

BOJ Discussion Paper

Research Unit

Capital Outflow Restrictions and Dollar Drainage

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Abstract

This paper identifies foreign cross-listings as a potential drain on reserves and a source of vulnerability to capital reversals for host nations. Simulations of a reasonably calibrated portfolio choice model demonstrate that restrictions on the outflow side of capital markets are effective in mitigating this vulnerability for Jamaica. A panel data analysis that distinguishes between outflow and inflow restrictions shows that outflow restrictions do not decrease the total amount of capital in the economy. These restrictions, therefore, have the potential to limit reserve drainage without stunting capital market growth.

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1 Introduction

Despite the rapid pace of financial market globalization, substantial impediments to capital flows still remain in most developing countries. Investors in these countries, therefore, cannot benefit from the portfolio diversification, consumption smoothing and external investment opportunities that are commonly associated with liberal financial markets. One potential way that the investors of financially repressed economies can circumvent local regulations is by cross-listing their stocks in foreign stock exchanges. In particular, cross-listing of shares in more liberal markets gives the investors the potential to access hard currencies such as the US dollar or the Euro which they can then use to invest in global financial markets. While this is a beneficial process for the investors of repressed economies, it can be destabilizing for the host country that is the source of hard currency funding. If, for example, investors sell shares, convert to US dollars and exit the country, foreign exchange reserves would be depleted (hereafter, this mechanism is referred to as a dollar drainage). This is especially concerning for small open economies like Jamaica that are highly vulnerable to exchange rate fluctuations.

In this paper, we make two distinct contributions to the literature. First, while a majority of the studies on cross-listing associate this activity with greater access to capital and way to gain credibility in global markets for foreign firms, we approach the issue from the opposite direction and identify foreign cross-listings as a source of vulnerability to capital reversals for host nations. We then study the impact of capital outflow restrictions as a way to mitigate this vulnerability. Second, we use an empirical analysis that distinguishes between outflow and inflow restrictions and we find evidence that it is inflow restrictions that have a negative effect on the total amount of capital in the economy. The overall inference, therefore, is that outflow restrictions not only prevent dollar drainage but they are also the preferable form of restrictions as they are not the main impediment to capital market growth.

We begin by showing some evidence that foreign cross-listings in Jamaica are becoming sufficiently large. We then assess the efficacy of regulatory policies that aim to minimize the incentives for dollar drainage and measure the potential benefits of cross-listing for local investors. In doing so, we approach the analysis from the perspective of investors. To investigate the efficacy of regulation, we determine how foreign investors, unable to access US dollars in their own country,

would react to the different degrees of regulation in the country where they are cross-listing shares. Our inferences are drawn from a simple portfolio choice model where a foreign investor has three options: list shares in her own country, cross-list in a more liberal economy, say Jamaica, and keep her funds in this economy or convert funds obtained from selling shares to US dollars and invest abroad. If she chooses the latter option, however, the investor has to pay a tax per every dollar she takes out of the country. In our model, the investor determines the composition of her portfolio in two stages. In the first stage, she chooses the share of her funds in Jamaica that she would like to convert to US dollars and invest abroad where she earns the foreign rate of return. This decision is made by maximizing a utility function that weighs returns of her portfolio against its variance. After finding the optimal composition of her funds that she would keep in or take out of Jamaica, the investor chooses how much to cross-list in Jamaica and how much to list in her own country in the second stage. In doing so, she uses the optimal shares of funds from the first stage. In other words, given the composition of funds that she would keep and take out of Jamaica, she chooses the share of her funds that she would like to bring to Jamaica. Solving the investor's problem in the second stage, we find the optimal shares that represent the funds kept in her own country and brought to Jamaica. The optimal share parameters that we derive are functions of the mean and variance of asset returns and their covariances across country pairs, and their form is similar to a Sharpe ratio.

We proceed by calibrating the model with stock market and exchange rate data from Trinidad and Tobago (T&T, the economy where investors' access to hard currency is restricted), Jamaica (the host-economy), and US (the foreign economy) to draw quantitative inferences. In this analysis, the free parameter is the regulatory taxes on capital outflows. We examine how changing the value of this free parameter affects the T&T investors' optimal portfolio shares. Our simulations demonstrate three mechanisms. First, the share of T&T investor's cross-listed funds in Jamaica are inversely related to regulatory costs. The reason is that the returns to cross-listing and draining dollars decreases with higher taxes on capital outflows and thus the T&T investor decreases her portfolio allocation to Jamaica. Second, the taxes are effective in preventing dollar drainage and the T&T investors keeps a higher share of her capital in Jamaica under stringent restrictions. Third, we find that the negative effect of taxes on capital inflows is mostly offset by its negative

effect on capital outflows which keeps total foreign funds in Jamaica stable. This is an important finding in our paper. It implies that while restrictions on outflows are effective in preventing the potential destabilizing migrations of capital, they also disincentivize capital inflows.

In our numerical analysis, we conduct several sensitivity tests. We first find that dollar drainage increases when there is a positive wedge between asset market returns in the US and those in Jamaica, and that restrictions aiming to curb dollar drainage are more effective under this calibration of the model. Second, we observe that the effectiveness of regulation is also higher when Jamaican asset market volatility is low since the negative effects of regulation on dollar drainage are stronger than its negative effects on capital inflows, as less volatile Jamaican assets offer a better investment opportunity. Conversely, we find that the T&T investor decreases the amount of cross-listing if asset market volatility in T&T is smaller compared to Jamaican and the US. Finally, we focus on the covariance of asset market returns across countries and find that when the covariance between US and Jamaican asset returns is low or negative there is higher level of cross listings in Jamaica given that US investments offer a better hedge. While the lower covariance also increases dollar drainage, outflows are smaller than inflows given the greater hedging opportunities. We find that regulation decreases the total funds in Jamaica as it decreases the returns to hedging. Overall, these results imply that capital outflow restrictions are most effective and beneficial when the host-country has relatively lower asset market returns and volatility and its asset markets are highly integrated with foreign asset markets. Further analysis indicates that the total capital in the host nation shrinks if taxes are levied on the inflow side of capital markets and that countercyclical taxes (a lean against the wind policy) are preferable to procyclical taxes for asset market stability in the host nation.

Next, we approach the topic from a different angle and determine whether the cross-listed shares offer any benefits to Jamaican investors. This analysis allows us to conclude whether restrictions that discourage capital inflows, cross-listings in particular, are justified or not. If for example, the shares that are listed have low and highly volatile returns, that also do not offer any diversification benefits, capital restrictions could be justified given the potential for dollar drainage. To determine the potential benefits of cross-listing for Jamaican investors, we use historical stock returns for 4 foreign companies listed on the Jamaican Stock Exchange (JSE)

and a cross-listed shares index. Using these data, we compute the optimal portfolio shares of a Jamaican investor who chooses to allocate her funds to the foreign shares or to a Jamaican stock market exchange-traded fund (ETF). To do so, we solve a utility function where the investor weighs returns of the portfolio against its variance. We also measure the utility of the investor with and without the cross-listed shares to determine whether the cross-listing is beneficial. Our results show that for each foreign company and the general cross-listed shares index, the investor has a higher level of utility with the cross-listed shares and that she has a long position in foreign shares. This finding is robust to using alternative values for the risk aversion parameter.

Overall, our findings imply that cross-listings offer benefits to Jamaica and that any restriction that discourages this financial activity would be imprudent. More generally, our methodology provides a simple guideline to determine whether existing cross-listings in any country are justified or not.

In the final part of our analysis, we use cross country data to investigate the efficacy of capital controls. Specifically, we obtain annual data for 100 countries and 25 years to construct a data set that includes both measures of capital flows and capital restrictions. The capital flows data and macroeconomic data that allows us to incorporate local economic conditions are from the International Financial Statistics (IFS) database. We refer to the latter set of data as pull factors as a more healthy economy could potentially attract capital to the country. In our analysis, we distinguish pull factors from push factors such as the Chicago Board Options Exchange Volatility Index (VIX) that reflect global financial market conditions (the perception of risk in particular). The financial restrictions data are obtained from Fernández et al. (2016) where the authors use IMF's Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) to compile de jure information about restrictions on different asset classes to build indices. These indices are available for all the countries and the time periods in our sample and they are reported separately for inflow and outflow restrictions. In our baseline estimations we use the overall inflow and outflow restriction indices that represent the average level of restrictions across all instruments (including equity, bonds, derivatives, direct investment, money market instruments).

We use our data set to estimate three unique models. In these models, we compare the growth rate of net capital inflows (the growth of inflows minus the growth of outflows) in countries with

high inflow and high outflow restrictions with those of countries with either low inflow, low outflow or both low inflow and low outflow restrictions. Our results first show that countries with low inflow restrictions are characterized by higher growth rate of net capital inflows compared to countries with high restrictions on both side of the market. Second, we find that it is inflow restrictions, and not outflow restrictions, that are negatively related to net capital inflows. We also find that net capital flows are more sensitive to push factors with high restriction countries experiencing a sharper retrenchment of capital during heightened risk in global financial markets compared to other countries. This interaction, similarly, is only significant for countries with low inflow restrictions. Local pull factors, by contrast, are relatively less important for capital flows.

Overall, from the different estimations that we conduct we infer that a more nuanced approach to determining the efficacy of capital controls is required. Specifically, we find that considering capital restrictions on both the inflow and the outflow side is critical and that it is inflow restrictions and its interaction with global push factors that are negative related to net capital inflows. This observation is consistent with those from our portfolio choice model.

The remainder of this paper is structured as follows. Section 2 provides a review of the relevant and recent literature on the topic. Section 3 provides some stylized facts for capital flow and restrictions in Jamaica while Section 4 outlines the methodology to investigate the potential effects of capital outflow restrictions in Jamaica. Section 5 presents empirical evidence and Section 6 concludes.

2 Literature Review

There is a long-standing literature that documents the benefits to financial liberalization, especially for the long-term growth potential of countries. Studies such as Demirguc-Kunt and Maksimovic (1998), Laeven (2003), Love (2003) and Rajan and Zingales (1998), for example, find that firms with financial constraints, especially those that are small, experience more robust growth and they become less vulnerable to local conditions if the economy is financially liberalized. Henry (2000) and Bekaert et al. (2001) further document the positive effects of financial liberalization on investment allocation and equity market liquidity, respectively. There are many other studies with similar findings. On the other hand, there is an equally well-established liter-

ature (e.g. Aysun and Honig, 2011; Korinek, 2011, 2013; Jeanne, 2010; Kaminsky et al., 1998) revealing the destabilizing effects of capital flows that justifies some form of capital management to reduce volatility and improve social welfare.

In this paper, we take a neutral stance on the economic effects of capital management and instead investigate if these practices are effective in maintaining a stable amount of capital in the economy. The evidence is mixed for the effectiveness of capital controls in the literature. While most studies using a panel for developing countries find that the composition of capital can be altered with restrictions, shifting the composition to more stable and long term capital (e.g., De Gregorio et al., 2000), these studies show no evidence that capital controls change the total amount of capital inflows or outflows. Cardenas and Barrera (1997), Cardoso and Goldfajn (1998), Chamon and Garcia (2016), Goh (2005) and Jinjarak et al. (2013) find similar evidence from a single economy. Also studies such as Fernandez et al. (2015) and Cardarelli et al. (2010) find no evidence that countries are using capital controls countercyclically (the welfare enhancing policy in theoretical studies).[1] On the other hand, studies such as Cardarelli et al. (2010) and Kaplan and Rodrik (2002) find that countries with higher restrictions draw smaller amount of inflows compared to more liberal countries and that they are able to restrict outflows. These are consistent with the findings of Ostry et al. (2011a, 2011b, 2012) and Eichengreen and Mussa (1998) that restrictions effectively prevent a credit boom-bust cycle and they promote financial and exchange rate stability through signaling effects. An overwhelming majority of this literature investigates the impact of inflow restrictions on capital inflows. In our paper, we distinguish between inflow and outflow restrictions and consider net capital inflows, and we find that outflow restrictions are preferable to inflow restrictions as they limit reserve drainage without stunting capital market growth.

Unlike the strands of literature mentioned above, the macroeconomic impact of cross-listing is an unexplored topic. Most of the literature on cross-listing is in the area of finance and the findings reveal both return and diversification benefits for firms/investors that cross-list share in other countries (e.g. Allen and Macdonald, 1995; Hagris, 2000; Karolyi, 1998, 2006; Miller, 1999). Majority of this literature is on the access of foreign firms to US markets - the predominant

[1] In fact, Fratzcher (2014) shows that capital restrictions can become more stringent during financial turmoil.

market for cross-listing activity. In our paper, we incorporate foreign investors' decision to cross-list in a foreign economy, other than the US, and track their benefits from doing so. Our focus, however, is on the macroeconomic stability implications for the host economy. We demonstrate that cross-listing of foreign shares could potentially drain reserves and destabilize the economy and that capital outflow restrictions are the most effective tools to disincentivize dollar drainage.

3 Capital flows and restrictions in Jamaica

Knowledge of CFM techniques is important to policy makers in Jamaica given the country is susceptible to highly volatile capital flow patterns, the effects of which are exacerbated due to the relatively thin and concentrated local financial market. Net private cross border capital flow data for Jamaica demonstrate an asynchronous and volatile pattern for inflows and outflows (see Figure 1). When compared to portfolio flows, FDI flows have been the least volatile over the period displayed in the figure. While temporal changes in the relative volatility of private portfolio outflows vis-à-vis inflows highlights a reduction in the former below the latter (see Figure 2), the overall high volatility of portfolio flows justifies more deliberate management. A decomposition of net private capital flows also reveals that bank and other private flows and portfolio debt flows are the main drivers of volatility over time (see Figure 3) implying that market based restrictions that are binding for private agents are more appropriate forms of restrictions for Jamaica.

To quantify the riskiness of capital flows for Jamaica, we use a simple capital flow at risk (CFAR) analysis that characterizes the entire distribution of capital flows for Jamaica, putting special emphasis on tail outcomes.[2] Characterizing distributions is particularly useful in the context of capital flows because one avoids the reliance on arbitrary thresholds to define extreme events (sudden stops and surges) and the mean level of flows as the only indicator. We use quarterly data for non-FDI private capital outflows for the period March 2012 to December 2021 and we explore various data moments including skewness and kurtosis to characterize the distribution of non-FDI private capital outflows and the corresponding probability density functions.[3] Our

[2] Risks to capital flows were quantified - with a focus on 'tail' events, to identify the likelihood/probability of significant/extreme inflows and outflows.

[3] In our analysis, we mainly consider portfolio and other investment flows. While there are also concerns surrounding FDIs aimed at facilitating tax avoidance as well as other forms of cross border capital flows, these are outside of the scope of this project.

findings imply that there is a 5 percent chance that outflows in any quarter will exceed US$556.0 million (see Figure 4). While this is a small probability, the potential risks are high given that the possible amount of capital reversal is roughly one-sixth of Jamaica's foreign exchange reserves.

Turning to the current state of capital outflow controls in Jamaica, we observe that while relatively strong controls exist to limit residents' purchases of foreign assets abroad, other potential outflow channels, particularly those on the repatriation/redirection of nonresidents' funds, enjoy more lax regulations.[4] In this paper, we identify the latter as a potential risk. With deeper global and regional financial integration, issuances or sale of assets locally by nonresidents, through stock and bond markets, have increased recently. Jamaica does not impose explicit limitations on these activities, highlighting an area of exposure to the economy.

Recent cross listings (of companies originally listed on regional stock exchanges) onto the JSE have increased, in respect of the market capitalization of the entities, and therefore may pose increasing risk of capital outflows with potential implications for the foreign exchange market. Significant capital outflows can materialize if substantial volumes of non-residents holdings of these securities are cross listed and sold on the JSE, and the proceeds converted and repatriated.[5] Though trading of cross listed shares during the first half of 2022 appear muted, and may suggest limited incidence of capital expropriation, the potential still exists. It is therefore important to investigate the dynamics in this market in an effort to understand future risks to dollar drainage. More generally, the constantly changing patterns and conduits through which cross border capital flows are transmitted require agility on the part of the government of Jamaica and those of other developing countries to have knowledge of CFM measures to current realities. In this paper, we consider one aspect of the changing conditions and investigate the cross-listing response of foreign firms of financially repressed economies as a means to access hard currency funding.

[4] To mitigate against potentially destabilizing capital outflows, Section 22 of the Bank of Jamaica Act, the Banking Services Act and the Securities Act imposes investment limits and restrictions on qualify asset purchases abroad by resident financial institutions. Pension funds and insurance companies can invest in issued or guaranteed by the governments of Canada, the United Kingdom and the United States up to a maximum of 10.0 percent of total assets. The investment limit for securities dealers (SDs) and collective investment schemes (CIS) is higher at 25.0 percent. Deposit taking Institutions (DTIs) - commercial bank, merchant banks and building societies -loans to non-residents are subject to statutory lending limits and other prudential requirements applicable. Loans to any group is limited to 10.0 percent of the DTIs capital base for un-collateralized loans and a maximum of 40.0 percent for collateralized loans. Additionally, there are also prudential provisioning requirements applicable to the extension of credit.

[5] The stocks referred to here are those that were originally listed on a foreign exchange and has been subsequently cross listed on JSE.

4 Methodology

Below, we construct a portfolio choice model and simulate it by using data from Jamaica, the US and T&T to investigate the effects of capital outflow restrictions. We then measure the benefits of cross listings for Jamaican investors.

4.1 A partial equilibrium framework

In this section, we build a simple partial equilibrium framework that allows us to describe the portfolio choice of a foreign investor that is considering whether and how much to cross-list in Jamaica. We assume that there are two components of the investor's returns. The returns in her country of origin, R_D, are given by,

$$R_D = \mu_D + \varepsilon_D \tag{1}$$

where μ_D represents the expected capital gain and dividend component of returns. We assume that μ_D is measured in US dollars so that the expected component of a local exchange rate depreciation/appreciation against the US dollar is a part of μ_D. The reason we follow this approach is that the investor will use US dollar returns to compare the returns across different investment strategies across countries. ε_D above is a random variable that represents the shocks to the investor's returns. An increase in ε_D captures either an appreciation of the local currency relative to the US dollar or an unexpected increase in stock prices. The latter can be thought of as an unexpected change in the overall stock market index since we do not distinguish amongst the different stocks that are to be cross-listed. We assume that the shock variable has a mean value of 0 and a variance of $\sigma^2_{D,E}$. Hereafter, we refer to this shock as a financial shock.

The variance of the returns in the domestic economy are then given by,

$$Var\left(R_D\right) = \sigma^2_D \tag{2}$$

The investor has the option to cross-list in Jamaica. If she does so, her returns, R_J, are given by,

$$R_J = \left(1 - \phi_F\right)\left(\mu_J + \varepsilon_J\right) + \phi_F\left(\mu_F - \lambda + \varepsilon_F\right) \tag{3}$$

where μ_J similarly denotes the capital gains in Jamaica measured in US dollars. Unlike the previous scenario, however, the investor can sell a share ϕ_F of her stocks, convert the funds to US dollars and purchase US dollar assets in foreign economies. This action is the source of US dollar drainage in Jamaica. The converted funds earn the foreign returns to capital μ_F but they are subject to capital outflow regulations which cost the investor λ for each dollar invested abroad. ε_J is similarly a shock variable that for positive values represents a Jamaican dollar appreciation against the US dollar. ε_F is the corresponding shock for the investor's returns in foreign economies. Unlike the other shocks, however, this shock represents the unexpected changes in foreign asset prices. Both of these shocks are also referred to as financial shocks to simplify terminology.

The variance of the investor's returns in Jamaica are given by,

$$Var\left(R_J\right) = \left(1-\phi_F\right)^2 \sigma_J^2 + \phi_F^2 \sigma_F^2 + 2\rho_{jf}\left(1-\phi_F\right)\phi_F \sigma_J \sigma_F \tag{4}$$

In our framework, the investor determines her optimal portfolio in two steps. First, she chooses how to allocate the funding obtained in Jamaica to Jamaican dollar and US dollar assets by maximizing the following function:

$$\max \;\; \left(1-\phi_F\right)\mu_J + \phi_F\left(\mu_F - \lambda\right) - \frac{\gamma}{2} Var\left(R_J\right) \tag{5}$$

According to this standard problem, the firm weighs returns against risk when determining the optimal allocation of funds. Here γ is a risk aversion parameter. The solution to this problem yields the following optimal share of foreign asset holdings:

$$\phi_F^* = \frac{\left[\left(\mu_F - \lambda\right) - \mu_J\right]/\gamma + \sigma_J^2 - \rho_{jf}\sigma_J\sigma_F}{\sigma_J^2 + \sigma_F^2 - 2\rho_{jf}\sigma_J\sigma_F} \tag{6}$$

Notice here that if $\sigma_F = 0$, the expression transforms into $1-\phi_F^* = \left[\mu_J - \left(\mu_F - \lambda\right)\right]/\gamma\sigma_J^2$, where $1-\phi_F^*$ is the standard optimal share of risky assets in a portfolio with risky and risk free assets. More specifically, the condition above implies that the firm would hold a higher share of Jamaican assets if returns to these assets are relatively larger, the Jamaican financial market risk is low, foreign financial risk is high and/or the firm is not too risk averse. The covariance term appearing

in both the numerator and the denominator demonstrates the portfolio diversification mechanism in model. If the correlation between the two shocks is negative and high, for example, the investor chooses a more balanced portfolio.[6] Conversely, if the correlation is positive and high, the investor chooses a more unbalanced portfolio.

After obtaining ϕ_F^* and the optimal returns from cross-listing in Jamaica, the investor then chooses how much to list locally and how much to list in Jamaica. In so doing, she solves the following maximization problem:

$$\begin{aligned} &\max \ \phi\left[\left(1-\phi_F^*\right)\mu_J+\phi_F^*\left(\mu_F-\lambda\right)\right]+\left(1-\phi\right)\mu_D \\ &-\frac{\gamma}{2}\left[\phi^2 Var\left(R_J^*\right)+\left(1-\phi\right)^2 Var\left(R_D\right)+2\phi\left(1-\phi\right)Cov^*(R_{J,}R_D)\right] \end{aligned} \tag{7}$$

where ϕ is the share of listings in Jamaica and the last term on the right hand side is the covariance between the two financial shocks multiplied by portfolio weights. The variables with a * superscript are measured by using ϕ_F^*. The covariance term is given by $Cov^*(R_{J,}R_D) = \left(1-\phi_F^*\right)\rho_{jd}\sigma_J\sigma_D + \phi_F^*\rho_{fd}\sigma_F\sigma_D$. Notice here that the firm uses, and takes as given, the optimal value of ϕ_F in this second step. The maximization of equation(7) with respect to ϕ yields the following optimality condition:

$$\begin{aligned} &\left(1-\phi_F^*\right)\mu_J+\phi_F^*\left(\mu_F-\lambda\right)-\mu_D \\ &-\gamma\left[\phi Var^*\left(R_J\right)-\left(1-\phi\right)Var\left(R_D\right)+\left(1-2\phi\right)Cov^*(R_{J,}R_D)\right]=0 \end{aligned} \tag{8}$$

$$\phi^* = \frac{\left(1-\phi_F^*\right)\mu_J+\phi_F^*\left(\mu_F-\lambda\right)-\mu_D}{\gamma V^p} + \frac{Var\left(R_D\right)}{V^p} - \frac{Cov^*(R_{J,}R_D)}{V^p} \tag{9}$$

where V^p is given by, $V^p = Var^*\left(R_J\right) + Var\left(R_D\right) - 2Cov^*(R_{J,}R_D)$. According to the expression above, the investor chooses to cross-list a higher proportion of its shares in Jamaica if the expected returns in Jamaica are relatively higher, the variance of the domestic financial shock is a larger component of the portfolio variance and if the correlation between the two financial shocks is negative and large in magnitude. The latter implies that the firm chooses to invest in Jamaica if

[6] The investor's share of foreign assets without the negative correlation, $\phi_F^{*'} = \frac{[(\mu_F-\lambda)-\mu_J]/\gamma+\sigma_J^2}{\sigma_J^2+\sigma_F^2}$, is less (more) than the share with the negative correlation if $\phi_F^{*'} < 0.5$ ($\phi_F^{*'} > 0.5$).

doing so offers a greater hedge against domestic financial risk.

The central focus of this paper is on the effects of capital flow regulation. For this purpose, we derive the sensitivity of investment shares to regulatory taxes as follows:

$$\frac{d\phi_F^*}{d\lambda} = -\frac{1}{\gamma\left(\sigma_J^2 + \sigma_F^2 - 2\rho_{jf}\sigma_J\sigma_F\right)} \tag{10}$$

$$\frac{d\phi^*}{d\lambda} = -\frac{\phi_F^*}{\gamma} - \phi^*\frac{dV^p}{d\lambda} + \frac{\left(\mu_J - \mu_F + \gamma\rho_{fd}\sigma_F\sigma_D - \gamma\rho_{jd}\sigma_J\sigma_D\right)}{\gamma^2\left(\sigma_J^2 + \sigma_F^2 - 2\rho_{jf}\sigma_J\sigma_F\right)} \tag{11}$$

$$\frac{d\left(1-\phi_F^*\right)\phi^*}{d\lambda} = \frac{\phi_F^*}{\gamma\left(\sigma_J^2 + \sigma_F^2 - 2\rho_{jf}\sigma_J\sigma_F\right)} + \left(1-\phi_F^*\right)\frac{d\phi^*}{d\lambda} \tag{12}$$

First of these sensitivities, given by equation (10), shows how an increase in regulation affects the share of US dollar drainage from Jamaica. In particular, an increase in capital outflow taxes, prompts the investor to reduce the share of her funds (already in Jamaica) to foreign assets which, in turn, mitigates US dollar drainage.

Equation (11) shows that stricter regulation can also curb the share of cross-listings in Jamaica. According to the first term on the right hand side, this negative effect is larger if the optimal allocation to foreign assets is larger in the investor's Jamaican portfolio. In other words, if Jamaican capital markets act only as a source of funding for US dollar investments outside of Jamaica, higher taxes on capital outflows would deter firms from cross listing in Jamaica. The second term on the right hand side shows the distortionary effects of regulation on portfolio variance. Specifically, the optimal choice between foreign and domestic assets are distorted by capital outflow taxes and there is a deviation from the balanced portfolio variance V^p. This deviation would be positive if Jamaican financial shocks are relatively more volatile and if foreign assets are a better hedge against domestic financial risk compared to Jamaican assets. The third term on the right hand side suggests that the negative effects of restricting outflows would be mitigated to the extent that Jamaican assets offer a higher rate of return.

To summarize we find that regulation can increase the share of funds in Jamaica by restricting outflows but it could also shrink the amount of funds entering Jamaica at the same time. The optimality condition in equation (12) shows these two potentially counteracting effects of regulation on Jamaican capital markets. The first term on the right hand side shows the positive

effects of limiting US dollar drainage and the second term shows the potentially negative effects of regulation on capital inflows. Below we calibrate and simulate our model to compare the strength of these two counteracting effects.

4.2 Quantitative analysis

In this section, we first use data from Jamaica, the US and Trinidad and Tobago to simulate our model and determine how the investment decisions of a T&T investor would be altered by the changes in Jamaican capital outflow regulation. We then measure the benefits of foreign cross-listing for Jamaican investors by comparing two portfolios: one with and one without the foreign cross-listing. Finally, we use cross-country data to determine how capital outflow regulation is related to the stability of portfolio flows.

4.2.1 Regulation and investment shares

To draw quantitative inferences from the model described in the previous section, we obtain financial market data for three economies: Jamaica, T&T, and the US. The economies of T&T and the US represent the domestic and foreign economies in the model and Jamaica is the host nation. As a first step, we measure the average capital gains, μ_J, μ_D and μ_F, as the average annual return on the general stock market indices, Jamaican Stock Exchange (JSE), Trinidad & Tobago Stock Exchange (TTSE), Wilshire 5000, Total Market Index (W5000) over the monthly sample spanning 2009:01 to 2020:07. When using JSE and TTSE indices we subtract the changes in USD exchange rates (local currency per US dollar) to obtain the US dollar returns on stocks. We use the same exchange rate adjusted returns to fix the volatility and the covariance variables in the model. Since we use exchange rate adjusted returns for Jamaica and T&T, we use both the changes in the exchange rate and the stock returns to measure financial market volatility in these two countries. Specifically, let $\varepsilon_{e,t}$ and $\varepsilon_{s,t}$ denote the changes in the exchange rate and the local currency denominated stock returns then the financial market volatility is measured as $vol\left(\varepsilon_{e,t}\right) + vol\left(\varepsilon_{s,t}\right) + 2cov\left(\varepsilon_{e,t}, \varepsilon_{s,t}\right)$. The average annual stock market returns in the sample period for Jamaica, T&T and US are 11.17, 2.51 and 11.75, respectively. The corresponding asset return volatilities are 17.62, 2.87 and 13.39, respectively. Note here that the smaller volatility in

T&T is mainly due to the fixed exchange rate regime in this country.

The key free parameter in our simulations is λ that represents regulatory costs. We proceed by calculating the optimal values of the share parameters, ϕ^* and ϕ_F^* that correspond to the different values of λ. It is useful to note here again that ϕ^* represents that optimal share of stock offerings in Jamaica (cross-listings) for a T&T investor, and ϕ_F^* represents this investor's share of funds raised in Jamaica that are converted to US dollars and invested in US assets.

Figure 5 displays the effects of changing regulatory costs (the x-axis values) on investment shares (y-axis values). The figure demonstrates these effects for different levels of investor risk aversion. If the risk aversion parameter increases, the investor assigns greater weight to the volatility of a portfolio, and its portfolio choice is driven by the mean values of assets returns otherwise. It should be noted here that 2.5 is a commonly used value for the coefficient of risk aversion in the literature. In all figures (more apparent in the first two), regulation has two counteracting effects. First, as demonstrated by the dashed line, the share of T&T investor's cross-listed funds (ϕ^*) decreases as the regulatory costs increases. The reason is that the potential earnings from converting cross-listed funds to US dollars and investing these funds abroad decreases with more strict CFM. Given lower prospects for returns, the T&T investor allocates a smaller share of its investment to Jamaica. Second, the T&T investor has smaller gains from taking the funds that they already have in Jamaica out of the country when regulatory costs of doing so increases. Therefore, as demonstrated by the blue dotted line, the share of investor's funds that remain in Jamaica ($1-\phi_F^*$) increase. In these figures we also report the total share of investment that enters and remains in Jamaica $\phi^* [1 - \phi_F^*]$ with the solid black line. This line is relatively stable in all four figures suggesting that the two effects of regulation mostly offset each other.

It should also be noted here that regulation has greater impact if the cross-listing foreign investors are less risk averse. Under this scenario they are more motivated by returns and if regulatory costs decrease net returns, they choose not to cross-list in Jamaica or leave Jamaica if they have already cross-listed their shares. As the coefficient of risk aversion increases, the investor discounts the disparity in returns at a greater rate and they focus more on volatility. As displayed in the bottom two figures, if risk aversion is considerably high, regulation has very little impact on investment shares and the investor chooses the assets that have the lowest volatility

and those that offer the highest diversification benefits.

Notice here that the difference between the red dashed line and the solid line represents US dollar drainage from the Jamaican economy. This difference shrinks as regulatory costs increase indicating that while regulation may not necessarily increase total foreign investment in Jamaica, it does curb US dollar drainage.

We proceed by conducting two sensitivity analyses. First, we measure investment shares for different levels of market returns. The results from this exercise are reported in Figure 6. To derive the first set of figures, we decrease and increase the Jamaican stock market return by 25 percent. The figures reasonably show that the investor allocates a greater share of its assets to Jamaica if returns are higher. The more important inference here is that the suppressing effect of regulation on US dollar drainage is stronger if Jamaican assets offer lower returns on average as shown in the second figure on the top. Given lower returns, the T&T investor converts a greater share of its funds to US dollars and exits the country. Regulatory restrictions are thus more binding and effective under this scenario. The figures in the middle row indicate that the level of cross-listings increase (decrease) if T&T asset market returns are lower (higher). The figures in the bottom row demonstrate that US dollar drainage is higher when US dollar assets offer a higher return and that CFM regulation is more effective under this parameterization.

Second, we alter the volatility and covariance of asset returns to observe the impact of regulation on the amount of funds that enter and remain in Jamaica. As displayed in Figure 7, we do this for all three of the economies. The central observation in the top figure is that if Jamaican asset volatility decreases, the positive effects of regulation on limiting US dollar drainage dominates the negative effects of regulation on incentives to cross-list and the amount of funds that enter and remain in Jamaica increase. This is more clearly observed if the volatility of Jamaican assets is much smaller compared to its baseline value. The middle figure as expected show that if T&T assets offer lower volatility for the investor, they choose to remain in T&T and the funds in Jamaica decrease, with regulation having the same effects it does under the baseline scenario. The results in the bottom figure suggest that if US dollar denominated foreign assets are more volatile, the T&T investor has less to gain by cross-listing and thus the total share of foreign investment in Jamaica decreases. With a higher level of US asset volatility, increasing regulatory

costs is less powerful as the decision to buy foreign assets is driven mostly by higher volatility rather than returns.

Figure 8 shows the share of funds that are invested and remain in Jamaica for alternative asset return covariance values. Specifically, we change the covariance between Jamaican and US asset returns to higher, lower and negative values. We find that investment shares are higher when covariance is low or negative as Jamaican assets offer a better hedge against US investments. While the funds that leave Jamaica also increase, outflows are less than inflows given the greater hedging opportunities. For each simulation, regulation has a negative impact on the total funds in Jamaica as it decreases the returns to hedging. The decline in the shares is more pronounced when US-Jamaica asset return covariance is more negative.

4.2.2 Other considerations

So far, we have considered capital outflow restrictions as the only deterrent to dollar drainage. It is, however, reasonable to postulate that capital inflows would also serve the same purpose. In this section, we alter the portfolio choice model described above to introduce restrictions on the inflow side. Specifically, the foreign investor now pays a tax to cross-list shares in Jamaica but faces no taxes when she decides to take her funds out of the country. Using this framework we re-derive the optimal share of funds converted to US dollars and invested in US dollar denominated assets as,

$$\phi_F^* = \frac{\left[\mu_F - \mu_J\right]/\gamma + \sigma_J^2 - \rho_{jf}\sigma_J\sigma_F}{\sigma_J^2 + \sigma_F^2 - 2\rho_{jf}\sigma_J\sigma_F}. \tag{13}$$

Notice here that the regulatory parameter does not affect the optimal mix between Jamaican and US dollar assets in the absence of outflow taxes. Using ϕ_F^* in the second stage maximization problem, we find the optimal share of funds allocated to Jamaica as,

$$\phi^* = \frac{\left(1-\phi_F^*\right)\mu_J + \phi_F^*\mu_F - \lambda - \mu_D}{\gamma V^p} + \frac{Var\left(R_D\right)}{V^p} - \frac{Cov^*(R_J, R_D)}{V^p} \tag{14}$$

where the regulatory parameter λ now represents the taxes on the funds brought from T&T. Compared to the baseline expression taxes have a bigger impact on ϕ^*. The reason is that the taxes apply to every unit of capital entering Jamaica instead of the fraction of these units that

leave the country.[7]

We use the same data from the US, Jamaica and T&T to simulate the model and obtain quantitative inferences. The results are displayed in Figure 9. The top two graphs can be used to compare the results with outflow and inflow restrictions. With inflow restrictions, the optimal share of funds allocated to US assets (share of funds that remain in Jamaica), ϕ_F^*, is independent of the regulatory parameter as explained above. Compared to earlier simulations, there is a sharper decline in the share of funds brought to Jamaica which in turn causes a drop in the total amount of capital in Jamaica.

Next, we include taxes on both sides. In doing so, we evenly distribute the burden of taxes across inflows and outflows so that the investor pays the tax rate $\lambda/2$ if she takes out a unit of capital from Jamaica or brings a unit of capital into Jamaica. The simulation results displayed in the first subplot of the middle row show that while the restrictions are able to decrease the migration of capital from Jamaica, this effect is weaker compared to the baseline case and with the disproportionate drop in capital inflows, the amount of capital in Jamaica declines with higher taxes.

As mentioned in the introduction, a common theoretical prediction is that (see, Fernandez et al., 2015 and Cardarelli et al., 2010) countercyclical capital regulation is welfare enhancing for countries. While empirical evidence shows that these policies are not typically used in developing countries, a natural experiment for our analysis would be to track the behavior of international investors if Jamaica were to follow a cyclical regulatory policy. We, therefore, proceed by re-calculating optimal portfolio shares when regulatory policy is either procyclical or countercyclical. We assume that when policy is procyclical, capital outflow taxes decrease (increase) when asset returns in Jamaica increase (decrease). Conversely, we assume that there is positive relationship between outflow taxes and asset returns under a countercyclical policy. Notice that the latter is a "lean against the wind" policy that suppresses the influx of capital as investors face higher taxes when pulling funds out of the country. When simulating procyclicality, we assume that returns linearly approach zero as regulatory taxes reach their maximum value. When simulating counteryclicality, conversely, we assume that the return on Jamaican assets increase to two times

[7] With capital outflow taxes, the share of funds that leave the country, ϕ_F^*, also decrease, reducing the impact of taxes on ϕ^*.

its baseline value when taxes approach their maximum value.

The results displayed in Figure 9 show that with procyclical policy higher taxes prompt a more substantial drop in the amount of capital in Jamaica as higher regulatory taxes correspond to lower returns on Jamaican assets. The investor allocates a smaller share of funds to Jamaica compared to the baseline scenario with acyclical regulation because she not only faces higher taxes when investing in US assets but also lower returns on the funds she keeps in Jamaica. By contrast, a countercyclical policy keeps the total amount of funds in Jamaica stable. Share of funds entering Jamaica decrease while higher taxes and higher return on assets have a relatively offsetting effect on the optimal shares allocated to Jamaica. This decline in funds is counteracted by the higher share of retained funds as now the investors are less inclined to leave (drain reserves). This finding is consistent with the common theoretical welfare enhancing property of countercyclical policies in the literature and it justifies their usage in regulating capital flows.

4.3 Benefits to Jamaican investors

In this section, we approach the issue from a different angle and investigate the benefits of the cross-listing to Jamaican investors. While this analysis is not directly related to capital outflow restrictions, it can provide critical information that either justifies or invalidates these restrictions. For example, if the cross-listed shares are highly volatile, with low returns and low diversification benefits then capital outflow restrictions that discourage investors who are entering Jamaica to obtain US dollars and invest elsewhere would be more appropriate.

To conduct this analysis we solve the following maximization problem for a Jamaican investor:

$$\max\ U = \mu_J \phi_J + \mu_i (1 - \phi_J) - \frac{\gamma}{2} \left[Var(R_J) (\phi_J)^2 + Var(R_i) (1 - \phi_J)^2 + 2\phi_J (1 - \phi_J) Cov(R_i, R_F) \right] \tag{15}$$

where U is the utility function, and μ_J and μ_i are the mean returns on a JSE exchange traded fund (ETF) and the foreign company i's stock, respectively. The objective is to find the optimal weight, ϕ_J, using historical data and to measure and compare the investor's utility with and without the foreign company's stock. The higher the utility with the cross-listing and higher the optimal value of $1-\phi_J$, the higher are the benefits from the foreign company's entry (cross-listing).

The maximization problem yields the following optimality condition:

$$\phi_J^* = \frac{(\mu_J - \mu_i)/\gamma + Var(R_i) - Cov(R_i, R_F)}{Var(R_J) + Var(R_i) - 2Cov(R_i, R_F)} \tag{16}$$

To compute this ratio, we use stock price data for 4 foreign shares cross-listed in the JSE. In addition, we use the Jamaican cross-listed shares index. The data are monthly and span the period August 2019 to May 2022. In measuring stock returns we use the last observation of the month. The sample period choice is determined by data availability. In our computations, we use different levels for the risk aversion parameter γ.

The first 5 columns of Table 1 report average returns and standard deviation of the returns for the five shares and the JSE, and also the correlation between the 5 shares and the JSE. Notice first that since our sample period mostly overlaps with the COVID-19 pandemic, majority of the returns and the investors utility during this period are negative. Second, while all five shares have lower returns and higher volatility compared to the JSE, they offer significant diversification benefits as they exhibit a low, and sometimes negative, level of correlation with the JSE. Given these benefits, a Jamaican investor is able to reduce the volatility of her portfolio by holding foreign shares as displayed in column 7. Despite lower average returns, her utility is also higher for the portfolio that includes the cross-listed share and thus the portfolio weight for these shares are positive or the most part. We do, however, obtain a slight short position for the shares of firm 2 when the risk aversion parameter is equal to 1. According to our calculations, firm 3 offers the best investment opportunity as the investor is able to gain greater utility through diversification and lower portfolio volatility. The inferences are similar when we use different parameter values for risk aversion. As the parameter value decreases, the investor assigns higher weights to foreign shares that offer higher returns. It should be noted that while we only consider reasonable values for risk aversion parameter, the ordering of the firms in terms of their weight can significantly change for extreme values of γ.

The more general inference here is that the cross-listing of foreign shares is beneficial to Jamaica and that any regulatory policy that stunts this activity could increase financial volatility. These inferences, however, could change depending on the characteristics of future cross-listings.

Our framework in this section offers a straightforward guideline to determine whether a new cross-listing is justified or not from the perspective of general financial market stability.

5 Regulatory restrictions and capital flows

In this section, we explore the relationship between capital restrictions and capital flows by estimating panel models with cross-country data. While we carry out a number of tests throughout the section, the focus is on the projection we make above. Specifically, our computational analysis above predicted that capital outflow restrictions can be more stabilizing for the total amount of capital in an economy than capital inflow restrictions. To test whether this prediction is supported by data, we configure three different specifications.

5.1 Methodology

In the first model, we distinguish between different levels and types of capital restrictions by using a dummy variable approach. This model is given by,

$$\begin{aligned}\tilde{I}_{i,t} = \mu_1 + \beta_1' F_{i,t-1} + \gamma_{lh}' F_{i,t-1} * D_{i,t-1}^{lh} + \gamma_{ll}' F_{i,t-1} * D_{i,t-1}^{ll} + \\ \gamma_{hl}' F_{i,t-1} * D_{i,t-1}^{hl} + \lambda_{lh} D_{i,t-1}^{lh} + \lambda_{ll} D_{i,t-1}^{ll} + \lambda_{hl} D_{i,t-1}^{hl} + \varepsilon_{i,t}\end{aligned} \tag{17}$$

where $\tilde{I}_{i,t}$ represents the growth rate of net capital inflows (the growth of capital inflows minus the growth of capital outflows) in country i in year t, $I_{i,t}$, relative to the average growth rate of capital inflows in the sample, $\bar{I}_t$, and it is given by $\tilde{I}_{i,t} = I_{i,t} - \bar{I}_t$. We measure inflows in this form to account for global surges and retrenchments in portfolio flows that can affect countries symmetrically. The vector $F_{i,t}$ includes factors that are possible drivers of capital inflows. In the baseline formulation, we use the country specific real GDP growth rate, $\tilde{Y}_{i,t}$ (also measured relative to sample averages), as a local pull factor and the growth rate of a global financial market volatility index as the global push factor. We do estimate our model with alternative sets of factors in our sensitivity analysis.

The unique part of the specification above is our definition of the dummy variables. We classify countries into 4 groups in each year by using measures of capital restrictions (see below

for a description). A country, say country i, is designated with the lh superscript in year t if it has lower capital inflow and higher capital outflow restrictions relative to the average levels of these restrictions in this year and the dummy variable $D^{lh}_{i,t} = 1$. We follow a similar approach to construct dummy variables that represent low inflow and low outflow restrictions, $D^{ll}_{i,t}$, and high inflow and low outflow restrictions, $D^{hl}_{i,t}$. Notice here that countries with high inflow and high outflow restrictions serve as the comparison group. The dummy variable coefficients, therefore, represent the impact of regulations on inflows relative to countries with high restrictions on both types of flows. Our focus in equation (17) is also on the interactive variable coefficients. The signs of these coefficients determine the effects of regulation on the sensitivity of inflows to local pull and global push factors. If for example the β coefficient corresponding to local GDP growth is positive and the corresponding γ_{lh} coefficient is negative then this implies the pull effects of economic growth on capital inflows is weaker in a country with low inflow and high outflow restrictions.

The second model that we use can be represented as follows:

$$\tilde{I}_{i,t} = \mu_2 + \beta_2' F_{i,t} + \lambda_{ki}\tilde{R}^{ki}_{i,t-1} + \lambda_{ko}\tilde{R}^{ko}_{i,t-1} \tag{18}$$
$$\gamma_{ki}' F_{i,t}\tilde{R}^{ki}_{i,t-1} + \gamma_{ko}' F_{i,t}\tilde{R}^{ko}_{i,t-1} + \eta_{i,t}.$$

The indices that we use to capture the degree of capital regulations are continuous variables. In the specification above we utilize this nature of the data. The variable $\tilde{R}^{ki}_{i,t-1}$ represents the deviation of country i's capital inflow regulation variable from the average level of inflow restrictions. The variable $\tilde{R}^{ko}_{i,t-1}$ is similarly constructed to gauge the relative level of outflow restrictions in country i. The interactive variable coefficients then have a similar interpretation. If the γ coefficient has the same sign as the corresponding β coefficient and both coefficients are significant, for example, this could indicate an increase in the sensitivity of net inflows to the factor. Conversely, if the two coefficients have different signs this would suggest lower sensitivity. While this approach allows us to more fully utilize the capital restrictions data, we should note a potential shortcoming. If countries that have high inflow restrictions also have high outflow restrictions and vice versa then the power of the tests could be weakened by the high colinearity between $\tilde{R}^{ki}_{i,t-1}$ and $\tilde{R}^{ko}_{i,t-1}$.

The final specification that we use is a hybrid model containing features from both approaches above. This specification is given by,

$$\tilde{I}^{r}_{i,t} = \alpha' F^{r}_{i,t-1} + \upsilon_{i,t} \tag{19}$$

where $\tilde{I}^{r}_{i,t}$ and $F^{r}_{i,t-1}$ similarly represent the growth rate of capital inflows and the pull and push factors, respectively. This time however the country-specific variables are measured differently. As in the first model, we divide countries into 4 groups based on their relative levels of inflow and outflow restrictions (hh, lh, ll, hl). The country specific variables are measured relative to the average value of the corresponding variable for the hh group. The relative capital inflow and GDP growth rate variables for a country i at time t in the hl group, for example, are given by $\tilde{I}^{r,hl}_{i,t} = I^{hl}_{i,t} - \bar{I}^{hh}_{t}$ and $\tilde{Y}^{r,hl}_{i,t} = Y^{hl}_{i,t} - \tilde{Y}^{hh}_{t}$. The positive values of these variables imply that the inflow and GDP growth rate of country i (a high inflow, low outflow restriction country in year t) are higher than the corresponding average growth rates across high inflow high outflow restriction countries in year t. The α coefficients then can be interpreted as the responsiveness of capital inflows to domestic and global factors relative to countries with high inflow and high outflow restrictions.

In estimating all three models described above, we use the linear fixed effects estimator of Correia (2015) that allows us to include both time and country fixed effects. It is important to note here that there are two aspects of our methodology that mitigate endogeneity risks. First, the capital restriction measures that we use (see below for a description) are mostly time invariant for the countries in our sample. The lower degree of volatility is especially noticeable when compared with that of capital flows. Second, for a majority of the countries in our sample, it is reasonable to assume that global push factors are exogenously determined. Most of the economies in our sample are too small to have any major effect on global financial markets. While this cannot be said for a few large open economies in our sample, leaving them out in our sensitivity analyses does not change our main inferences as discussed below. Finally, using the lagged value of the right hand side variables reduces the chances of reverse casuality especially given that data set is annual in frequency.[8] We should also note here that given the large time dimension of our sample, the fixed

[8] All Granger casuality tests reject the null hypothesis that current capital flow growth rates Granger-cause lags

effects estimator that we use is a better option given the Nickell bias in Arellano–Bover/Blundell–Bond type dynamic panel estimations with relatively large number of time periods.

5.2 Data

To estimate the three models described above, we combine three sets of data and form an annual panel data set with 100 countries, both developing and developed, and 25 years (1995 to 2019).[9] The first set of data is obtained from the International Financial Statistics (IFS) database. The most critical measure that we construct from these data is the growth rate of net portfolio equity inflows. To derive this measure we subtract the growth rate of portfolio equity investment assets from the growth rate of portfolio equity investment liabilities. Here, the liability variable is the inflow component as it represents the purchase of corporate securities by nonresidents and the assets variable is the outflow variable as it represents the purchase of foreign corporate securities by the residents of a country. From the IFS database we also obtain macroeconomic variables that capture local economic conditions and therefore could drive capital flows. Hereafter, we refer to these variables as pull factors. In our baseline estimations, we use the real GDP growth rate as the pull factor. In our sensitivity analysis, we do use the changes in unemployment, interbank lending rates, and US dollar reserves as alternative pull factors.

Turning to push factors, those that originate outside of the country that drive capital flows, we use the growth rate of the Chicago Board Options Exchange Volatility Index (VIX) as our baseline measure. High values of this index indicates heightened perception of risk in equity markets not only in the US but also throughout the world. We also use the growth rate of US federal funds rate and the spread between the Moody's Seasoned Baa Corporate Bond yield and the yield on 10-Year Treasury bills at constant Maturity as two alternative measures. These

of the pull and push factors, and capital flow restrictions at the 10% level.

[9] The countries in our sample are: Algeria, Angola, Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Bolivia, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Canada, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Georgia, Germany, Ghana, Greece, Guatemala, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Islamic Republic of, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Kenya, Kingdom of Eswatini, Korea, Kuwait, Kyrgyz Republic, Latvia, Lebanon, Malaysia, Malta, Mauritius, Mexico, Moldova, Morocco, Myanmar, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Singapore, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia.

measures are considered by many to be driver of financial flows across countries (see for example, Miranda-Agrippino and Rey, 2020). The data used to construct our push measures are obtained from the Federal Reserve Bank of St. Louis, FRED database.

Next, we combine the capital flow, push and pull factor data described above with indices of capital flow restrictions provided by Fernández et al. (2016). The authors build on IMF's Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) to collect de jure information and then compile this information to form restriction indices, with higher values indicating a higher degree of restriction. In their narrative approach, they convert no/yes survey questions to 0/1 values and take averages across different asset classes to construct overall indices. The indices are reported on an annual frequency and they date back to 1995. We use the authors' updated data set that includes indices up to 2019. This is the reason why our sample period spans 1995 to 2019. The indices that we use (the overall restrictions index) captures the degree of restrictions on both the inflow and outflow of various capital types including equity, bonds, derivatives, direct investment, money market instruments The overall restriction indices are measured as the average restrictions across all instruments. Both the inflow and outflow restriction indices range between 0 and 1 and are continuous variables. In estimating our first and third models described above, we classify countries as hl, hh, lh, ll restriction countries in a given year by comparing their corresponding restriction index to its average value in that year.

5.3 Results

The results obtained from the estimation of model 1 are displayed in Table 2. The table displays the results for different definitions of pull and push factors. To obtain the results in the first three columns we use the real GDP growth rate as the pull factor. Since our regression variables are measured as deviations from average values across countries and since the push factors are the same for each country in a given time period, these factors only appear in the interactive terms and not as separate variables. The results in the first row suggest that while GDP growth rate is a significant determinant of net portfolio inflows (inflow growth rate minus outflow growth rate), unemployment, interest rates and foreign currency reserves are not significantly related to these flows. In the estimations with the alternative pull variables, the VIX index growth rate is the push

factor. The value 0.381 reported in the first row of the first column suggest that if a country's real GDP grows by 1 percent more than the average growth rate across countries in a given year, the growth rate of her portfolio inflows are 0.381 percent higher than the average growth rate across all countries in the next year.

The signs and the significance of the three dummy variables suggest that countries with lower restrictions on the inflow side or both sides experience faster portfolio inflow growth compared to countries with high restrictions on both inflows and outflows. The insignificance of the high inflow, low outflow restrictions coefficient implies that lower restrictions attract portfolio flows only if they apply to the inflow side of a country's capital market. The inferences are similar for the other push and pull factors that we use (columns 2, 3, 5 and 6).

The coefficients of the interactive variables that include push factors suggest that an increase in the risk perception of global investors, a US monetary tightening and an increase in corporate credit risk prompt a faster retraction/outflow of capital from countries that have high inflow and high outflow restrictions. This is a key observation in our paper. It suggests that the de jure restrictions are not effective in curbing outflows of capital from countries under adverse global financial conditions. Given that countries with higher capital controls are also those that are more prone to financial volatility, our results imply that there is a stronger retrenchment of capital from countries with higher controls when global financial markets are turbulent. The coefficients of the interactive terms with GDP growth point in the same direction. The negative and significant coefficients suggest that a negative GDP growth generates a more rapid outflow of capital from countries with high inflow and outflow restrictions relative to the countries under other classifications. We should note, however, that the coefficients of the interactive terms with the pull factors are less significant compared those with the push factors, only significant when GDP growth rate is the pull factor. Notice also that the coefficients of the interactive terms with high inflow, low outflow restrictions are all insignificant. These results, similar to the coefficients of the restriction dummy variables, demonstrate that the liberalization of restrictions on the inflow side of capital markets is more important than doing so on the outflow side.

Next, we include the continuous inflow and outflow restriction variables in our estimations of model 2. In these estimations, the variables have the similar form as they are measured as

deviations from average values across countries. Panel A of Table 3 reports the coefficients and their corresponding standard errors side by side. The results in the first two columns show that inflow and outflow restrictions are negatively and positively related to capital flows, respectively. The disparity in the results from model 1 and model 2 estimations is one other important finding in our paper. Specifically, this disparity implies that while restrictions on the inflow and outflow side of capital markets, when considered independent of the other, have the expected relationship with capital flows, with inflow restrictions reducing inflows and outflow restrictions entrapping capital (and hence increase net capital inflows relative to other countries), the relationship can change when the restrictions are considered together. High inflow restrictions, for example, reduce capital inflows only if they are matched with high outflow restrictions. Moreover, the insignificant interactive variable coefficients imply that our nuanced approach to investigating capital restrictions is important for capturing the sensitivity of capital flows to pull and push factors. The results displayed in the last set of columns confirm this projection. To obtain this results we include both the continuous and categorical measures of the restriction variables. The results show that the coefficients of the interactive terms with the continuous restriction variables are insignificant while the categorical dummies and their interaction with the push factor, similar to our previous results, are significantly related to capital inflows. The significant coefficients also have the same signs as those in our estimations of the first model.

We proceed by estimating the third model where the pull and the capital inflow variables are measured relative to the average values across countries with high inflow and high outflow restrictions. The results displayed in Table 4, consistent with our earlier inferences, generally demonstrate that the sensitivity of net capital inflows to capital restrictions is only related to push factors. Pull factors, by contrast, are not related to the said sensitivity. This observation is made by considering the different measures of pull and push factors displayed in the column headers. More specifically, the positive and significant coefficient of the push factor implies that the inflows of capital for countries that have either low inflow, or low outflow restrictions or have both low inflow and low outflow restrictions grow faster than the inflows of countries with high inflow and high outflow restrictions when global financial market risk is heightened. Conversely, if these economies grow faster than economies with high restrictions on both side of the market

do not attract a relatively higher level of capital.

Our findings indicating that there is a shift of capital from countries with high restrictions to those with low restrictions could potentially reflect flight to quality. As a final test, we estimate all three models by excluding data from the G-7 economies and Switzerland since these countries serve as safe havens during financial turmoil. In these estimations we use the VIX and the real GDP growth rate to capture the push and pull drivers of capital, respectively. The signs and significance of the coefficients displayed in Table 5 are similar to those in our earlier estimations. Moreover, we find that the coefficient estimates are not significantly different from their baseline counterparts. These results indicate that our inferences apply to both smaller and larger economies of the world. We should also mention that excluding other advanced economies produced similar coefficients but these coefficients became less significant as we omitted more countries.

6 Conclusion

This paper demonstrated that capital outflow restrictions are effective tools to stabilize the amount of foreign capital in an economy and that there is no evidence that they stunt the growth of capital markets. A simple portfolio choice model focusing on cross-listing as a form of capital inflows illustrated that while capital outflow restrictions can curb the loss of US dollar reserves, they can also disincentivize capital inflows. This inference was drawn by calibrating the model to data from Trinidad and Tobago, Jamaica and the US. Further analysis revealed that outflow restrictions and countercyclical capital flow management are preferable to inflow restrictions and procyclical policies, respectively, when fostering financial stability. Our numerical analysis also demonstrated that discouraging cross-listing for Jamaica could be costly for Jamaica as the cross-listed shares offer utility gains for Jamaican investors. The final part of the paper used a panel data set with 100 countries and 25 years to investigate the relationship between capital flows and capital restrictions (both on the inflow and the outflow side). The results showed that net capital inflows have grown faster in countries with low level of restrictions and that these flows skew towards the more liberal economies when global financial markets are more volatile. Local pull factors, by contrast, were relatively less important for capital flows. More importantly the results revealed that it is inflow restrictions, not outflow restrictions, that are negatively related to the

total amount of capital in the economy.

There are several natural directions that future research can take in light of these findings. In our portfolio choice model we have considered only the short term effects of capital outflow restrictions. Our empirical finding that net capital inflows are negatively related to restrictions, however, could imply that restrictions can decrease the amount of foreign capital in the economy in the long-run. One interesting direction for future research could be to extend the framework in this paper by distinguishing between long-run and short-run costs of pulling capital out of a country. This would allow one to compare the short-run and long-run effects of capital flow management.

Given data availability, our panel data analysis focused on portfolio inflows and not the volume of cross-listing. Investigating how the latter form of capital flows interact with restrictions, and push and pull factors would be a natural way to proceed with this research topic. This direction has not been taken to the best of our knowledge.

In our model, we approached the interaction of capital flows and restrictions from the perspective of a nonresident investor. If capital outflow restrictions apply asymmetrically to residents and nonresidents in a country, our framework would be appropriate. However, if outflow restrictions do not distinguish between residents and nonresidents, it would be necessary to extend the model to accommodate this aspect of restrictions. In our numerical analysis, we also assume that the buyers of the cross-listed shares are residents. It would be informative to re-configure the model so that the cross-listed shares are partially purchased by nonresidents, who bring in US dollars to buy these shares. While this mechanism is outside the scope of our analysis since investors in our model are mainly cross-listing to obtain US dollars, we predict that the strength of our findings would be diminished if the buyers of the cross-listed shares are nonresidents who bring US dollars to Jamaica.

In our estimations we use *de jure* restrictions. It would be interesting to derive market-based measures that capture *de facto* restrictions and incorporate these in our empirical specifications. Our results point to the possibility that the inferences from the two types of restrictions can be different.

Finally, our policy recommendations apply only to capital types that enter the country only

to access hard currencies and leave. It would be necessary to measure the potential negative externalities generated by outflow restrictions that do not discriminate between these short-term potentially damaging flows from those that are long-term and an important source of funding for economic growth. We should, however, mention that the restrictions in our analysis would be more binding for investors that do not intend to keep their funds in Jamaica for a long period of time.

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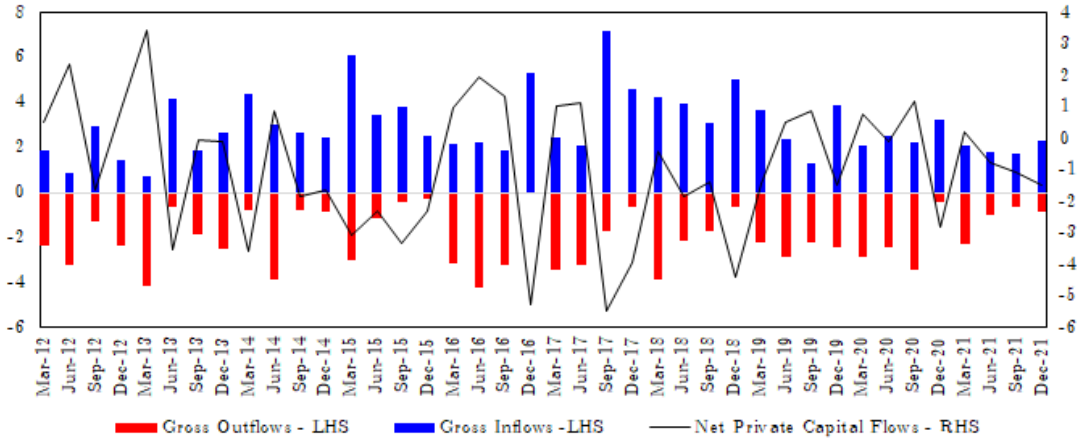
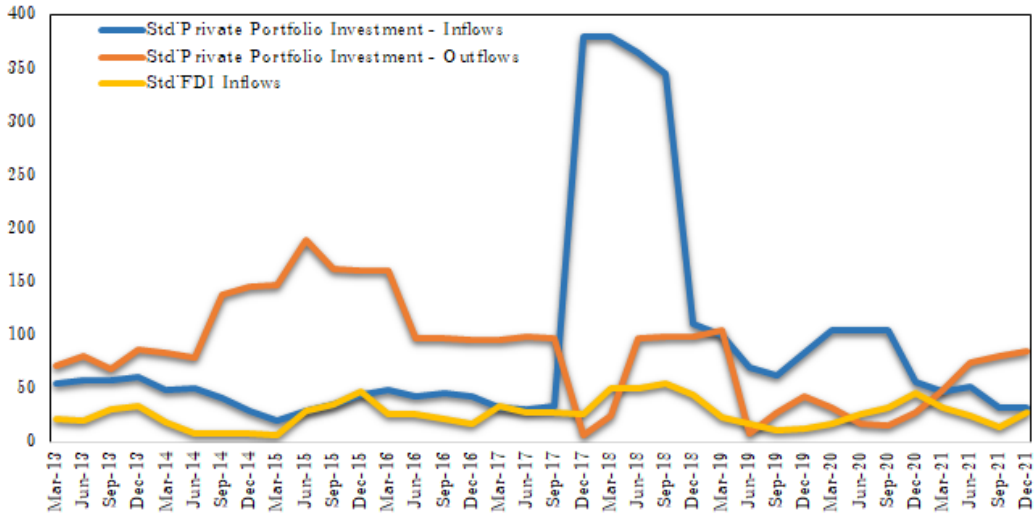
Figure 1. Evolution of Gross and Net Capital Flows (Percent of GDP)



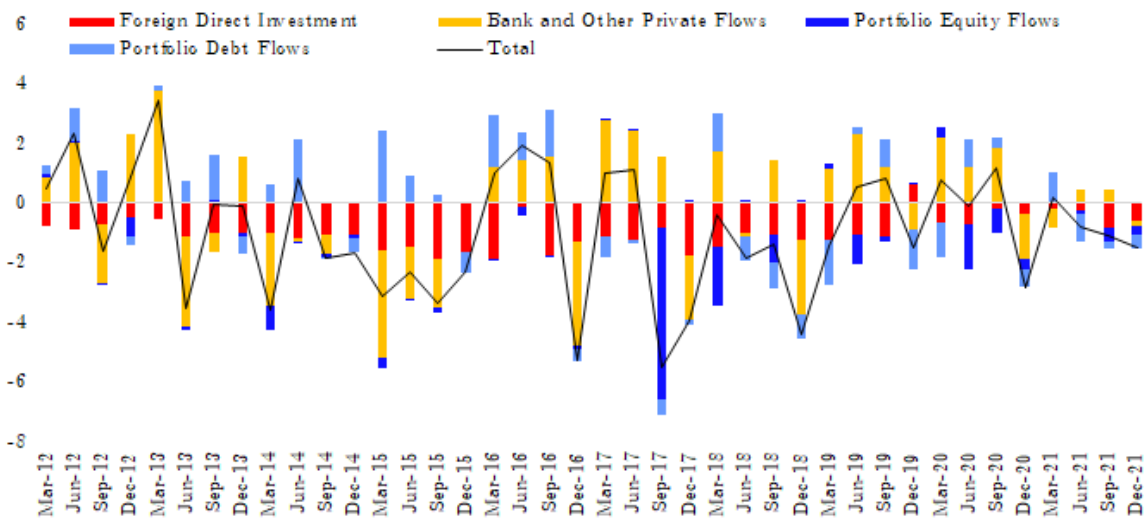
Note: Net private capital flows are the sum of private foreign direct investment, portfolio, derivative, and other investment flows in net terms. Gross capital inflows and outflows include both private and official flows.

Figure 2. Volatility of Portfolio and FDI Flows (US dollars, millions)



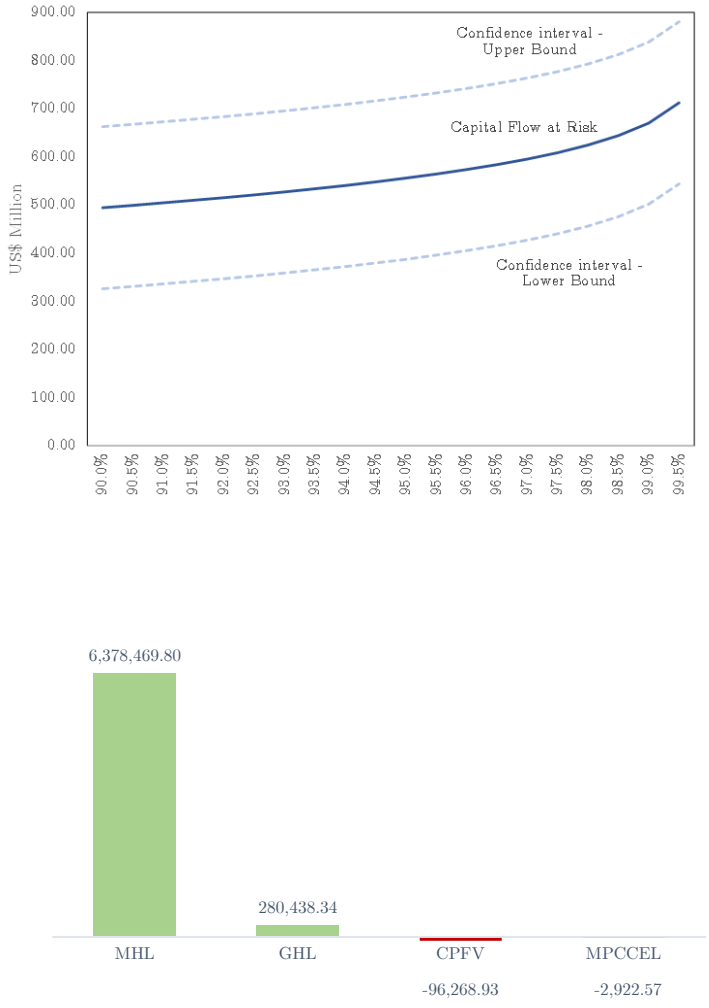
Note: Standard deviations are measured by using monthly data.

Figure 3. Composition of Private Capital Flows (Percent of GDP)



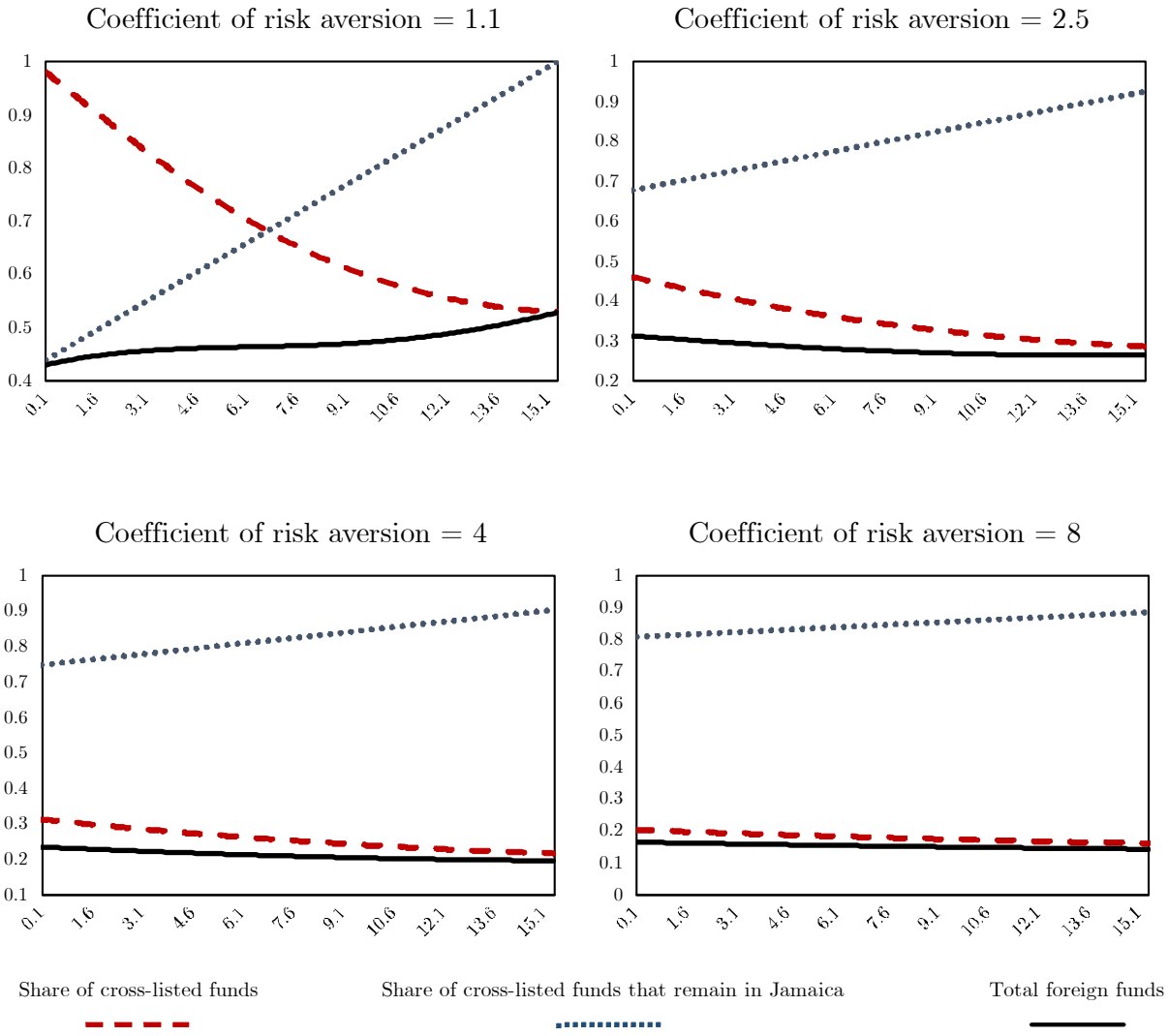
Note: Private flows in the figure represent net amounts (inflows minus outflows).

Figure 4. Capital Flow at Risk - Non-FDI Private Capital Outflows



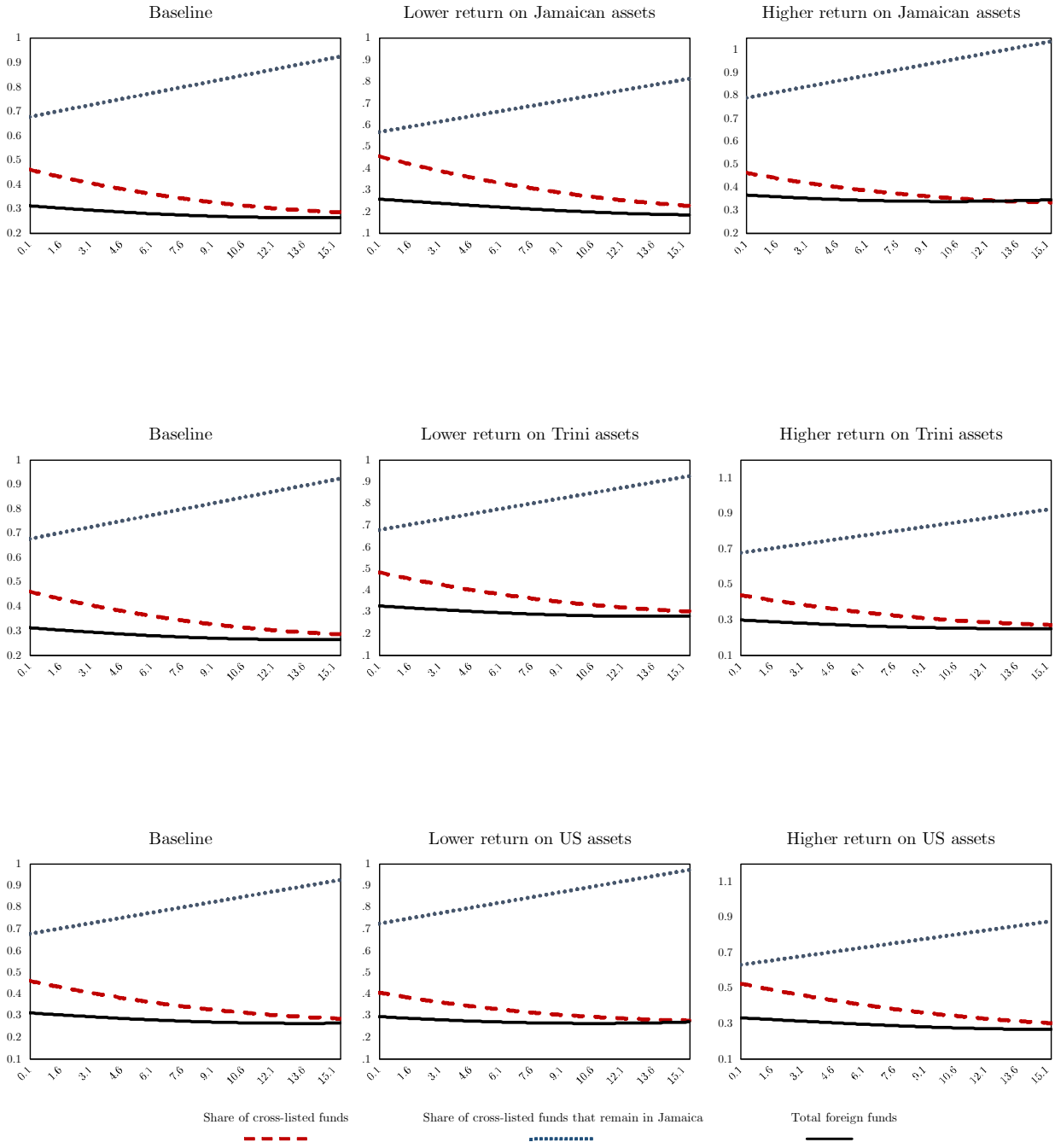
Note: The confidence intervals are measured at 95%.

Figure 5. Regulation and capital flows



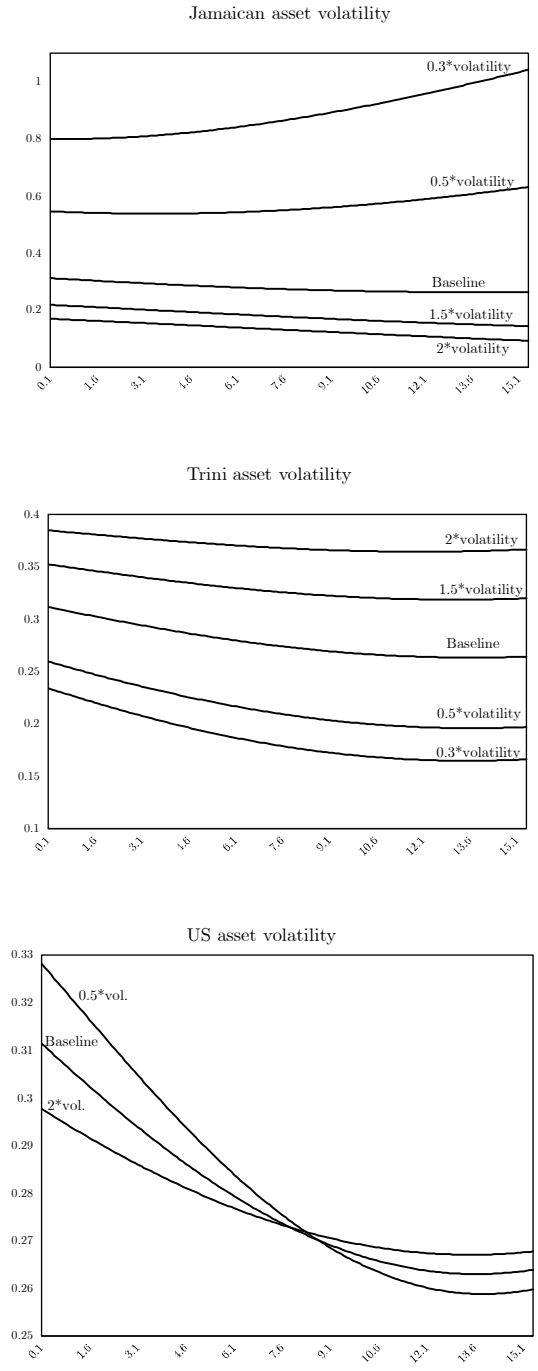
Note: This figure shows how the share of a foreign investor's funds cross-listed in Jamaica, the share of the cross-listed funds that are liquidated, converted to US dollars and invested in foreign assets (i.e., US dollar drainage), and the funds that remain in Jamaica depend on the level of capital outflow taxes in Jamaica.

Figure 6. Regulation and returns



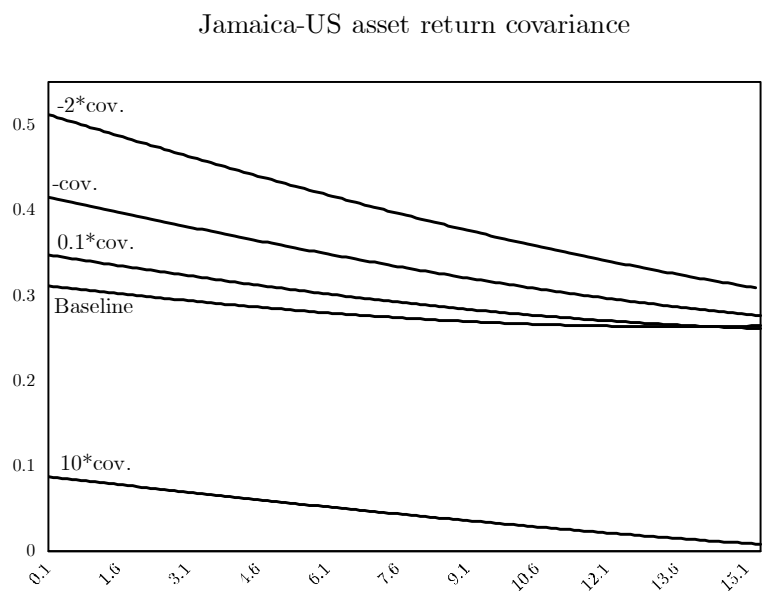
Note: This figure shows how the share of a foreign investor's funds cross-listed in Jamaica, the share of the cross-listed funds that are liquidated, converted to US dollars and invested in foreign assets (i.e., US dollar drainage), and the funds that remain in Jamaica depend on the level of capital outflow taxes in Jamaica. Higher and lower returns in the three countries represents 25% deviation from the baseline returns.

Figure 7. Regulation and asset return volatility



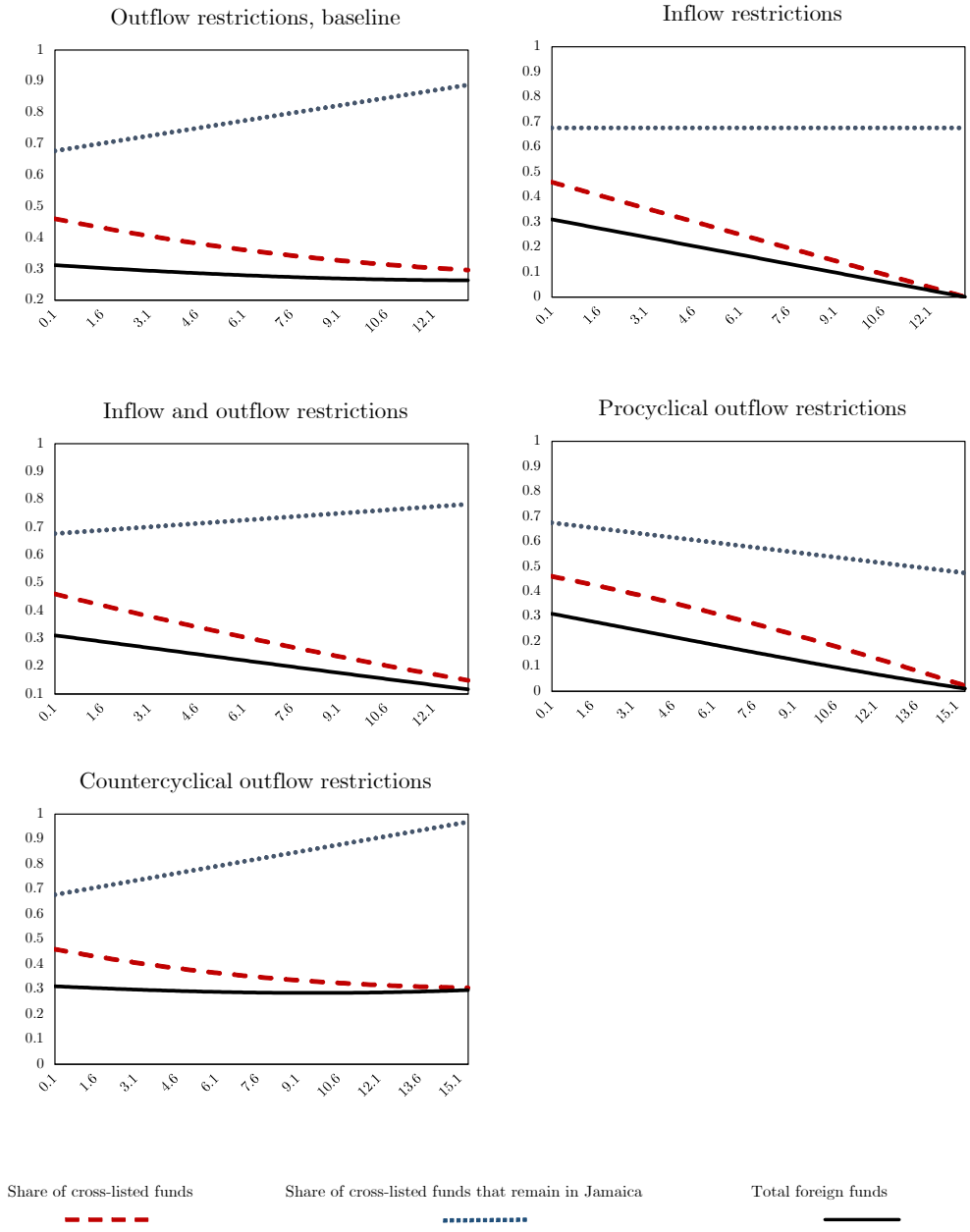
Note: This figure shows how the share of a foreign investor's funds that remain in Jamaica depend on the level of capital outflow taxes in Jamaica for different levels of asset market volatility.

Figure 8. Regulation and asset return covariance



Note: This figure shows how the share of a foreign investor's funds that remain in Jamaica depend on the level of capital outflow taxes in Jamaica for different levels of covariance between the US and Jamaican asset market returns.

Figure 9. Inflow restrictions and the cyclicality of regulation



Note: This figure shows how the share of a foreign investor's funds cross-listed in Jamaica, the share of the cross-listed funds that are liquidated, converted to US dollars and invested in foreign assets (i.e., US dollar drainage), and the funds that remain in Jamaica depend on the level of capital outflow taxes in Jamaica. For inflow restrictions the regulatory taxes are applied to inflow of capital and for inflow and outflow restrictions the taxes apply to both types of flows. The asset market returns are negatively and positively related to the degree of regulation for the simulations with procyclical and countercyclical regulation, respectively.

Table 1. Benefits of cross-listing for Jamaican investors

	Firms	JSE Return	JSE Volatility	Firm Return	Firm Volatility	Firm, JSE Covariance	Portfolio Return	Portfolio Volatility	Utility without cross-listed	Utility with cross-listed	Portfolio weight of cross-listed
Coefficient of risk aversion = 2.5	Firm 1	0.798	4.380	-1.430	10.392	0.179	0.595	4.254	-23.179	-22.022	0.091
	Firm 2	0.798	4.380	-40.923	43.261	-0.032	0.610	4.358	-23.179	-23.131	0.005
	Firm 3	0.798	4.380	-3.473	5.877	-0.145	-0.682	3.264	-23.179	-13.996	0.347
	Firm 4	0.798	4.380	0.714	10.248	0.092	0.787	4.150	-23.179	-20.743	0.130
	Cross-listed shares index	0.798	4.380	-0.575	10.207	0.050	0.609	4.096	-23.179	-20.358	0.138
Coefficient of risk aversion = 1	Firm 1	0.798	4.380	-1.430	10.392	0.179	0.622	4.258	-8.793	-8.444	0.079
	Firm 2	0.798	4.380	-40.923	43.261	-0.032	1.159	4.445	-8.793	-8.722	-0.009
	Firm 3	0.798	4.380	-3.473	5.877	-0.145	-0.503	3.302	-8.793	-5.954	0.305
	Firm 4	0.798	4.380	0.714	10.248	0.092	0.787	4.150	-8.793	-7.825	0.129
	Cross-listed shares index	0.798	4.380	-0.575	10.207	0.050	0.619	4.097	-8.793	-7.775	0.131
Coefficient of risk aversion = 4	Firm 1	0.798	4.380	-1.430	10.392	0.179	0.588	4.253	-37.566	-35.589	0.094
	Firm 2	0.798	4.380	-40.923	43.261	-0.032	0.473	4.348	-37.566	-37.335	0.008
	Firm 3	0.798	4.380	-3.473	5.877	-0.145	-0.727	3.259	-37.566	-21.971	0.357
	Firm 4	0.798	4.380	0.714	10.248	0.092	0.787	4.150	-37.566	-33.661	0.130
	Cross-listed shares index	0.798	4.380	-0.575	10.207	0.050	0.607	4.095	-37.566	-32.938	0.140

Note: This table compares the returns and volatilities of the JSE with the 4 foreign cross-listed shares and the cross-listed shares index. The last five columns report the returns, volatilities, investor utilities and the weights associated with the optimal portfolios (portfolios that maximize investors' utility) for different risk aversion parameter values.

Table 2. Panel estimations, model 1

	Push variables			Pull variables		
	VIX	Federal funds rate	Baa/T-Bill spread	UE Rate	Interest rates	Reserves
Pull	0.381	0.375	0.380	-0.020	-0.009	-0.024
	(0.203)*	(0.203)*	(0.204)*	(0.032)	(0.038)	(0.034)
Low inflow, high outflow restriction dummy	0.031	0.028	0.031	0.019	0.033	0.024
	(0.014)*	(0.015)*	(0.014)**	(0.015)	(0.014)**	(0.013)*
Low inflow, low outflow restriction dummy	0.023	0.019	0.023	0.015	0.027	0.023
	(0.014)*	(0.014)	(0.014)*	(0.014)	(0.014)**	(0.012)*
High inflow, low outflow restriction dummy	0.001	0.001	-0.003	-0.016	0.021	0.004
	(0.028)	(0.028)	(0.028)	(0.024)	(0.026)	(0.024)
Low inflow, high outflow restriction * pull	-0.455	-0.432	-0.431	0.031	0.072	-0.016
	(0.309)*	(0.297)	(0.311)	(0.035)	(0.066)	(0.038)
Low inflow, high outflow restriction * push	0.032	0.018	0.050	0.029	0.032	0.028
	(0.015)**	(0.010)*	(0.019)***	(0.017)*	(0.022)	(0.015)*
Low inflow, low outflow restriction * pull	-0.591	-0.631	-0.561	0.052	0.070	0.021
	(0.256)**	(0.251)**	(0.255)**	(0.038)	(0.055)	(0.038)
Low inflow, low outflow restriction * push	0.021	0.013	0.062	0.017	0.023	0.021
	(0.008)***	(0.007)*	(0.01)***	(0.005)***	(0.012)*	(0.007)***
High inflow, low outflow restriction * pull	-0.819	-0.672	-0.806	0.189	-0.092	0.013
	(0.609)	(0.550)	(0.581)	(0.116)	(0.102)	(0.07)
High inflow, low outflow restriction * push	0.028	0.038	0.068	0.031	-0.016	0.012
	(0.038)	(0.024)	(0.045)	(0.026)	(0.025)	(0.02)
Intercept	-0.045	-0.043	-0.044	-0.031	-0.045	-0.040
	(0.011)***	(0.011)***	(0.011)***	(0.01)***	(0.01)***	(0.009)***
Dependent variable lags	-0.165	-0.125	-0.142	-0.120	-0.217	-0.153
	(7.02)***	(5.43)***	(6.06)***	(16.33)***	(6.12)***	(9.02)***
Number of observations	1,051	1,051	1,051	1,024	785	1,217
R-squared	0.051	0.055	0.067	0.030	0.069	0.042

Note: This table reports the results obtained from the estimation of equation (17). The numbers in parentheses are the standard errors except for those corresponding to the dependent variable lags. The latter are the F-statistics.*, **, *** significant at 10%, 5%, 1%, respectively.

Table 3. Panel estimations, model 2

	Baseline		Without interactive terms		Including categorical dummies	
Pull	0.013	(0.113)	-0.054	(0.110)	0.444	(0.468)
Inflow restrictions	-0.060	(0.029)**	-0.058	(0.029)**	-0.004	(0.04)
Outflow restrictions	0.052	(0.024)**	0.044	(0.023)*	0.103	(0.031)***
Inflow restrictions * pull	-0.306	(0.783)			-1.053	(1.149)
Inflow restrictions * push	-0.047	(0.038)			0.057	(0.043)
Outflow restrictions * pull	0.916	(0.559)			0.645	(0.883)
Outflow restrictions * push	0.014	(0.031)			-0.008	(0.033)
Low inflow, high outflow restriction dummy					0.043	(0.02)**
Low inflow, low outflow restriction dummy					0.076	(0.023)***
High inflow, low outflow restriction dummy					0.040	(0.030)
Low inflow, high outflow restriction * pull					-0.762	(0.568)
Low inflow, high outflow restriction * push					0.045	(0.020)**
Low inflow, low outflow restriction * pull					-0.688	(0.767)
Low inflow, low outflow restriction * push					0.033	(0.010)***
High inflow, low outflow restriction * pull					-0.778	(0.764)
High inflow, low outflow restriction * push					0.028	(0.040)
Intercept	-0.028	(0.005)***	-0.027	(0.496)***	-0.071	(0.015)***
Dependent variable lags	-0.168	(7.02)***	-0.162	(6.94)***	-0.172	(7.43)***
Number of observations	1,051		1,051		1,051	
R-squared	0.048		0.043		0.058	

Note: This table reports the results obtained from the estimation of equation (18). The numbers in parentheses are the standard errors except for those corresponding to the dependent variable lags. The latter are the F-statistics.*, **, *** significant at 10%, 5%, 1%, respectively.

Table 4. Panel estimations, model 3

	Push variables			Pull variables		
	VIX	Federal funds rate	Baa/T-Bill spread	UE Rate	Interest rates	Reserves
Pull	-0.130	-0.194	-0.091	0.020	0.044	0.020
	(0.148)	(0.126)	(0.145)	(0.014)	(0.03)	(0.011)*
Push	0.007	0.017	0.041	0.005	0.003	0.008
	(0.003)**	(0.005)***	(0.003)***	(0.002)***	(0.005)	(0.003)**
Intercept	-0.024	-0.025	-0.024	-0.023	-0.026	-0.026
	(0.002)***	(0.001)***	(0.002)***	(0.001)***	(0.004)***	(0.002)***
Dependent variable lags	-0.122	-0.054	-0.103	-0.124	-0.122	-0.115
	(191.87)***	(1.79)	(109.15)***	(241.35)***	(83.83)***	(143.58)***
Number of observations	793	793	793	732	499	846
R-squared	0.0202	0.0198	0.0202	0.008	0.010	0.009

Note: This table reports the results obtained from the estimation of equation (19). The numbers in parentheses are the standard errors except for those corresponding to the dependent variable lags. The latter are the F-statistics.*, **, *** significant at 10%, 5%, 1%, respectively.

Table 5. Estimations excluding G-7 data

	Model 1		Model 2		Model 3	
Pull	0.396	(0.231)*	0.045	(0.125)	-0.050	(0.127)
Push					0.007	(0.004)*
Inflow restrictions			-0.083	(0.034)**		
Outflow restrictions			0.068	(0.028)**		
Inflow restrictions * pull			-0.418	(0.897)		
Inflow restrictions * push			-0.054	(0.049)		
Outflow restrictions * pull			1.015	(0.633)		
Outflow restrictions * push			0.015	(0.038)		
Low inflow, high outflow restriction dummy	0.041	(0.017)**				
Low inflow, low outflow restriction dummy	0.033	(0.015)**				
High inflow, low outflow restriction dummy	0.002	(0.035)				
Low inflow, high outflow restriction * pull	-0.399	(0.350)				
Low inflow, high outflow restriction * push	0.016	(0.030)				
Low inflow, low outflow restriction * pull	-0.596	(0.283)**				
Low inflow, low outflow restriction * push	0.030	(0.009)***				
High inflow, low outflow restriction * pull	-0.771	(0.804)				
High inflow, low outflow restriction * push	0.015	(0.055)				
Intercept	-0.055	(0.012)***	-0.032	(0.006)***	-2.759	(0.228)***
Dependent variable lags	-0.172	(7.95)***	-0.172	(7.86)***	-0.090	(14.89)***
Number of observations	901		901		670	
R-squared	0.055		0.050		0.007	

Note: This table reports the results obtained from the estimation of equations (17), (18) and (19) with the sample that excludes observations for the G-7 countries and Switzerland. The numbers in parentheses are the standard errors except for those corresponding to the dependent variable lags. The latter are the F-statistics.*, **, *** significant at 10%, 5%, 1%, respectively.