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INSTITUTIONAL INVESTOR OWNERSHIP AND TAX-INDUCED TRADING OF AMERICAN DEPOSITARY RECEIPTS

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Abstract. *This work is the first tax-induced empirical research that examines how investor tax homogeneity simultaneously affects ex-dividend day trading returns and volumes. Previous studies employ U.S. stocks that are investor tax heterogeneous to test tax-induced behaviors. However, regulatory tax heterogeneity induces diverse trading strategies for various investors who are subject to differential tax obligations. The heterogeneity of the investors makes it difficult for previous studies to summarize how tax affects the investors behaviors. Therefore, the innovation of this work in terms of data selection is to focus on American Depository Receipts (ADRs) which are investor tax homogeneous in order to examine whether tax on dividends will induce investors transactions during ex-dividend days. Furthermore, this study is the first in utilizing three-stage least squares (3SLS) and genetic algorithms to simulate the impact of institutional holding, tax rate, dividend yield, transaction cost, and risk factors on the ADR excess trading. The model-base management system we have constructed employs institutional ownership of ADR as an indicator for investor tax homogeneity to prove how investor tax homogeneity induces consistent trading strategy around ex-dividend day. Our analysis results provide convincing insights not only on investors rational tax-induced strategy, but also on implications for legislating tax policies in financial instruments.*
Keywords: Investor homogeneity, Three-stage least square methods, Tax induced hypothesis, Institutional investor

1. **Introduction.** Because tax is a critical cost for investors in making international stock trading decision, this paper uses a sample of American Depositary Receipts (ADRs) to test the tax-induced relations between trading volumes and returns because investor trading behaviors are more homogeneous for ADRs than for U.S. stocks on ex-dividend days. ADRs are securities that represent foreign companies outside the U.S. traded on U.S. exchanges [1]. ADR dividend incomes are subject to two kinds of taxes: one is the dividend income tax under U.S. jurisdiction and the other is the foreign withholding tax (imposed on dividend income) imposed by governments outside of the U.S. Meanwhile, U.S. stock holders only have to pay dividend income tax under U.S. jurisdiction. The main difference between ADRs and U.S. stocks is that ADR investors are subject to foreign withholding tax liability. The foreign tax rate for a given dividend distribution remains constant across all of the ADR investors regardless of U.S. status and investor income levels. ADR investors are more subject to homogenous tax than U.S. stock holders. Selling ADRs on ex-dividend days exempts the investor from the foreign withholding taxes on ADR dividend incomes. Therefore, investors are motivated to sell their stocks before the ex-dividend days to prevent the tax costs. On the ex-dividend days, they tend

to repurchase ADRs, raising the ADR prices and generating abnormal return on the ex-dividend days. The more the foreign withholding tax rates are, the more the abnormal return is on ex-dividend days.

However, there remains, for now, a scarcity of literature that focuses on tax-homogenous ADR investors to explore how the dividend tax stimulates simultaneous movement of trading volumes and returns. Most previous studies have employed U.S. stock as the samples to examine the tax-induced trading hypothesis [2], but U.S. stock investor trading behaviors are heterogeneous on ex-dividend days due to tax regulations. Under U.S. regulations, institutional investors are exempt from dividend income tax, so institutional investors will prefer to receive dividends. Conversely, U.S. governments impose taxes on dividend income of individual investors. Individuals for whom dividends are taxed at higher marginal rates will tend to give up dividends to avoid dividend income tax, while individuals for whom dividends are taxed at lower marginal rates are inclined to buy U.S. stocks before ex-dividend days. Regulatory tax heterogeneity induces diverse trading strategies for various investors who are subject to differential tax obligations [3]. The major disadvantage of using U.S. stocks as a sample to test tax-induced hypothesis is that the existing evidence concerning the effect of tax on U.S. stock returns is mixed.

Based on the above reasons, the first motivation of this study is to find investment objects that are investor tax homogeneous to examine the tax-induced hypothesis, in order to solve the drawback of previous studies which employ U.S. stocks that are investor tax heterogeneous and difficult to test tax-induced behaviors. Since all ADR investors are subject to an identical foreign withholding tax rate associated with the ADR dividend income, this paper uses a sample of ADRs to test whether the higher the taxes from the ADR issuing countries, the greater the abnormal return and transaction volume on ADR ex-dividend days. The innovation of this study is for the first time to prove the tax-induced trading in international financial investment, considering ADR investors abnormal trading behaviors to avoid tax.

The second motivation of this study is to utilize institutional ownership of ADR as an indicator for investor tax homogeneity. Institutional ownership of ADR is defined as the percentage that the ADRs are owned by institutional investors. This study examines whether the more homogeneous the investor tax, the greater extent the abnormal returns on ex-dividend days. According to Internal Revenue Code Section 904 of the U.S. jurisdiction, the ADR investors foreign tax credit is bounded by the U.S. marginal tax rate. When the U.S. marginal tax rate is smaller than the foreign tax rate subject to the ADR dividend income, the foreign tax credit ratio is bounded by marginal tax rate. The total amount of tax they have to pay for an ADR dividend income is the foreign tax liability to the country where the company that issues the ADR is located. Individual investors are obligated to pay tax to the U.S. government, so they are entitled to the tax credit. When the U.S. marginal tax rates are greater than the foreign withholding tax rates, the foreign withholding tax liability is not able to offset the U.S. tax liability for individual investors. The total amount of tax that individuals have to pay is equal to the amount of foreign tax liability as well as the excess portion paid to the U.S. Foreign tax liability represents the minimum of the taxation imposed on an ADR dividend income. Consequently, the higher the percentage that the ADRs are owned by institutional investors, the more tax homogenous the ADR investors are since all institutional investors are subject to the identical tax rate, namely, the foreign tax rate. The investor tax is more homogenous for investors of the ADRs with higher institutional ownership than those of ADRs with lower institutional ownership. ADR investors who hold the ADRs with high institutional ownership are more inclined to give up cash distribution, resulting in a consistent trading strategy which reduces trading volume, generating negative abnormal volume. From

aforementioned arguments, institutional holding of ADRs is a critical factor contributing to higher investor tax homogeneity in ADR than U.S. stocks. ADR provides us good opportunities to utilize institutional ownership as the indicator of investor tax homogeneity. The innovation of this work is to highlight the tax-induced hypothesis by examining how the investor tax homogeneity affects ADR trading behaviors.

This investigation for the first time utilizes three-stage least square (3SLS) methods to examine the tax-induced relevance of abnormal returns and abnormal volumes in the control of market risk and investor features. This paper focuses on ADRs and employs 1,424 cash dividend distributions of ADRs for 299 firms from 33 countries covering the period during 2003 to 2006 to thoroughly illustrate the investor homogeneity on excess trading behaviors. In the view of Michaely and Vila [4] that mathematically model how the tax heterogeneity (or investor homogeneity) affects trading volume, this work empirically further explores how the trading returns, not only trading volume, can be affected by institutional investors trading behavior on ex-dividend days. This paper is the first tax-induced empirical research that examines whether investor homogeneity simultaneously affects ex-dividend day trading returns and volumes. In contrast to the previous studies which employ the single OLS estimations [5], this investigation utilizes 3SLS methods to determine the interactive relevance of ADR abnormal returns and ADR abnormal volumes on ex-dividend days. The contribution of our analytical model is to precisely capture the exogenous impact of institutional holding, tax rate, dividend yield, transaction cost, and risk factors on the excess trading on the ex-dividend days. Furthermore, the results of 3SLS estimation methods are compared with those of 2SLS or OLS estimation methods to ascertain if the former estimations are more efficient. More specially, this study is the first in utilizing genetic algorithms (GA) method to simulate the numerical values of ADRs tax-induced cumulative abnormal returns (CAR) and cumulative abnormal volumes (CAV) during ex-dividend days, to prove that CAV can accurately predict CAR. This study constructs model-base management systems that can accurately explain the tax-induced price-volume relationship of ADRs and evaluate the economic consequence in tax policies. These technical innovations of the management systems show the important role of taxes in decision-making in the financial sector.

Our analytical results can mainly be applied to investment in international financial instruments and draft of tax legislation. Countries issuing cross-listing ADR (or stock) and those trading cross-listing ADRs (or stocks) are different. Both types of countries stipulate dividend income tax. The results of this study highlight that when investors engage in transnational ADR (or stock) transactions they will consider the tax policies of ADR (or stock) trading and ADR (or stock) issuing countries, proving the investor rationality in international financial management. This conclusion about investors rational behavior can be applied to investment in other financial instruments such as bank deposits, foreign exchange, futures and options. The results of this study prove that the tax policies will motivate investors to trade around ex-dividend days for the purpose of avoiding dividend income tax. Either ADR (stock) issuing or ADR (stock) trading countries, heavy tax of dividend income will lead to massive trading resulting in ADR (stock) fluctuations in prices during ex-dividend days. The result of this study can be applied as a reference for government legislation to prevent market volatility induced by heavy tax policies. Its implications can also be applied to tax policies on other financial instruments such as bank deposits, foreign exchange, futures and options.

2. Hypothesis Development.

2.1. Abnormal returns on ex-dividend day.

Kalay [6] argues that a market will value a dollar of dividends less than a dollar of capital gains. This investigation utilizes the after-tax rate of return on the ith ADR to formalize the fact that ex-dividend day prices of ADRs fall by less than the amount of the taxable dividend since ADRs are subject to withholding foreign tax rate under the regulations of ADR issuing countries:

$$\tilde{R}^{\tau}_{i,t} = \frac{\tilde{P}_{i,t} - P_{i,t-1}}{P_{i,t-1}}(1 - \tau_{i,g}) + \frac{D_{i,t}}{P_{i,t-1}}(1 - \tau_{i,d} - \tau_{i,f}), \tag{1}$$

where $\tilde{R}^{\tau}_{i,t}$ is the after-tax rate of ADR return on day t to the marginal investor in the ith ADR under U.S. regulations; $\tilde{P}_{i,t}$ is the price of the ith ADR at the end of day t; $\tau_{i,g}$ and $\tau_{i,d}$ are the present values of the capital gain and dividend income tax rate of the marginal investor for the ith ADR under U.S. tax regulations, respectively; $\tau_{i,f}$ is the foreign tax factor, which is defined as the excess value of the foreign withholding tax rate that exceeds the foreign tax credit boundary under U.S. jurisdiction for the ith ADR dividend income; and $D_{i,t}$ is the dividend paid per share for the ith ADR on day t. Variables of tax factors $(\tau_{i,g}, \tau_{i,d}, \tau_{i,f})$ and dividend income $D_{i,t}$ should be positive. By taking the expectations for Equation (1) and rearranging terms, we obtain Equation (2):

$$E(\tilde{R}^{\tau}_{i,t}) = E(\tilde{R}_{i,t})(1 - \tau_{i,g}) - \frac{D_{i,t}}{P_{i,t-1}}(\tau_{i,d} + \tau_{i,f} - \tau_{i,g}), \tag{2}$$

where $E(\tilde{R}_{i,t}) = \frac{E(\tilde{P}_{i,t}) - P_{i,t-1} + D_{i,t}}{P_{i,t-1}}$ is the expected pre-tax rate of return on day t for the ith ADR. If the expected after-tax rates of return are constant over time, then $E(\tilde{R}^{\tau}_{i,t}) = E(\tilde{R}^{\tau}_{i})$, for all t. Equation (2) can be rewritten as:

$$E(\tilde{R}_{i,t}) = \gamma_{0,i} + \gamma_{1,i} d_{i,t}, \tag{3}$$

where

$$\gamma_{0,i} = \frac{E(\tilde{R}^{\tau}_{i,t})}{1 - \tau_{i,g}} \tag{4}$$

$$\gamma_{1,i} = \frac{(\tau_{i,d} + \tau_{i,f} - \tau_{i,g})}{(1 - \tau_{i,g})}, \quad d_{i,t} = \frac{D_{i,t}}{P_{i,t-1}}. \tag{5}$$

Equation (3) captures the essence of the tax induced hypothesis in its simplest form and states the ADR returns $E(\tilde{R}_{i,t})$ as the positive function of foreign tax factor $\tau_{i,f}$. The tax effects of dividends will only be reflected in the ex-dividend day returns because dividend yields $d_{i,t}$ are nonzero only on the ex-dividend day. In Equation (3), the foreign tax factor $\tau_{i,f}$ is higher for ADRs which are owned by larger proportion of institutional investors because they do not have tax credit. The foreign liability is attributed to the tax premium $(\gamma_{1,i} d_{i,t})$, thus inducing ex-dividend day abnormal returns $E(\tilde{R}_{i,t})$. Namely, the more the institutional investors hold the ADRs, the larger the abnormal returns $E(\tilde{R}_{i,t})$ on ADR ex-dividend days as the hypothesis constructed as follows:

H_{11}: ADR abnormal returns on ex-dividend days are positively associated with the institutional holdings.

In addition, the higher the foreign withholding tax rate is, the higher the tax factor $\gamma_{1,i}$ is. The foreign tax rate is a positive function of the required rate of pre-tax returns $E(\tilde{R}_{i,t})$ on ex-dividend days, if the marginal investors tax rate on dividend income, including U.S. and foreign taxation $(\tau_{i,d} + \tau_{i,f})$, is greater than the present value of the capital gains tax rate $\tau_{i,g}$, namely, $(\gamma_{1,i} > 0)$. When the foreign tax is high and the dividend yield is great,

ADR investors are subject to an extra tax liability ($\tau_{i,f} d_{i,t}$) that causes the tax premiums ($\gamma_{1,t} d_{i,t}$) to upgrade significantly. ADR investors are thus more inclined to sell ADRs cum-dividend and repurchase ADRs ex-dividend on ex-dividend days, and thus cause ex-dividend day abnormal returns. Such foreign tax liability causes apparently abnormal returns on ex-dividend days for ADRs with great foreign tax costs. The hypothesis is constructed as follows:

H_{12}: Foreign tax liability induces ADR abnormal returns on ex-dividend days.

2.2. **Abnormal volumes on ex-dividend days.** Michaely and Vila [4] models the ex-dividend day excess trading in the following manner:

$$V_{i,t} = \frac{1}{2} D_{i,t} \left\{ \sum_{j=1}^{N} |(\alpha_j - \bar{\alpha})(K_j/\sigma_e^2)| \right\}, \tag{6}$$

where $D_{i,t}$ is the amount of dividend paid per share for ith ADR on day t, K_j is the level of risk to tolerance for investor j. $\bar{\alpha}$ is the average preference for dividends versus capital gains in the economy, weighted by investors levels of risk tolerance K_j, so $(\alpha_i - \bar{\alpha})$ represents the investors tax heterogeneity. σ_e^2 is the total risk of a stock, and N is the total number of investors in the economy. Equation (6) indicates that noise trading is an important factor for the increase in investor heterogeneity $(\alpha_i - \bar{\alpha})$, so trading volume is a positive function of the investors tax heterogeneity. Conversely, investor tax homogeneity reduces the trading volumes. Furthermore, trading volume is a function of the investors level of risk to tolerance K_j, so riskier ADR markets give investors high level of risk to tolerance, inducing greater trading volumes.

The U.S. tax-exempt institutions, which do not pay any tax to the U.S. government, cannot benefit from the tax credit. The tax rate institutional investors have to pay for an ADR dividend income is the foreign tax rate to the country where the company that issues the ADR is located. Hence, the U.S. tax-exempt institutions are tax homogenous, since all ADR investors are subject to the identical foreign withholding tax rate. Briefly, the extent of investors tax heterogeneity is lower for ADRs with higher institutional holding. Taxes on dividend incomes of ADRs induce institutional investors to uniformly sell ADRs cum-dividend and repurchase ADRs on ex-dividend days. From Equation (6) that indicates trading volume as a negative function of the investors tax homogeneity, the ADR abnormal volumes on ex-dividend day are likely to decrease due to investor homogeneity. This paper offers the following hypotheses.

H_{21}: ADR abnormal volumes on ex-dividend days are negatively associated with the institutional holdings.

According to Internal Revenue Code Section 904, the total amount of tax ADR investors have to pay for an ADR dividend income is exactly the foreign tax liability to the country where the company that issues the ADR is located when the foreign tax rate subject to the ADR dividend income is more than the marginal tax rate under U.S. tax regulations. At this time, the ADR investors are identically subject to the foreign withholding tax rate, so they are homogenous in tax obligations. The heavier the imposed foreign tax rate on an ADR dividend income, the higher the probability that ADR dividend income is only subject to foreign tax rate; this contributes to the homogeneity of the investors. Hence, investors tax heterogeneity $(\alpha_i - \bar{\alpha})$ becomes smaller, reducing the trading behaviors on ex-dividend days. Particularly, the reduction effect on trading volume is obvious as the dividend paid per share $D_{i,t}$ is great. The foreign tax liability is equal to foreign withholding tax rate multiplying divided yields. The higher the foreign tax liability is, the less the tax-induced trading volumes. We hypothesize the following:

H_{22}: Foreign withholding tax liability reduces ADR abnormal volumes on ex-dividend days.

2.3. **The relation between abnormal returns and abnormal volumes.** Foreign tax liability is the minimums of the taxation imposed on ADR dividend income. As the foreign tax rate imposed on dividend income is fairly high, the U.S. marginal tax rate is unlikely to be higher than the foreign tax rates. ADR investors are only subject to foreign withholding tax rate and equally have to pay the foreign tax liability. The tax ratio paid by individual investors is the same as that paid by institutional investors. This consistently encourages ADR investors to sell ADRs cum-dividend and to repurchase ADRs on ex-dividend days. Abnormal returns are contemporaneously relevant to abnormal volumes on ex-dividend days because of the tax-induced trading behaviors. The hypothesis is offered:

H_3: Tax induces simultaneous variations of ADR abnormal returns and ADR abnormal volumes on ex-dividend days.

3. Methodology.

3.1. **Data and sample.** This investigation obtains the sample of cash distributions for ADRs from the Center for Research in Securities Prices (CRSP) database. Our sample consists of 1,424 cash dividend distributions or 299 firms from 33 countries over the period from 2003 to 2006. The trading returns and volumes of ADRs are collected ranging from 2002 to 2007 not only to estimate the expected returns and expected volumes but also to compute the abnormal returns and abnormal volumes on ex-dividend days. The CRSP database provides ex-dividend date and rates of returns for each ADR. In addition, data of institutional ownership is collected through compustat database.

3.2. **Estimation of abnormal returns.** This paper employs Serra [7] market models to explore the abnormal returns. This paper defines the ex-dividend days as day 0. Negative (positive) days represent days prior (subsequent) to the ex-dividend days. The estimation interval represents the periods from day -260 to day -11 and the ex-dividend interval represents the periods from day -10 to day 10. We utilize the data in the estimation interval to measure the parameters in Equation (7):

$$R_{i,t} = \ell_i + \beta_i^{US} R_{crsp,t} + \beta_i^{fm} R_{fm,t} + \varepsilon_{i,t}, \tag{7}$$

where $R_{i,t}$, $R_{crsp,t}$ and $R_{fm,t}$ are the rates of return on day t for ADR i, the CRSP weighted index, Datastream weighted market index for the country where the ADR is issued. After the regression (7) is performed in the estimation interval, we obtain the parameters $\hat{\ell}_i$, $\hat{\beta}^{US}$, $\hat{\beta}^{fm}$. This paper captures the risk factors by beta coefficients $\hat{\beta}^{US}$ and $\hat{\beta}^{fm}$. The sample firms in our research execute cash dividend distributions for several times. However, risk factors $\hat{\beta}^{US}$ and $\hat{\beta}^{fm}$ are estimated for each cash distribution event which occurs in different time. This paper then applies Equation (7) to calculate the expected returns, $E(R_{i,t}) = \hat{\ell}_i + \hat{\beta}_i^{US} R_{crsp,t} + \hat{\beta}_i^{fm} R_{fm,t}$. We then follows Charitou et al. [8] to calculate the actual returns minus the expected returns to measure the abnormal return $AR_{i,t}$ for the ith ADR on day t during the ex-dividend periods using Equation (8) below:

$$AR_{i,t} = R_{i,t} - \left(\hat{\ell}_i + \hat{\beta}_i^{US} R_{crsp,t} + \hat{\beta}_i^{fm} R_{fm,t}\right). \tag{8}$$

3.3. **Estimation of abnormal volumes.** The abnormal volume is estimated as the daily trading volume minus daily normal trading volume during event period as proposed by Michaely and Vila [4]. We define normal daily trading volumes as the mean of daily

trading volume during the non-event periods as Equation (9), so abnormal volume during event (ex-dividend) period is as Equation (10):

$$NV_i = \frac{\sum_{t\in[-40,-10]\cup[10,40]} Vol_{i,t}}{60} \tag{9}$$

$$AV_{i,t} = \frac{EV_{i,t}}{NV_{i,t}} - 1, \quad t \in [-10, 10], \tag{10}$$

where $EV_{i,t}$ and $VOL_{i,t}$ are the daily trading volumes during the event (ex-dividend) period and non-event period, respectively. $CAR_{i,\tau}(-10,T)$ and $CAV_{i,\tau}(-10,T)$ represent CARs from day -10 to day T, and CAVs from day -10 to day T, in other words, $CAR_{i,\tau}(-10,T) = \sum_{\tau=-10}^{T} AR_{i,\tau}$ and $CAV_{i,\tau}(-10,T) = \sum_{\tau=-10}^{T} AV_{i,\tau}$. This work constructs the model of price-volume relationship for ADRs as Equation (11):

$$CAR_{i,\tau}(-10,T) = \lambda_0 + \lambda_1 \ln(CAV_{i,\tau}(-10,T)) + e_{i,\tau}. \tag{11}$$

This work is the first to combine GA method with least square method to explore the CAR and CAV relations during the ex-dividend periods. Sexton, Dorsey and Johnson [9] and Sexton and Dorsey [10] state that the GA is a global search procedure more capable of finding the best solution by searching from one population of solutions to another, while simultaneously sampling the total parameter space. The reason of adopting GA approach by this work is that the nonlinear least square method requires GA to obtain initial values relatively close to unknown parameter estimates. Next, this work follows Burden and Faires [11] to optimize parameters, so the optimizations may easily converge. Finally, this work follows Kochanek [12] and Sutheebanjard and Premchaiswadi [13] to examine forecast errors to investigate the forecast accuracy of Equation (11).

3.4. **Regression test.** After calculating the abnormal returns and abnormal volume, we employ OLS, 2SLS and 3SLS to estimate the determinants of excess trading behaviors considering the contemporaneous movement of returns and volumes. We construct simultaneous equation systems (12):

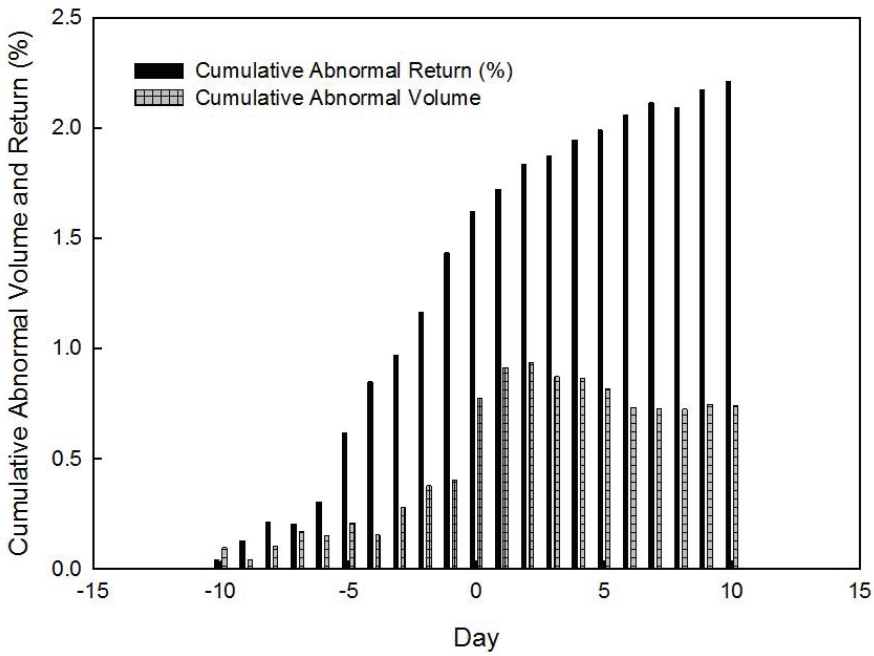
$$\begin{cases} AR_{i,t} = \theta_0 + \theta_1 AV_{i,t} + \theta_2 (Tax_{i,t} \times Dividend\ Yield_{i,t}) + \theta_3 Inst_{i,t} \\ \qquad +\theta_4 Transaction\ Cost_{i,t} + \theta_5 \beta_{i,t}^{US} + \theta_6 \beta_{i,t}^{fm} + \varepsilon_{i,t} \\ AV_{i,t} = \pi_0 + \pi_1 AR_{i,t} + \pi_2 (Tax_{i,t} \times Dividend\ Yield_{i,t}) + \pi_3 Inst_{i,t} \\ \qquad +\pi_4 Transaction\ Cost_{i,t} + \pi_5 \beta_{i,t}^{US} + \pi_6 \beta_{i,t}^{fm} + \varepsilon_{i,t} \end{cases} \tag{12}$$

where $AR_{0,it}$ and $AV_{0,it}$ are the abnormal return and abnormal volume on ex-dividend days (day 0). $Inst_{i,t}$ represents institutional ownership. $Yield_{i,t}$ is computed as the cash dividend divided by the price. $Transaction\ Cost_{i,t} = \frac{bid_{i,t} - ask_{i,t}}{(bid_{i,t} + ask_{i,t})/2}$ is the ex-day bid-ask spread and is calculated from the bid minus ask prices divided by the average bid and ask prices for the ith ADR at time t. $\hat{\beta}_{i,t}^{US}$ and $\hat{\beta}_{i,t}^{fm}$ are beta coefficients estimated from CRSP index and the local market index where the ith ADR is issued, so $\hat{\beta}_{i,t}^{US}$ and $\hat{\beta}_{i,t}^{fm}$ capture the risk factors. The two risk factors based on conventional financial theory are included in the regression (12). This research examines the significance of the coefficients θ_3 and π_3 by t-statistics to test the hypothesis H_{11} and H_{21}, respectively. This research examines the significance of the coefficients θ_2 and π_2 by t-statistics to test the hypothesis H_{12} and H_{22}, respectively. In addition, t-statistics also examines whether or not the coefficients θ_1 and π_1 are significant from zero to test the hypothesis H_3 that indicates the relevance between abnormal returns and abnormal volumes on ex-dividend days.

4. Empirical Results.

4.1. **The results of abnormal returns and abnormal volumes.** Average CARs and CAVs from −10 days to +10 days around the ex-dividend day for our sample firms are presented in Figure 1. Abnormal returns dramatically jump on ex-dividend days (day 0) in Figure 1. Since a double tax, i.e., a U.S. tax and a foreign withholding tax, may be applied to the ADR dividend income, the tax effect is apparent on ex-dividend days. Also, the patterns of the CAV substantially increase before ex-dividend days. Particularly, the patterns of abnormal returns and volumes approximately run together around the ex-dividend periods. Abnormal returns and volumes dramatically jump precisely on ex-dividend days. ADR investors accelerate their sales prior to ex-dividend days and consistently repurchase ADRs exactly on ex-dividend days. As a result, both the abnormal returns and volumes are obviously observed on ex-dividend days and the finding suggests tax-motivated trading returns and volumes simultaneously.

The abnormal returns on the ex-dividend day average 0.3711%, which is significantly positive at the 1% level based on the results of the t-statistics. Since all ADR investors are subject to an identical foreign withholding tax rate associated with the ADR dividend income, tax homogeneity enables them to give up the dividend and to repurchase ADRs on dividend days, thus inducing the abnormal returns on ex-dividend days. Regarding abnormal volume, abnormal volumes are significantly positive on 5 days of ten days $(-1, -10)$ after the ex-dividend day. Except for insignificant abnormal volume on days −10 and −7, abnormal volumes are significantly positive prior to ex-dividend days. Abnormal volumes are 0.1973 and 0.2681 on day −2 and −1, respectively, while decline to



Note: The ex-dividend date is set as day 0 in this figure. Negative days represent days prior to the ex-dividend date and positive days represent days subsequent to the ex-dividend date.

FIGURE 1. Cumulative abnormal volume and cumulative abnormal return (%) during ex-dividend period

TABLE 1. Statistical result of abnormal returns on ex-dividend days for firms which issue ADRs from different countries

Country	N	Mean (%)	T-statistics	Country	N	Mean (%)	T-statistics
Argentina	15	0.3749	0.42	Japan	187	0.4600	3.23
Australia	86	0.4184	2.56**	Luxembourg	6	−0.1126	−0.07**
Austria	2	−1.0474	−0.50	Mexico	93	0.3648	2.10
Brazil	77	0.5209	2.87***	Netherlands	76	0.3348	1.83**
Chile	41	0.3029	2.04**	New Zealand	29	0.4611	1.70*
China	29	−0.005	−0.02	Norway	9	−0.1007	−0.16
France	73	0.3982	2.20**	Philippine	5	0.0031	0.01
Germany	27	1.4679	3.91***	Potugal	4	−0.3211	−1.14
Greece	4	0.4371	0.35	Russia	1	1.5157	
Hong Kong	20	0.1185	0.24	South Africa	52	−0.0531	0.16
Hungary	1	1.2488		Spain	29	0.2933	2.70
India	32	0.5075	1.44	Sweden	12	1.4219	2.61**
Indonesia	5	0.9797	2.31	Switzerland	18	0.7133	3.86**
Ireland	25	0.3898	1.14	Taiwan	18	2.0669	2.19***
Israel	31	0.3266	0.98	Turkey	2	0.5067	0.34**
Italy	31	0.7327	1.13	United Kingdom	372	0.0912	1.18
Korea	12	1.2089	2.67***				

1. *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
2. The ex-dividend date is set as day 0 in this figure. Negative days represent days prior to the ex-dividend date and positive days represent days subsequent to the ex-dividend date.
3. N is the observation number.

TABLE 2. Abnormal return distributions which are classified by institutional ownership

Institutional ownership	Observation	Mean (%)	Standard Deviation	T-statistics
0%-10%	1,142	0.3393	0.0185	6.20***
10%-20%	165	0.4683	0.0169	3.56***
20%-30%	26	0.8337	0.0224	1.90*
30%-40%	49	−0.2180	0.0154	−0.99
40%-50%	6	0.8319	0.0218	0.93
50%-60%	22	0.8369	0.0128	3.06***
60%-70%	11	0.6793	0.0144	1.57
70%-80%	3	0.9128	0.0002	76.53***

Notes: *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

0.1847 on day 0. Abnormal volume is more obvious before rather than after ex-dividend days, which suggests that the trading strategy is less consistent before ADR ex-dividend days than after ADR ex-dividend days. ADR investors try to choose various optimal days to sell the ADRs at the low cost, while ADR investors motivate to repurchase ADRs exactly on ex-dividend days, contributing to the consistency of the trading strategy on ex-dividend days. Noise trading prior to the ex-dividend day is an important factor for the increases in trading volume. In addition, the simulated results of Equation (11) prove that CAV can accurately predict CAR value. The average error rate of the CAR predicted value from Equation (11) is only 0.1332 on the ex-dividend day. The error rate is defined as the difference between actual and predicted CAR values and then divided by

Table 3. Abnormal volume distributions which is classified by institutional ownership

Institutional ownership	Observation	Mean	Standard Deviation	T-statistics
0%-10%	1,142	0.224571	1.0779	7.04***
10%-20%	165	0.095495	0.7320	1.68*
20%-30%	26	−0.002350	0.4690	−0.03
30%-40%	49	−0.067150	0.6693	−0.70
40%-50%	6	0.368794	0.8592	1.05
50%-60%	22	−0.173030	0.3735	−2.17**
60%-70%	11	0.077539	0.5268	0.49
70%-80%	3	−0.021110	0.2752	−0.13

Notes: *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Table 4. The difference of abnormal return and abnormal volume among the various levels of withholding foreign tax rate against the non-tax group

		Abnormal return		Abnormal volume	
Tax rate	Observation	Difference (%)	T-statistics	Difference	T-statistics
0.10 vs. 0	14	−0.1030	−0.3371	0.1093	0.7821
0.15 vs. 0	36	−0.0550	−0.3677	−0.0870	−0.8580
0.18 vs. 0	36	0.0120	0.0706	−0.2877	−1.7180*
0.20 vs. 0	268	0.3201	2.3543***	−0.0245	−0.3286
0.25 vs. 0	171	0.1793	1.2459	0.0758	0.9811
0.27 vs. 0	31	0.5368	0.8209	0.1275	0.8263
0.30 vs. 0	127	0.6727	3.3852***	0.0847	0.8203
0.35 vs. 0	37	0.4028	2.8208***	−0.0363	−0.2631

Notes: *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

the actual CARs. Our results suggest the tax-induced price-volume relationship of ADRs due to dividend income tax.

The statistical results for the abnormal returns and abnormal volumes for ADRs issued from different countries on the ex-dividend days are expressed in Table 1. Table 2 and Table 3 exhibit the abnormal return distributions and abnormal volume distributions which are classified by institutional ownership. The average abnormal returns are positive, except for the group where the institutional ownership is within 30%-40%. The abnormal returns increase approximately monotonously with the foreign tax rate in Table 2. This suggests that the higher the percentage that the ADRs are owned by institutional investors is, the more tax homogenous the ADR investors are, causing the greater abnormal returns on ex-dividend days. This result is consistent with hypothesis H_{11} that the investor tax homogeneity induces abnormal returns on ex-dividend days. In addition, Table 3 shows the average abnormal volumes are 0.2246 for ADRs which only have 0-10% foreign ownership, while abnormal volume drops as the foreign ownership is more than 10%. The abnormal volumes appear to exhibit a somewhat downward trend as the institutional ownership increases, consistent with hypothesis H_{21}.

In this section, we divide our sample into two sub-samples: one sub-sample is the tax group, consisting of ADRs which are subject to various levels of withholding foreign tax rate. The other sub-sample is the non-tax group of ADRs issued by countries where do not levy taxes on ADR dividend incomes. Table 4 exhibits the difference of abnormal

Table 5. 3SLS, 2SLS and OLS estimation results of the abnormal trading behavior regressed on foreign tax liability, transaction costs and risk factors

	Abnormal volume		Abnormal return	
OLS estimation	Coefficient	t-value	Coefficient	t-value
Constant	0.0035	2.88***	0.1975	2.91***
Abnormal volume			1.4126	0.95
Abnormal return	0.0005	0.95		
Foreign tax liability	0.5658	5.56***	11.5678	2.01**
Institutional ownership	0.0050	1.17	−0.6998	−2.96***
Transaction cost	−0.0886	−1.78*	−2.0354	−0.73
β of ADR	−0.0018	−1.53	0.1077	1.61
β of the issuing country	0.0001	−0.05	−0.0912	−1.55
2SLS estimation				
Constant	−0.0802	−0.52	0.0021	1.45
Abnormal volume	78.9064	2.76***		
Abnormal return			0.0074	2.38***
Foreign tax liability	−32.7103	−1.72**	0.4802	4.16***
Institutional ownership	−1.0589	−2.49*	0.0097	1.94**
Transaction cost	4.9074	0.91	−0.0737	−1.37
β of ADR	0.2457	1.96**	−0.0026	−1.93**
β of the issuing country	−0.0843	−0.84	0.0006	0.50
3SLS estimation				
Constant	−0.1204	−1.00	0.0013	1.03
Abnormal volume			0.0110	10.46***
Abnormal return	90.1132	9.25***		
Foreign tax liability	−39.1136	−3.50***	0.4348	3.97***
Institutional ownership	−1.1109	−2.73***	0.0123	2.68***
Transaction cost	5.9114	1.22	−0.0657	−1.23
β of ADR	0.2657	2.30***	−0.0029	−2.29***
β of the issuing country	−0.0832	−0.83	0.0009	0.81

Notes: *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

return and abnormal volume between these two sub-samples. The abnormal returns are significantly greater for ADRs subject to 20%, 30% and 35% foreign withholding tax rate levels than the non-tax group. The difference of the abnormal returns are 0.3201%, 0.5368% and 0.6727% between non-tax group and ADRs subject to foreign tax rates of 20%, 27% and 30%, respectively, and the abnormal returns appear to exhibit a somewhat upward trend as the foreign tax rate increases. The more the foreign withholding tax rate, the more the ADR investors become taxable investors who would, accelerate their sales before ex-dividend days and delay their purchases until the ex-dividend days, leading to abnormal returns on ex-dividend days. Referring the abnormal volume, the abnormal volume is insignificantly greater for the tax-group than for the non-tax group.

4.2. **The results of regressions.** The OLS, 2SLS and 3SLS estimation results are exhibited in Table 5. In 3SLS and 2SLS equations, ADR abnormal returns on ex-dividend days are positively associated with the institutional holdings, consistent with hypothesis

H_{11}. Investors of ADRs with greater institutional ownership sell more ADRs prior to ex-dividend days and repurchase more ADRs exactly on ex-dividend days, causing higher abnormal returns on ex-dividend days. In addition, ADR abnormal volumes on ex-dividend days are negatively associated with the institutional holdings, consistent with hypothesis H_{21}. The finding implies that investors of ADRs with greater institutional ownership are more tax homogenous than other investors of ADRs with smaller institutional holdings. Investor tax homogeneity reduces the occurrence of noise trading, so the trading volumes decrease.

Under the 3SLS, 2SLS and OLS estimations of the first equation, the abnormal returns reveal significantly positive relationships with foreign tax costs, the foreign tax rates multiplying dividend yields. When the foreign tax liability is high, ADR investors are to a larger extent subject to an extra tax liability withheld by the foreign tax jurisdiction. This leads to a great deal of ADRs cum-dividend and the acquisition of ADRs ex-dividend. The results support hypothesis H_{12} that positive associations exist between ADR abnormal returns and foreign tax liability. Besides, Table 5 shows that abnormal volumes reveal significantly and negatively related to foreign tax liability under the 3SLS and 2SLS estimations of the second equation. The heavier the foreign tax liability is, the more consistent the trading strategy is for ADR investors. This supports the hypothesis H_{22} that negative relations exist between ADR abnormal volume and foreign tax liability. The results of our 2SLS and 3SLS estimations also show that the coefficient of risk factor $\hat{\beta}_{i,t}^{US}$ is significantly and positively related to abnormal volume, while significantly and negatively associated with abnormal return. It implies that risky ADR trading markets induce greater abnormal trading volumes on ex-dividend days, supporting the views of Michaely and Vila [4].

Furthermore, abnormal returns on ex-dividend days are significantly related to abnormal volumes under 3SLS estimations. This suggests the interactive relations between abnormal returns and abnormal volumes during ex-dividend days, consistent with hypothesis H_3. On the other hand, this positive relationship is not statistically significant under OLS estimations. Because 3SLS considers the contemporaneous covariance between error terms $\sigma_{1i\ 2i} = E(\varepsilon_{1i,t}, \varepsilon_{2i,t})$, the 3SLS estimators are asymptotically efficient. Besides, the absolute value of the coefficient of risk factor in U.S. markets is greater than that in foreign market. Risk in U.S. markets is significantly and negatively related to the ADR ex-dividend returns in 3SLS regressions, while insignificant in OLS regression. The 3SLS results conform to the portfolio theory that investors may engage in trading activities only when the returns from the trading activities exceed the risk premiums. Thus, the risk in U.S. market deters the abnormal returns of ADRs in our study. Investors give up trading as ADRs bears high costs of risk.

4.3. **Practical example.** Table 6 provides examples of tax credits imposed on dividend incomes from ADRs. All ADR investors who pay foreign dividend withholding tax are entitled to a foreign tax credit bound to the U.S. marginal tax rate according to Section 904 of the Internal Revenue Code. Assume a corporation investor obtains 5 million incomes in U.S. and 1 million ADR dividend incomes; the total taxable income is 6 million. If we do not take foreign tax credit into account, the corporation has to pay 2,040,000 for his income tax liability to U.S. government. The marginal tax rate of this investor is 34%. When the foreign tax rate subject to the ADR dividend income is 30%, foreign tax liability derived from ADR dividend income is 300,000. Because the foreign tax rate 30% is smaller than the marginal tax rate 34%, the investor has the tax credit amount 300,000. The following table exhibits that the investor has to pay 1,740,000 for U.S. tax and 300,000 to the country where the equities that underlie ADR are issued. The tax

credit can fully offset the foreign tax liability, so it makes no difference in total tax liability for the investor to invest ADRs or purely U.S. stocks. However, when the foreign tax rate subject to the ADR dividend income is 35% and the tax credit ratio is bound to 34%, the investor only has tax credit amount 340,000. The investor has to pay 1,740,000 for U.S. tax and 350,000 to the country where the equities that underlie ADR are issued. The ADR investor has to pay incremental 10,000 in comparison with investors who only invest securities issued in United States. For individual investors, when their foreign withholding tax rates are greater than the U.S. marginal tax rate, the excess portion is not able to offset the U.S. tax liability. The total amount of tax that individuals have to pay is equal to the amount of foreign tax liability. In summary, foreign tax liability represents the minimum of the taxation imposed on an ADR dividend income. As the foreign withholding tax rate regulated by the ADR issuing country is high, the tax cost of the ADR investment will be higher than the investment in US stocks, inducing ADR holders to sell before ex-dividend days and then purchasing again afterwards, resulting in abnormal returns on ex-dividend days. Our empirical results listed in this research prove the occurrence of abnormal returns on ADR ex-dividend days. However, Table 1 shows that even though in year 2003, 23 out of 33 countries impose foreign withholding tax rate on ADR dividend income, the abnormal returns rates on ADR ex-dividend days are lower than the foreign withholding tax rate of each corresponding country. During ex-dividend periods, speculators cannot secure profit by engaging in transactions opposite to activities of those investors intending to avoid tax. Although ADR demonstrates the ex-dividend day effect, the possibility for arbitrage is still limited.

5. **Conclusions.** Although institutional investors are exempt from U.S. dividend income tax, these institutional investors are still subject to foreign tax liability imposed on dividend incomes. In contradiction of dividend income tax imposed on U.S. stocks, identical foreign tax rates enable ADR investors to be more homogenous in taxation than U.S. stock holders, so ADR data provides us good opportunity to explore the tax-induced trading hypothesis. This paper employs 1,424 cash dividend distributions for 299 firms from 33 countries covering the period during 2003 to 2006 to examine how investor homogeneity affects the excess trading behaviors on ex-dividend days. These tests document that, as predicted, there is a statistically and economically significant and positive return precisely on ADR ex-dividend days. Since a double tax, i.e., a U.S. tax and a foreign withholding tax, may be applied to the ADR dividend income, the tax effect is apparent on the ex-dividend day. The results indicate that ADR abnormal returns on ex-dividend days are

Table 6. Practical example of ADR dividend income tax

Tax rate of the country	30%	35%
ADR dividend income	1,000,000	1,000,000
Withholding foreign tax	300,000	350,000
Foreign tax credit bound	340,000	340,000
Tax paid to U.S. government	2,040,000	2,040,000
Less: Foreign tax credit	(300,000)	(340,000)
Net tax paid to U.S. government	1,740,000	1,700,000
Add: Tax paid to the country	300,000	350,000
Total tax amount	2,040,000	2,050,000
Incremental tax amount	0	10,000

positively associated with the institutional holdings in 3SLS equation. Institutional ownership is the indicator of investor tax homogeneity. The higher the institutional ownership for ADRs is, the more the investors are inclined to sell ADRs cum-dividends and repurchase ADRs on ex-dividend days. Consequently, abnormal returns on ex-dividend days runs positively related to institutional holdings. In addition, ADR abnormal volumes on ex-dividend days are negatively associated with the institutional holdings. Since the U.S. tax-exempt institutions do not pay any tax to the U.S. government, they cannot share any tax credit. The total amount of tax they have to pay for an ADR dividend income is equal to the foreign tax liability to the country where the company that issues the ADR is located, so ADRs with larger institutional holdings are more homogeneous in dividend income taxation than those with smaller institutional ownership. Because large institutional holding in ADRs gives rise to investor tax homogeneity, the result implies that investor homogeneity strengthens the uniform trading, thus reducing trading volumes on ex-dividend days. Since ADR investors with greater foreign tax liabilities sell more ADRs cum-dividend and acquire more ADRs ex-dividend, the magnitude of abnormal returns is a function of the foreign tax costs levied on ADR dividend income. Furthermore, the results of 3SLS regression reveal a significantly positive relationship between the abnormal returns and abnormal volumes on ex-dividend days. The finding is consistent with tax-motivated hypothesis and specifically supports the casual relevance of abnormal returns and abnormal volumes on ex-dividend days from ADR markets.

An important contribution of this paper is to incorporate tax in explaining the cross-sectional variation in abnormal returns and abnormal volumes around the ex-dividend days. Both academic and practical fields emphasize the tax effect on enterprise strategies [16]. As cross-listing firms have become prevalent in recent years, ADR investors and ADR issuing corporations have to take double taxation into consideration in their investment decisions and dividend policies. Previous studies have not supported the tax-induced trading hypothesis. Shaw [14] explores the significant abnormal return and volume around ex-dividend days of untaxed master limited partnerships (MLPs). Frank and Jagannathan [15] find that the average fall in stock prices on ex-dividend days appeared to be smaller than the amount of the dividend, even though neither dividends nor capital gains are taxed in Hong Kong. Such results cast serious doubt on the effects of tax as a valid explanation for abnormal behavior on dividend days. This investigation has provided specific evidence of how investors tend to sell ADR before ex-dividend days to avoid tax then buy ADR on ex-dividend days. The conclusions of this study provide a reference for investors in decision-making regarding international financial investment as well as for governments in taxation policy-making.

The application of this study is stated in terms of the following four aspects. First, this conclusion of this work serves as a reference for investors in decision-making regarding international stock trading as well as for governments in taxation policy-making. Second, this investors rational tax-induced strategy can be applied to investment in other financial instruments such as bank deposits, foreign exchange, futures and options. Third, the result of this study can be applied as directions for government legislation to prevent market volatility induced by heavy tax policies. Fourth, its legislative implications can also be applied to tax policies on other financial instruments such as bank deposits, foreign exchange, futures and options.

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