term is strong in the predicted direction. Relative to U.S. institutions' weights, Canadian institutions' weights on Canadian stocks increase significantly with dividend yield. By contrast, *y* does *not* enter significantly, indicating no U.S. vs. Canadian difference in the preference for U.S. dividends. The regression also shows, with the significant loading on *CDN*, home bias not driven by dividend yield.

How do the separate U.S. and Canadian investment decisions contribute to the weight difference? Since the Canadian economy is smaller, equation (3) suggests that the Canadian contribution is larger. We address the question by decomposing $CDN13F_i$-$US13F_i$ into $CDN13F_i$-VW_i and $US13F_i$-VW_i, and then repeating the regression with

$CDN13F_i$-$US13F_i$ replaced by $CDN13F_i$-VW_i and $US13F_i$-VW_i. Results are in the second and third rows, respectively, of Table 1, Panel A.

The coefficients on *CDN*y* show Canadian portfolio weights tilting towards Canadian dividends at ten times the rate that U.S. weights tilt away, consistent with the relative sizes of the economies. Neither the U.S. nor the Canadian holdings turn out to be sensitive to the yields of U.S. stocks.

It is worth repeating these tests on mutual-fund holdings in particular, because that is where the disadvantage of U.S. retirement money in mutual funds should be most apparent. Also, because Canadian retirement money in mutual funds is not represented, due to the RSP structure, the represented Canadian mutual-fund accounts are generally taxable, and therefore generally eligible for the Dividend Tax Credit. As before, we calculate the aggregate portfolios of U.S. and Canadian funds and define $USMF_i$ and $CDNMF_i$ to be the weight of stock *i* in the U.S. and Canadian portfolios, respectively. We then repeat the regressions of Table 1, Panel A, with *US13F* and *CDN13F* replaced by *USMF* and *CDNMF*, respectively. What we find, reported in Table 1, Panel B, is that the sensitivity of mutual fund holdings to Canadian dividends is in fact higher than the sensitivity of institutional holdings in general. Again, there is no sensitivity to U.S. dividends.

What do these results imply for firm ownership? That is, how does U.S. ownership of Canadian firms change as the firms' dividend yields increase? We can answer by first adding up for each firm the shares owned by U.S. institutions and the shares owned by Canadian institutions (as shown on 13f), and dividing by the firms' shares outstanding, then sorting firms into dividend-yield buckets, and then averaging across firms within buckets. The result is presented as Figure 4.

U.S. ownership shrinks substantially as yield increases. The U.S. ownership is over six times higher for zero-dividend firms, and less than two times higher for the high-dividend firms. While ownership figures from 13f filings are not exhaustive, particularly for Canadian investors, these results are strong evidence that the dividend tax significantly concentrates ownership of higher-dividend Canadian firms in Canada.

VI. Summary and Conclusion

Cross-border taxation impedes cross-border investment, but the effect of this impediment depends on how well investors can work around it. Working around it means dealing with dividends efficiently when they arrive, and also adapting to dividends in the first place when choosing what to buy. We focus on the U.S./Canada border and we make three points. First, by looking directly at the efficient transaction for disadvantaged investors, we establish that these investors can reclaim some, but not all, of the tax, so they suffer a modest penalty when their cross-border investments pay dividends. Second, by disaggregating the U.S. and Canadian markets into a few portfolios, we show that the effect of dividend taxes on efficient portfolio weights is much larger than it appears to be when the markets are not disaggregated. Finally, U.S. investors avoid Canadian dividends, at a rate with strong implications for the foreign ownership of Canadian firms, but Canadian investors do not avoid U.S. dividends.

One perspective on these results is that a small dividend tax can have a small wealth effect, but a large effect on who owns which securities. In particular, a foreignerspecific tax may have only a modest effect on the wealth of domestic and foreign citizens, and on the cost of capital, and yet significantly boost the domestic ownership of higher-dividend domestic corporations. This could be inadvertent, in that governments could prefer *no* effect of withholding on net returns, but it could instead be a policy goal. The correlation of the effect with dividend yield may be unfortunate but it also may be unavoidable, if foreigners are to be taxed; the other source of return, capital gains, is much harder to tax from over the border.

Another perspective is that when Harry Markowitz invented portfolio theory, he offered it as both advice and prediction, and this paper is about the prediction. The prediction is not about risk-required expected returns, it is about portfolios. The comparative statics of the model depend on parameters that are observed only partially, but we see enough to predict, and then confirm, that this small tax has a big effect in an interesting direction. Further exploration of these comparative statics is a promising area for future work. Of particular current interest is the potential effect on governance of U.S. firms of reducing U.S. taxation of their dividends to rates far below what cross-border taxable accounts pay. Another sort of exploration is in the other direction, i.e., to infer the covariance of assets not just from sample returns, but also from the effect of expected-return differences on investment differences.

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Table I
Canadian and U.S. Institutional Portfolio Weights Related to Dividend Yields

VW_i is the value weight of stock *i* among all U.S.-listed stocks. From the 13f filings for 12/31/00 we calculate the aggregate portfolio of all reporting U.S. institutions, and the aggregate portfolio of all reporting Canadian institutions; $US13F_i$ is the weight of stock *i* in the former, and $CDN13F_i$ is its weight in the latter. From mutual funds' most recent portfolio disclosures as of 12/31/00 we calculate the analogous statistics $USMF_i$ and $CDNMF_i$. The dividend yield of stock *i*, y_i, is its 2001 dividends divided by its 12/31/00 price. CDN_i is 1 if stock *i* is Canadian, and 0 otherwise. The table reports coefficients and t-statistics from regressions where the independent variables are CDN_i, y_i and CDN_i*y_i, and the dependent variables are as indicated.

Panel A: All Institutional Investors (13f Data)

Dep. Variable	Intercept	CDN_i	y_i	CDN_i*y_i
$CDN13F_i$-$US13F_i$	-0.00002	0.00082	0.00012	0.0977
	(*-4.01*)	(*14.9*)	(*0.65*)	(*25.0*)
$CDN13F_i$-VW_i	-0.00002	0.00077	0.00001	0.08933
	(*-4.11*)	(*13.7*)	(*0.07*)	(*22.3*)
$US13F_i$-VW_i	-0.000001	-0.00005	-0.00011	-0.00837
	(*-0.44*)	(*-2.13*)	(*-1.33*)	(*-4.94*)

Panel B: Mutual Funds Only (CDA/Spectrum Data)

Dep. Variable	Intercept	CDN_i	y_i	CDN_i*y_i
$CDNMF_i$-$USMF_i$	-0.00009	0.00173	0.00013	0.25001
	(*-7.23*)	(*14.5*)	(*0.26*)	(*29.3*)
$CDNMF_i$-VW_i	-0.0001	0.001719	-0.00017	0.2427
	(*-6.71*)	(*13.4*)	(*-0.32*)	(*26.5*)
$USMF_i$-VW_i	-0.0000	-0.00002	-0.00029	-0.00731
	(*-0.00*)	(*-0.36*)	(*-1.68*)	(*-2.38*)

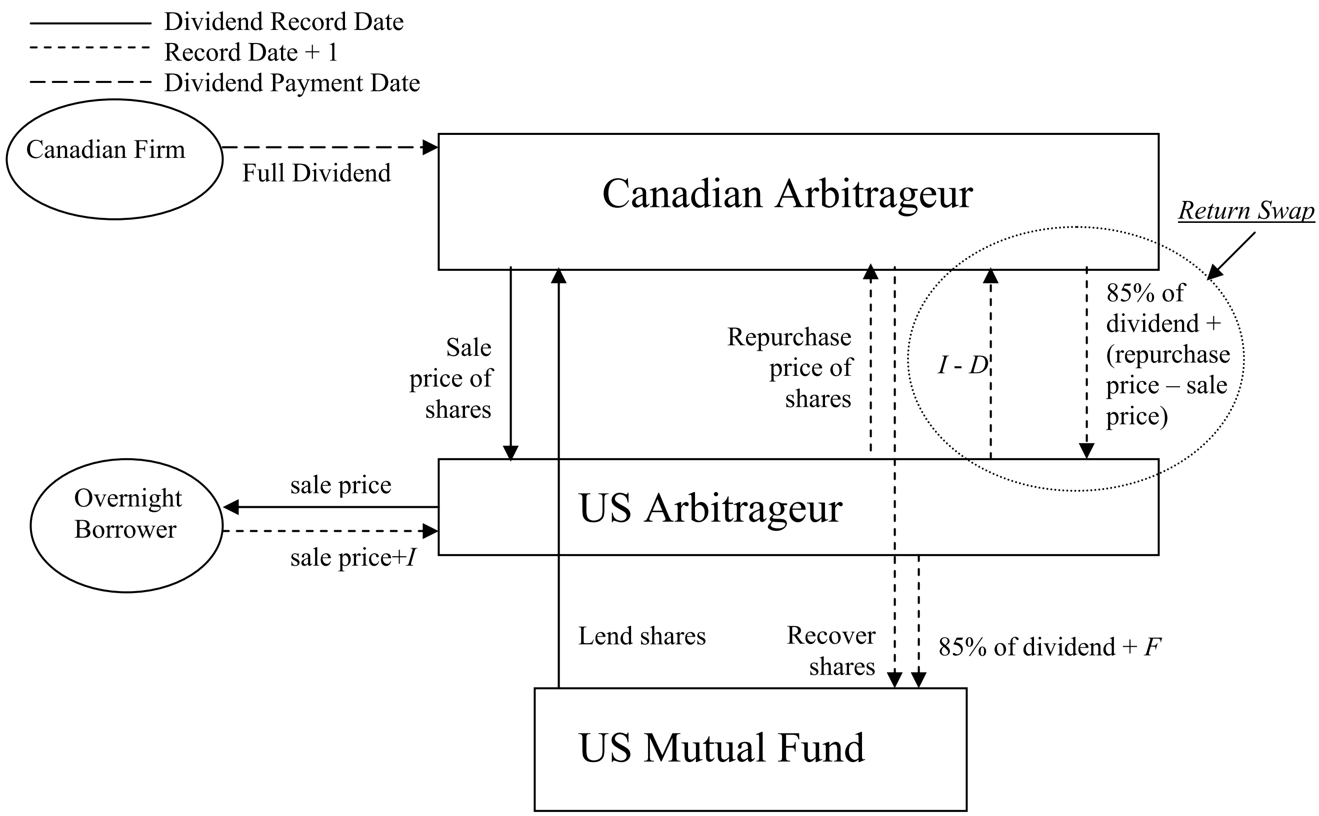

Figure 1. Structure of Withholding-Tax Arbitrage Between U.S. and Canada.

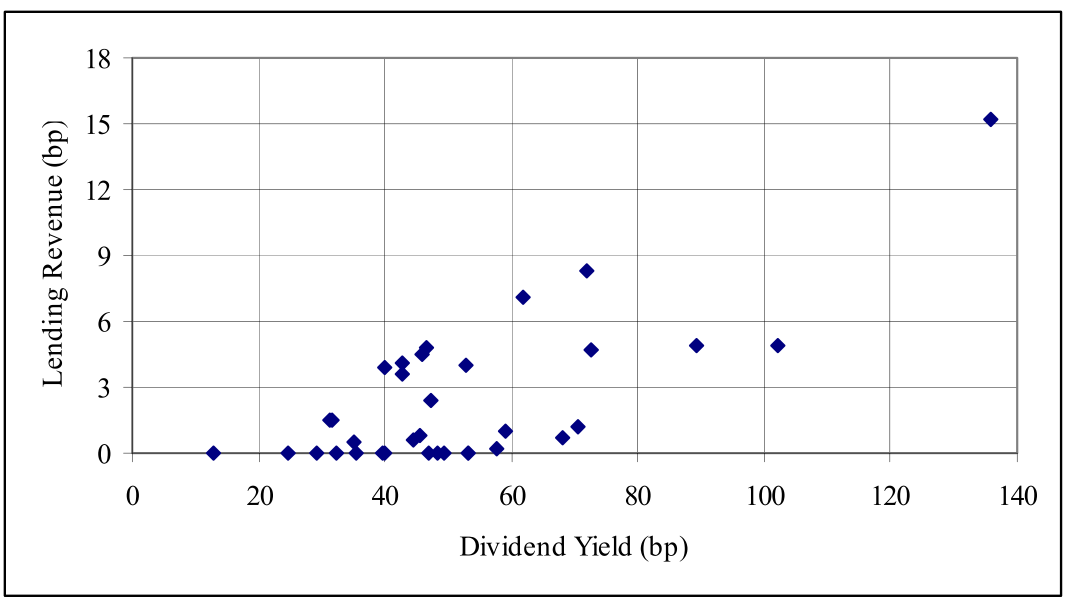

Figure 2: Lending Revenue v. Dividend Yield. For each record date, the dividend yield Y_i is on the horizontal axis and the lending revenue C_i is on the vertical axis.

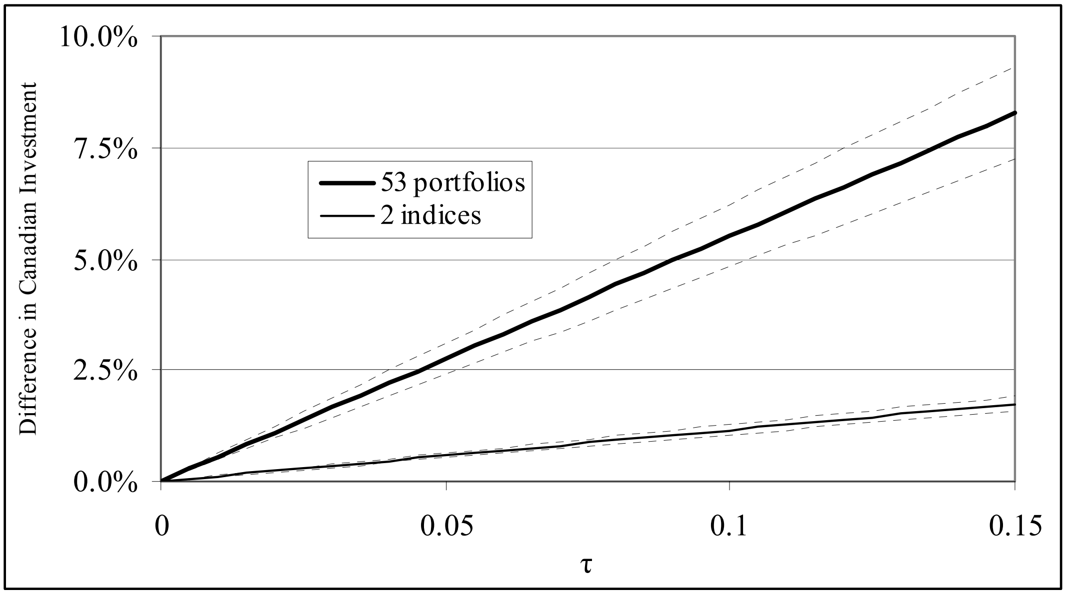

Figure 3: Effect of Tax on Canadian Investment, With and Without Disaggregation. For values of the net tax τ from 0 to 15%, the solid lines show $\delta_{53}(\tau)$ and $\delta_2(\tau)$, i.e., the advantaged investor's weight on Canada minus the disadvantaged investor's weight. The dashed lines show 5% and 95% confidence-interval bands generated by bootstrapping.

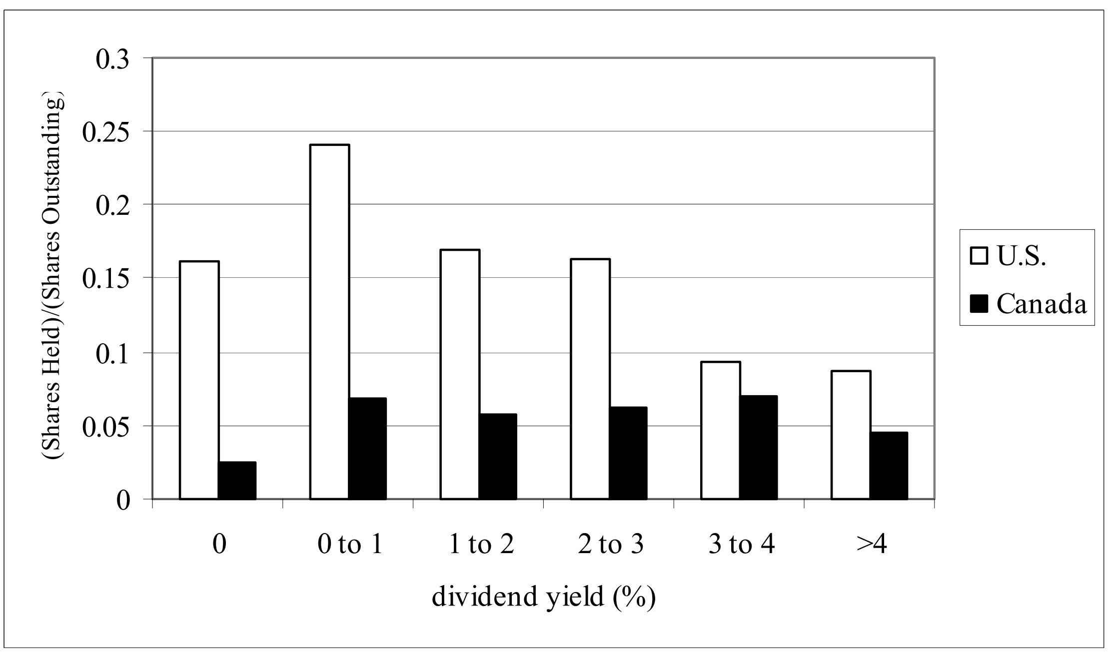

Figure 4: Fraction of Canadian Firms Held by Canadian and U.S. Institutions, Sorted by Dividend Yield. Holdings are as of 12/31/00, as reported to the SEC on form 13f.

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