Breaking Down Borders: The Impacts of Capital Control and Heterogeneous Spillover

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Abstract

Capital controls are used as macro-prudential policy to safeguard domestic economy from the volatility of external capital flows. However, the signaling effect of capital control interacts with the intended effect and can lead to heterogeneous outcome on gross capital flows. This paper examines possible heterogeneity in the direct and spillover effects of capital control on gross capital flows. First, I introduce the signaling effect of capital control in a portfolio choice model with a multi-country set up to demonstrate the possible heterogeneity in the direct effect and the spillover effect on gross capital flows as one country increases capital taxation on capital inflows. I argue that the direct effect and spillover effect of capital control can be heterogeneous on capital inflows due to the signaling effect of capital control. To validate the heterogeneity, I use quarterly capital flows data to different institutional sectors in a spatial econometric framework. The empirical findings indicate that the domestic direct effect of capital control moderates portfolio inflows to the public sector whereas the portfolio inflows to banks and the corporate sector does not respond to the domestic capital control measures. The spillover effect of capital control increases capital inflows to all sectors in other countries.

Keywords: Capital control, Spillover effect, Portfolio Choice, Signaling effect, Spatial Durbin Model
JEL Codes: F32,F41, C21

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1 Introduction

As global integration has intensified, emerging market economies have become more closely linked to global financial cycles. During the boom phase of these cycles, these economies have gained greater access to inexpensive foreign capital. However, when sudden stops occur, capital flight ensues, often leading to macroeconomic crises. To address this volatility in foreign capital flows, capital controls have emerged as a viable policy measure to safeguard domestic economies (Korinek, 2010, 2011; Jeanne and Korinek, 2010; Costinot et al., 2014).

However, it is important to consider that capital control measures also convey a signaling effect to foreign investors, influencing their perception of the domestic economy. Bartolini & Drazen (1997) and Drazen (1997) argue that such policies can create a negative image in the minds of foreign investors, suggesting a lack of domestic controls. Additionally, capital controls can lead to spillover effects as capital flows divert to other destination countries.

The direct and spillover effects of capital controls subsequently affect the flow of international capital across different destination countries. Notably, the nature of capital flows varies significantly across distinct institutional sectors, such as the public sector, corporate sector, and banks. Recent studies by Avdjiev et al. (2018) and Emter, Killeen & McQuade (2021) indicate that the drivers of capital flows to these sectors can differ considerably. Their findings suggest that global risk aversion plays a crucial role in driving capital flows to the banking and corporate sectors, while its effect on capital flows to the public sector is comparatively muted.

Considering the heterogeneity of capital flows across these institutional sectors, this paper examines the diverse effects of capital control policies on gross capital inflows to different sectors of the economy, specifically exploring the direct and spillover effects. Furthermore, the paper incorporates a portfolio choice model to provide a structural interpretation of this heterogeneity, particularly emphasizing the impact of the signaling effect.

This paper contributes to three significant areas of literature. Firstly, it examines the direct and spillover effects of capital controls. Secondly, it explores the impact of capital controls on capital

flows across different institutional sectors. Lastly, it proposes a structural framework to explain the heterogeneous effects of capital controls using a portfolio choice model that incorporates the signaling effect.

Capital controls have emerged as a policy toolkit for countries facing volatile capital flows. Since the early 1990s, emerging market economies have progressively liberalized their capital accounts, granting greater access to foreign financial markets. This integration has prompted global investors to rebalance their portfolios in search of higher yields. Consequently, during financial booms, these economies have experienced an influx of cheap foreign capital. However, when global financial sentiment wanes, foreign capital swiftly withdraws, leading to currency depreciation and balance of payment crises. This heightened financial integration has resulted in increased macroeconomic and financial instability (Reinhart and Rogoff, 2009). In response, policymakers have imposed capital control measures to modulate capital flows. Capital controls, often considered part of the macroprudential toolkit, effectively restrict the volatility of capital flows, safeguarding domestic economies from sudden stops and currency fluctuations, thereby promoting macroeconomic and financial stability. Such benefits have justified the implementation of capital controls (Korinek et al., 2010; Jeanne and Korinek, 2010; Costinot et al., 2014). The IMF has also emphasized the role of capital controls in ensuring financial stability (IMF, 2011, 2012), further supporting their inclusion in policy tools (Ostry, 2011 & 2011).

However, the effectiveness of capital controls has been questioned due to the signaling effect they create (Bartolini Drazen, 1997; Drazen, 1997). The imposition of capital account restrictions can be perceived as hostile by foreign investors, suggesting a lack of domestic controls and instability within the domestic economy. Consequently, capital controls have a lasting impact on capital flows to recipient countries. Recent studies by Jinjarak, Noy, and Zheng (2013) and Forbes et al. (2016) have observed similar signaling effects in their empirical analyses, with Forbes et al. noting a more pronounced effect on public sector flows. Conversely, the spillover effect of capital controls is observed through the redirection of capital flows to other destination countries. Scholars such as Giordani et al. (2017) and Pasrica et al. (2018), following Forbes et al. (2016), attribute this spillover effect to the risk transfer motives of global investors. When one country increases capital account restrictions, capital flows divert to other destinations in search of higher returns. However, this spillover exposes other destination countries to multilateral externalities affecting social welfare

(Korinek, 2011; Costinot et al., 2014).

This paper analyzes the direct and spillover effects of capital controls in a multi-country setting, focusing on portfolio inflows and other investment inflows separately. The distinction between these two types of inflows is essential as they exhibit distinct characteristics. Existing literature suggests that portfolio inflows are more responsive to capital controls due to their short-term nature (Forbes et al., 2016). In addition to this segmentation of inflows, the paper employs a novel identification strategy to analyze the direct and spillover effects of capital controls more parsimoniously. Existing empirical specifications of capital control effects impose identifying restrictions on the propagation of capital control shocks across countries. Recent studies use panel data to analyze the direct effects of capital controls, where the direct effect originates from a country's own capital account openness, and the spillover effect emerges from the capital controls of other countries. This paper extends the spatial Durbin model to analyze the impact of the direct and spillover effects, incorporating a country's own capital account openness and spatially lagged values of capital account openness from other countries (excluding the own country) in the panel regression. This approach benefits from the spatial models' ability to identify spillover effects through spatial dependence, enhancing the parsimony of the analysis

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a country's own capital account openness and spatially lagged values of capital account openness from other countries (excluding the own country) in the panel regression. This approach benefits from the spatial models' ability to identify spillover effects through spatial dependence, enhancing the parsimony of the analysis.

In addition to the identification strategy, this paper explores the heterogeneous effects of capital controls on global capital flows across different institutional sectors, namely the public, banking, and corporate sectors. Recent research by Avdjiev et al. (2018) highlights the heterogeneity of capital flows across these sectors, with varying factors influencing the flows. Global risk aversion has a more significant impact on capital flows to banks and corporations, while its effect is less significant for capital flows to the public sector. Emter et al. (2020) also examined cross-border claims of the banking sector on non-banking institutions in Ireland and found that these flows are affected by both monetary policy tightening and macro-prudential policies. Furthermore, Kim and Zhang (2020) observed that the business cycle fluctuations of global capital flows differ between private sector and public sector flows, with private sector flows generally being pro-cyclical and flows to the public sector being counter-cyclical. These findings underscore the importance of conducting a sector-wise analysis of capital flows in the context of capital control shocks.

Capital control shocks are typically designed to manage capital account openness and, as a result, impact capital flows at the aggregate level. However, the effects of such capital account restrictions can vary across sectors due to underlying heterogeneity. Therefore, a detailed analysis of the heterogeneous impact of capital controls can provide policymakers with valuable insights for designing appropriate policy measures. Moreover, the role of institutional flows also varies across different crisis episodes. For instance, sovereign debt played a significant role in the Latin American balance of payment crisis in the early 1990s (Aguiar and Amador, 2011; Gourinchas and Jeanne, 2013), while private sector flows dried up during the East Asian Crisis in 1997 (Corsetti et al., 2000; Rajan, 2009). In this study, I analyze the direct and spillover effects of capital controls on capital inflows across these institutional sectors to uncover any heterogeneity in the effects of capital controls.

Using quarterly capital flows data, this paper examines the impact of capital control measures on different institutional sectors. The results show that capital control measures have a significant moderating effect on portfolio inflows to the public sector, reducing them considerably. However, the

direct effect of capital controls has a lesser impact on inflows to banks and corporations, indicating a heterogeneous effect across sectors. This heterogeneity can be attributed to the signaling effect of capital controls, where investors perceive these measures as a lack of domestic control in the destination countries. This perception prompts global investors to rebalance their portfolios away from the public sector of foreign countries. This finding aligns with previous research by Forbes et al. (2016), where fund managers highlighted that capital control signals control risk for sovereign bonds.

Additionally, the paper observes a spillover effect of capital controls across all sectors, with a slightly higher impact on corporations followed by the banking sector. This spillover effect can be explained by the hedging mechanism and risk aversion of investors. However, the effects on other types of investments are not statistically significant. Furthermore, portfolio adjustments due to the direct and spillover effects are found to be immediate in nature. When faced with higher capital account restrictions, investors promptly adjust their portfolio debts away from the destination country imposing capital controls. This adjustment is particularly observed in portfolio flows to the public sector. On the other hand, the spillover effect begins immediately as investors realign their portfolios towards other destination countries, with the adjustment taking place over time. Corporate flows exhibit a stronger response compared to public sector flows, with the adjustment process spanning 1-3 quarters.

Based on these observations, it can be argued that the effect of capital controls on capital flows is highly heterogeneous. The signaling effect emerges as a dominant factor contributing to this heterogeneity. To support the signaling mechanism, this paper proposes a portfolio choice model in a multi-country setup. Drawing on previous works by Devereux & Sutherland (2006, 2010) and Tille & Van-wincoop (2011), the paper extends the portfolio choice framework to a three-country setting, with the capital control shock modeled as an iceberg trade cost. The signaling effect of capital controls is introduced as incomplete information in the investors' portfolio choice problem. The paper posits that the heterogeneity in signaling effect leads to heterogeneous portfolio choices, which aligns with the empirical findings. Furthermore, the comparative statics analysis demonstrates that in the absence of the signaling effect, the direct effect and spillover effect of capital controls are homogeneous in nature.

The main contribution of this paper lies in validating the heterogeneity in the effects of capital

controls across different institutional sectors and extending the findings to a portfolio choice model to identify the signaling mechanism of capital controls.

Remaining of the paper is organized as follows - The portfolio choice model is described in **Section 2**. **Section 3** describes the empirical framework, data descriptions are provided in **section 4**, empirical findings are illustrated in **Section 5**. The paper concludes with summarizing of the findings in **Section 6**.

2 Portfolio choice with signaling effect

The direct effect and spillover effect of capital control is explained using portfolio choice model augmented with signaling effect from capital control. The rationale of using signaling effect in capital control is drawn from Forbes et. al. (2016). Forbes et. al. (2016) observed that the fund managers perceive capital control as an adverse signal towards the destination country. The signal effect is considered more severe in case of sovereign bonds. I extend the signaling effect in the investors' portfolio choice problem to explain the heterogeneity in direct and spillover effect of capital control.

2.1 Set up

The structural model is built upon the portfolio choice model of Tille & Van wincoop (2011). There are three countries - Country H, F1 and F2. Each country has one type of bond with maturity of 1 year. The net supply of bonds is unity in each country. One unit of capital and one unit of labor available for production in each country. Capital control in this model is introduced as iceberg trade cost - as investors invest outside their home country, they lose their return from foreign bonds due to capital control measures. Investors have different degree of risk aversion. The signaling effect is generated due to private signal received by the investors about the future state of economy and the signal is drawn from the announcement of capital controls. Investors can invest in home country as well as foreign country bonds. The investors' choice is dictated by the optimizing their portfolio return.

2.1.1 Production and consumption

The non-portfolio part of the model is kept simple. The production function is Cobb-Douglas with labor and capital as input of production. The production function can be written as

$$Y_{it} = A_{it}(L_{it})^{\theta}(K_{it})^{1-\theta} \tag{1}$$

where θ is the labor share in the production and $(1-\theta)$ is the capital share. I assume that each country is endowed with one unit of labor and one unit of capital. Hence the production function reduces to

$$Y_{it} = A_{it} \tag{2}$$

Household utility is a CES aggregator of home produced and foreign produced goods. The consumers have home bias in consumption i.e. they spend more home produced goods. The utility function of Coutry i household is given by

$$C_t^i = \left[\sum_{j=1}^{3} {\alpha_j^i}^{\frac{1}{\sigma}} C_{jt}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{3}$$

where σ is the elasticity of substitution and α_j^i is the relative preference towards commodity produced by country j. Under the assumption of home bias, $\alpha_i^i > 0.5$. The corresponding consumer price index can be written as

$$P_t^i = \left[\sum_{j=1}^{N} \alpha_j^i P_{jt}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{4}$$

Under the assumption of one price, the assumption of home bias ensures that the relative price of the foreign goods vis-a-vis P_t^i/p_t^H captures the movement of real exchange rate.

2.1.2 Asset market

Each country has their domestic bond with maturity of 1 year. The net supply of bonds is kept as unity for simplicity. The price of country i bond is $Q_{i,t}$. The holder of country i bond has a claim of $(1-\theta)$ of the total production of country i. Hence the nominal return of bond i is given by

$$R_{i,t+1} = \frac{Q_{i,t+1} + (1-\theta)A_{i,t+1}P_{i,t+1}}{Q_{i,t}} \tag{5}$$

The portfolio choice of investors is given by $\kappa^i_{j,t}$ (for i,j = 1,2,3) where i represents the residence country of the investor and $\kappa^i_{j,t}$ stands for the destination country portfolio share of country j at time t by investor from country i. Hence, $\sum_{j=1}^{3} \kappa^i_{j,t} = 1$ for all i = 1(1)3. However, investing outside home country incurs an iceberg trade cost, represented by $\tau^i_{j,t}$. Hence the portfolio return of the investor from country i is given by

$$R^{p,i}_{t+1} = \left[\sum_{j=1}^{N} e^{-\tau^i_{j,t}} \kappa^i_{jt} R_{j,t+1}\right] \frac{P^i_t}{P^i_{t+1}} \tag{6}$$

Since the financial market is incomplete, the wealth distribution is non-stationary in nature. Hence we assume that ϕ proportion of investors die every year and new investors born with same probability. The dying investors consume their net worth whereas the new investors are not eligible to participate in the financial market. The new investors work for the first year and then they can participate in the financial market. Given that assumption, the total wealth of nation follows stationary distribution. The wealth accumulation of typical investor from country i is given by

$$\mathbf{W}^i_{t+1} = \mathbf{W}^i_t * R^{p,i}_{t+1} \tag{7}$$

The wealth accumulation of any nation differs from Eq. 7 as the iceberg trade cost are assumed to be paid to the new born investors as endowment [1]. This assumption is required to ensure that there is no permanent transfer of assets from any country. The nation's wealth accumulation is given by

$$W_{i,t+1} = (1-\phi) \underbrace{\left[\sum_{j} \kappa^i_{jt} R_{j,t+1}\right] W_{i,t} \frac{P^i_t}{P^i_{t+1}}}_{\text{Wealth accumulation from investment}} + \underbrace{\theta \frac{A_{i,t+1}P_{i,t+1}}{P^i_{t+1}}}_{\text{Labor income}} \tag{8}$$

2.1.3 Market clearing

The goods market clearing condition is given by

[1] This assumption follows Tille & Van wincoop (2011)

$$A_{i,t} = \phi \sum_{j=1}^{N} \alpha_j \left(\frac{P_t^j}{P_{i,t}} \right)^{\sigma} W_{j,t} \tag{9}$$

The financial market clears if

$$Q_{i,t} = (1-\phi) \sum_{j=1}^{N} \kappa_{it}^j W_{j,t} P_t^j \tag{10}$$

2.1.4 Signaling effect in portfolio choice

I assume that the investors get their private signal from the capital control policy. The actual iceberg trade cost is given by $\tau_{j,t}^i$. We assume that $\tau_{j,t}^i$ is solely due to capital control and $\tau_{j,t}^i > 0$. The private signal of the investors arises due to information asymmetry of investor from country i about the state of economy of country j when $i \neq j$. As foreign investors lacks information about the true state of economy of country j, the information asymmetry arises. The private signal of country i investor about country j is given by

$$\theta_{j,t+1}^i | \tau_{jt}^i \sim F^j(\tau_{jt}^i, \gamma^i) \tag{11}$$

Here, $F^j(\tau_{jt}^i, \gamma^i)$ is the distribution of the signal which depends upon the risk aversion of investor and their perception about country j.

Given the private signal, the investor from country i creates an additional wedge $\theta_{j,t+1}^i$ about the future state of economy and investor's perceived iceberg trade cost becomes [2]

$$\tau_{jt}^{i*} = \tau_{jt}^i + \theta_{j,t+1}^i \text{ for } j \neq i \tag{12}$$

Following the signaling effect from Eq. 12, the portfolio return of country i investor is now

$$R_{t+1}^{p,i} = \left[\sum_{j=1}^{N} \underbrace{e^{-\tau_{j,t}^{i*}}}_{\text{Perceived wedge}} \kappa_{jt}^i R_{j,t+1} \right] \frac{P_t^i}{P_{t+1}^i} \tag{13}$$

[2] We assume that the investor has complete information about the state of economy of his home country and hence the signaling effect is assumed to be zero for home country

2.1.5 Investor problem

The decision space of any investor is the choice of $((\kappa^i_{jt}))$ so that they can maximize their utility. The investor's Bellman equation is given by

$$V(\mathbf{W}^i_t) = (1-\phi)\beta \mathbf{E} V(\mathbf{W}^i_{t+1}) + \phi\beta \mathbf{E} U(\mathbf{W}^i_{t+1}) \tag{14}$$

where $V(\mathbf{W}^i_t)$ is the value of wealth. The first part of the future value from Bellman Equation is due to the expected value of wealth given the investor survives and the last part is due to probability of dying. We assume that the utility function is given by

$$U(\mathbf{W}^i_{t+1}) = \frac{(\mathbf{W}^i_{t+1})^{1-\gamma^i}}{1-\gamma^i} \tag{15}$$

where γ^i is the coefficient of risk aversion of investor i. We further assume that

$$V(\mathbf{W}^i_{t+1}) = e^{v+f_i(S_{t+1})} \frac{(\mathbf{W}^i_{t+1})^{1-\gamma^i}}{1-\gamma^i} \tag{16}$$

where $f_i(S_{t+1})$ is the time variation of portfolio return which depends upon the current state of economy.

The first order condition of investor choice problem is derived by maximizing the Bellman equation subject to the portfolio return from Eq. 13 and wealth accumulation equation Eq. 7. The first order condition can be derived as

$$\begin{aligned} \mathbf{E}_t \Lambda^i_{t+1} \Big(e^{-\tau^{i*}_{jt}} R_{j,t+1} - R_{i,t+1} \Big) = 0 \ \forall i \\ \Rightarrow \mathbf{E}_t \Lambda^i_{t+1} RX_{ij,t+1} = 0 \ \forall i \end{aligned} \tag{17}$$

where Λ_{t+1} is pricing kernel,

$$\Lambda^i_{t+1} = \Big((1-\phi) e^{v+f_i(S_{t+1})} + \phi \Big) \Big(R^{p,i}_{t+1} \Big)^{-\gamma^i} \frac{P^i_t}{P^i_{t+1}} \tag{18}$$

The Bellman equation reduces to

$$e^{v+f_i(S_t)} = \beta \mathbf{E}\left((1-\phi)e^{v+f_i(S_{t+1})} + \phi\right)\left(R^{p,i}_{t+1}\right)^{1-\gamma^i} \tag{19}$$

2.1.6 Effect of capital control shock

When there is no signaling effect, the comparative statics of the first order condition of the investor with respect to $\tau^1_{2,t}$ is given by

$$\begin{aligned}
\frac{\partial \kappa^1_{2t}}{\partial \tau^1_{2t}} &= \frac{1}{\Delta} * \left[-\frac{1}{\gamma}\right] * \mathbf{E}_t \Lambda^1_{t+1}(R^{p,1}_{t+1})^{-1}(RX_{13,t+1})^2 \leq 0 \\
\frac{\partial \kappa^1_{3t}}{\partial \tau^1_{2t}} &= \frac{1}{\Delta} * \left[-\frac{1}{\gamma}\right] * \underbrace{\mathbf{E}_t \Lambda^1_{t+1}(R^{p,1}_{t+1})^{-1}(RX_{13,t+1} * RX_{12,t+1})}_{\text{Hedge}}
\end{aligned} \tag{20}$$

where the first equation corresponds to the change in country 2 portfolio share in country 1's investor portfolio in response to capital control shock of country 2 and the second equation reflects the re-balancing towards other foreign country bonds in response to capital control of country 2. Here $RX_{13,t+1} = e^{-\tau^1_{3t}} R_{3,t+1} - R_{1,t+1}$ is the excess return of country 3 bonds with respect to return of investor's home country bonds. Following Eq. 20, the capital control shock reduces the portfolio share of country 2 whenever the capital account restrictions increase in country 2. The re- balancing part of the investor's portfolio is driven by the covariance of excess return between country 3 bonds and country 2 bonds. If country 3 bonds provide a perfect hedge against the risk of country 2 bonds, the investor is likely to re-balance his portfolio towards country 3.

Eq. 20 provides the mechanism of portfolio re-balancing in response to capital control shocks. The portfolio switching towards other foreign country bonds is dictated by hedging which explains relative broad-based impact of spillover effect of capital control. However, following the first equation of Eq. 20, the reduction in portfolio share of country 2 happens in every positive shock of τ^1_{2t} and hence it does not explain the heterogeneity of the direct effect of capital control on portfolio allocations. Here, the signaling effect comes into help. So we derive the same comparative statics under the assumption of signaling effect. The comparative statics is given by

$$
\begin{aligned}
\frac{\partial \kappa^1_{2t}}{\partial \tau^1_{2t}} &= \frac{1}{\Delta} * \left[-\frac{1}{\gamma} \right] * \mathbf{E}_t \Lambda^1_{t+1} (R^{p,1}_{t+1})^{-1} \Big(1 + \frac{\partial \theta^1_{2,t+1}}{\partial \tau^1_{2t}} \Big) (RX_{13,t+1})^2 \\
&= \frac{1}{\Delta} * \left[-\frac{1}{\gamma} \right] * \mathbf{E}_t \Lambda^1_{t+1} (R^{p,1}_{t+1})^{-1} \Big(1 + \frac{\partial}{\partial \tau^1_{2t}} \mathbf{E}^*_t (\theta^1_{2,t+1}) \Big) (RX_{13,t+1})^2 \\
\frac{\partial \kappa^1_{3t}}{\partial \tau^1_{2t}} &= \frac{1}{\Delta} * \left[-\frac{1}{\gamma} \right] * \underbrace{\mathbf{E}_t \Lambda^1_{t+1} (R^{p,1}_{t+1})^{-1} \Big(1 + \frac{\partial \theta^1_{2,t+1}}{\partial \tau^i_{jt}} \Big) (RX_{13,t+1} * RX_{12,t+1})}_{\text{Hedge}}
\end{aligned}
\tag{21}
$$

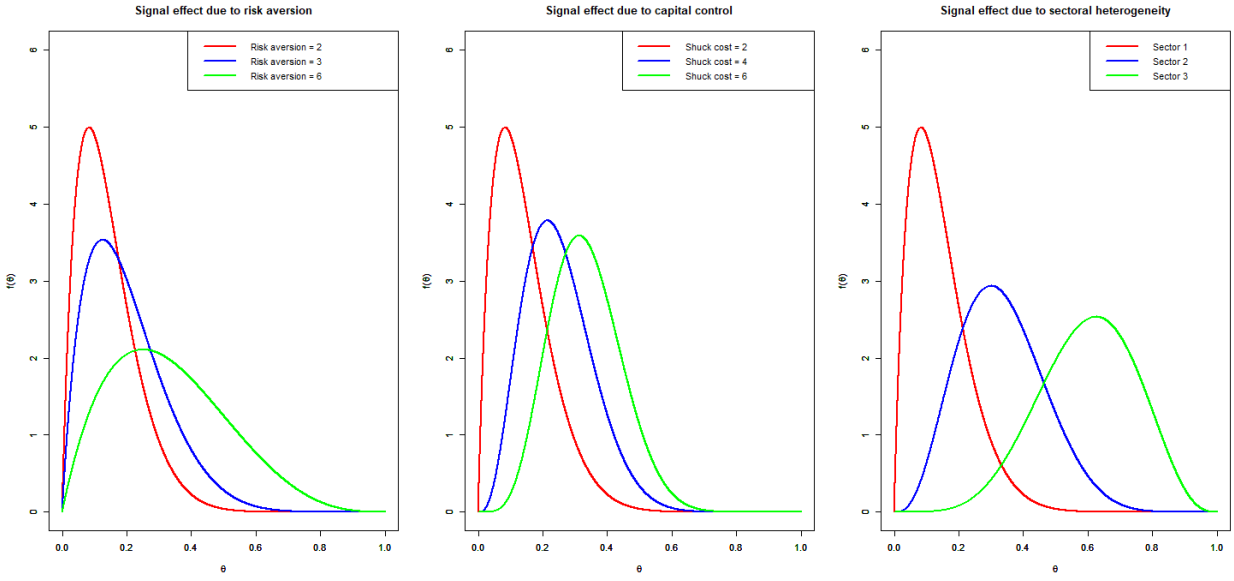
Compared to Eq. 20, the new comparative statics from Eq. 21 provides better insight about the role of signaling in the change of portfolio allocations due to capital control shock. Here, the additional term is i.e. $\Big(1 + \frac{\partial}{\partial \tau^1_{2t}} \mathbf{E}_t \theta^1_{2,t+1} \Big)$ captures the change in investor's perception about the state of economy given the capital control shocks. The source of heterogeneity in the direct effect and spillover effect is derived from this additional term. The differential change in the expected value of $\theta^i_{j,t+1}$ represents the change in private signal of investor about country 2. Any investor will make greater change in the portfolio share of country 2 bonds in his portfolio depending upon the magnitude of $\frac{\partial}{\partial \tau^1_{2t}} \mathbf{E}_t \theta^1_{2,t+1}$.

Following the fund managers' view from Forbes et. al. (2016), the change in the investor sentiment about the future state of economy of country 2 dictates the change in the portfolio share from country 2 (direct effect). If the fund managers perceives worsening of public sector due to their private signal from capital control measures, the investors will change their portfolio from public sector of country 2 to a greater extent. On the other hand, if the investors' private signal does not provide worsening off signal about the other sectors of economy (like banks and corporate), the direct effect of capital control will be muted. In terms of the spillover effect, one can use similar justification to explain the broad-based spillover effect across all sectors. The degree of hedging along with investor's private signal dictate their decision to switch to other country bonds when country 2 increases capital control.

The source of heterogeneous direct effect and spillover effect of capital control is thereby, modulated by the change in expected private signal about future wedge in response to the capital control

shocks. The expected value of $\theta^1_{2,t+1}$ depends upon the degree of risk aversion of investors and their assessment about the sector. The change in the distribution of the signal can be visually represented in following way - higher risk averse investors will adjust the value of θ^1_{2t} in greater magnitude than an investor with lower degree of risk aversion. Similarly, greater change in capital account restrictions leads to greater adjustment of θ^1_{2t} i.e. higher capital control in terms of greater tax on foreign investors will convey greater loss of investor sentiment. Finally, the sector heterogeneity in the private signal modulates the wedge parameter θ^1_{2t}. So combining these three factors, the final wedge θ^1_{2t} will be the source of heterogeneous direct effect and spillover effect (refer to Figure 1 for visual illustrations).

Figure 1: Distribution of investors' private signal



(High $\theta \rightarrow$ Low effective return)

3 Empirical Framework

To test the heterogeneity in capital control effect, I use multi country panel data set up to estimate the direct and spillover effect of capital control using a spatial Durbin model. Before getting into details, I discuss the rationale behind the choice of spatial models. The empirical framework is designed to estimate the direct and spillover effect of capital control. Though the direct effect is

relatively easier to identify, the spillover effect is difficult to quantify without suitable identifying restrictions. Unlike existing literature, the spillover shock of capital control is defined as weighted average of capital account restrictions of other countries. For instance, the spillover effect of capital control on any particular country (say, Brazil) depends upon the capital account openness of other similar countries. These other countries can be considered as destination substitutes for capital flows. Hence, increase in capital account restrictions in any one of these countries can divert capital flows towards Brazil. Hence the spillover effect is a combined measure of capital account restrictions in other countries (except own country). More specifically, the spillover shock variable can be written as

$$Cap_{it}^{Spill} = \sum_{j \neq i} W_{ij} Cap_{jt} \tag{22}$$

where W_{ij} suitable choice of weight matrix which estimates spillover and Cap_{jt} is the capital account restrictions/ openness in country j at time t. We assume that the weights are time invariant to avoid possible endogeneity in the estimation. The choice of w_{ij} dictates the spillover effect. w_{ij} can be interpreted as the weight of capital account openness/ restrictions of country j on country i. Since the choice of this weight matrix influences the empirical specification, a detailed discussion on w_{ij} is provided after the empirical specification.

Following the definition of spillover and suitable choice of weight matrix, the empirical framework can be described as follows

$$C_{it} = \gamma_D Cap_{i,t-1} + \gamma_S \sum_{j \neq i} w_{ij} Cap_{j,t-1} + \theta_D^M Macro_{i,t-1} + \beta X_{i,t-1} + \alpha_i + \epsilon_{it} \tag{23}$$

Here, i and j stands for destinations of capital flows and t represent time stamp. C_{it} is the cross - border gross flows of capital to country i at time t, $Cap_{i,t-1}$ is the measure of capital account restrictions at time (t-1), $\sum_{j \neq i} w_{ij} Cap_{j,t-1}$ is the spillover measure, $Macro_{i,t-1}$ is the macro prudential policy in country i at time (t-1), $X_{i,t-1}$ is the pull-push factors of capital flows which act as controls in the regression. α_i is the spatial fixed effects which captures country heterogeneity. The primary coefficients of interest are γ_D and γ_S. γ_D measures the direct effect of capital control and

γ_S is the spillover estimate. Here capital account restrictions, macro prudential policies and other controls are included with a lag of 1 quarter to avoid endogeneity bias.

Eq. 23 is equivalent to Spatial lagged exogenous model (SLX in short) where w_{ij} are the bilateral spatial weights. The model can be estimated using ordinary least squares. However, Eq. 23 fails to include the unobserved characteristics of investors which dictates capital flows to foreign countries. A typical example of such unobserved characteristics include investor sentiments towards these destination countries. These unobserved effects pose threat to the coefficient estimates due to omitted variable bias. In order to over the bias, I use an instrument which is weighted average of capital inflows to other destinations as proxy of investor unobserved characteristics. The rationale behind the instrument, can be drawn from the seminal work of Autor, Dorn and Hanson (2013). If the other destination countries are experiencing higher capital flows, the global investors are likely to be upbeat about their investment sentiment and that is likely to increase capital flows to destination country i. I use the same weight matrix w_{ij} to estimate the instrument variable. Here the underlying assumption is that the influence of other country's capital control spillover is proportional to the weight of those countries capital flows.

With this modification, the revised version of Eq. 23 can be written as

$$C_{it} = \rho^S \sum_{j \neq i} w_{ij} C_{jt} + \gamma_D Cap_{i,t-1} + \gamma_S \sum_{j \neq i} w_{ij} Cap_{j,t-1} + \theta_D^M Macro_{i,t-1} + \beta X_{i,t-1} + \alpha_i + \epsilon_{it} \quad (24)$$

Here the first term i.e. $\sum_{j \neq i} w_{ij} C_{jt}$ is the instrument controlling for unobserved investor characteristics.

Eq. 24 includes spatial lagged values of capital inflows and the specification follows Spatial Durbin Model (SDM). SDM models cannot be estimated using ordinary least squares due to the presence of spatial lagged terms (Elhorst, 2009). I follow the estimation methodology suggested by Elhorst (2009) and LeSage(2006,2010) to estimate the model at quarterly frequency.

Next, the empirical specification is modified by relaxing the assumption about lagged impact

of capital control. Here Eq. 24 is modified by introducing different lag length (including positive and negative lags). The negative lag value corresponds to the leading effect of capital control. A significant value of direct and spillover effect should indicate possible anticipation effect given a negative lag value. On the other hand, statistically significant coefficient value corresponding to positive lag value refers to gradual adjustment of the portfolio choice given the capital control shocks. The empirical specification can be written as

$$C_{it} = \rho \sum_{j} W_{ij} log(C_{jt}) + \gamma_{D,k} Cap_{it-k} + \gamma_{S,k} \sum_{j} W_{ij} Cap_{jt-k} + \theta^{M}_{D,k} Macro_{i,t-k} + \beta X_{it-1} + \epsilon_{it} \text{ for k = -1(1)5} \tag{25}$$

Eq. 25 is estimated using the same quarterly data and the lag values varied over (-1) quarter to 5 quarters. All the lagged variables are not included at the same time in the regression due to possible multi-collinearity issue. As the capital account restriction are slow moving variables, the subsequent lag values can be exactly identical in nature and hence, multiple lag values will create multi-collinearity, resulting in oversize coefficient estimates.

3.1 Choice of spatial matrix

As indicated previously, the choice of weights w_{ij} plays crucial role in the estimation of the direct and spillover effect. The spatial weights are derived as correlation between cross-border gross capital flows to destination i and j over time. Here the rationale is that if two countries receive similar gross capital inflows i.e. high correlation in absolute terms, they are deemed to strategic complements (if correlation is positive) or strategic substitutes (if correlation is negative). A typical global investor is likely to consider Country j as destination for his investment portfolio when country i increases capital account restrictions. With this rationale, the weights are also justified for spatial lagged variable. The choice of correlation coefficient as weight matrix can be justified from the gravity models of portfolio flows. Following the gravity equations, two countries with highly correlated capital flows are likely to have similar profile in the investors' choice set and thereby should be highly influenced by capital account restrictions of each other. However, the criticism of using time invariant correlation comes with the choice of time episodes. As the countries experience different

levels of capital account openness over time, I use full sample and sub-sample based correlation weights to quantify the spillover variable and lagged spatial variable. The weights w_{ij} is normalized such that sum of weights for country i adds up to 1 and own country weight become 0 i.e.

$$w_{ij} = \begin{cases} \frac{r_{ij}}{\sum_j r_{ij}} & \text{if } j \neq i \\ 0 & \text{if } j = i \end{cases} \tag{26}$$

where r_{ij} is the correlation coefficient between C_{it} and C_{jt} over time.

4 Data used

The Spatial Durbin Model (from Eq. 24) is estimated using quarterly data. This choice of high frequency is dictated by the findings of recent studies of capital flows (e.g. Avdjiev et. al (2018); Emter et. al. (2020) etc.). These studies observed immediate adjustments of capital flows in higher frequency. The time period of estimation is from Q1 1997 till Q4 2018. The choice of time period is dictated by the availability of quarterly cross border flows, capital account restriction index and other control variables. I consider 20 emerging market economies for the analysis given quarterly data availability. These countries are

Table 1: Choice of countries

Argentina	Brazil	Chile	Colombia	Mexico
Peru	China	India	Indonesia	Malaysia
Philippines	Thailand	South Africa	Costa Rica	Latvia
Poland	Romania	Hungary	Turkey	Ukraine

The effect of capital control is estimated on gross capital inflows given our choice of countries and the fact that majority of capital control measures adopted by these countries targeted capital inflows (Forbes et. al. (2016)). The cross-border gross capital flows data is sourced from BIS CBS and Avdjiev et. al (2018). BIS Consolidated Banking Statistics (CBS) provides cross border flows of capital inter-mediated by the banks. The data covers capital flows to banks and non-financial institutions. However, the coverage of capital flows in BIS data is mainly confined to cross-border

loans and deposits. To get a better understanding about the overall portfolio and other investment flows, the newly constructed data from Avdjiev et. al (2018) is used. This quarterly gross capital flows data provides a comprehensive coverage of capital flows covering data from IMF Balance of payments, BIS LBS and CBS data, BIS Debt Securities, World Bank data (Quarterly Debt Statistics and Debt reporting system) data with suitable imputation methods following BPM 6 accounting techniques [3]. In this data, the capital flows are segregated into portfolio flows and other investment flows. Currency & Deposits, Loans, Trade credit and Account receivables constitute other investments. The portfolio flows mainly represent portfolio debt flows as portfolio debt constitute majority of portfolio flows in balance of payment.

The shock variable is sourced from the capital account restriction index constructed by Fernandez et. al. (2016) and Pasricha et. al. (2018). One of the advantage of using these capital account restriction index is that the indices differentiates between inflow and outflow based restrictions across different asset categories. Since the analysis primarily focuses on the portfolio flows and other investment flows, we use overall inflow based restriction index as our primary shock variable. The other and most commonly used index is due to seminal work of Chinn-Ito (2008). However Chinn-Ito index is constructed at aggregate level and does not differentiate between inflows and outflows. I provide the following comparison of these three indices for reference

[3] For more details, refer to the data appendix of Avdjiev et. al (2018)

Chinn & Ito (2008)	**Fernandez** (2016)	**Pasricha** (2018)
IMF Report on Exchange Control and Exchange Openness		
		Local authority announcement
4 asset classes	6 asset classes	6 asset classes
181 countries	100 countries	16 countries
1970-2021	1995-2019	2001-2015
Aggregate	Inflow - Outflow	6 dimensions
Multiple exchange Rate	Money Market	Portfolio Debt
Current Account	Bonds	Portfolio Equity
Capital Account	Equity	FDI
Export proceeds	Mutual Fund	Financial Derivatives
	Financial Credit	Other Investment
	Derivatives	
	Commercial Credit	
	Guarantees (LOC)	
	Real Estate	
	FDI	

(Source: Author's compilation)

Next, the SDM model also includes country level macro-prudential policies as control of capital flows. The country level macro-prudential policy is sourced from IMF iMaPP database. The database provides the status of macroprudential policies by tagging binary dummy variables across each category of macro-prudential policies and the category-wise policy status is sourced from survey information sought from each country. The index, constructed by Alam et. al. (2019), is averaged across all policy categories to construct the overall index of macro-prudential policy.

The choice of control variables are sourced from existing literature of capital flows. Following Forbes and Warnock (2012), Ghosh et. al. (2014) and Giordani et. al. (2017), different pull and push factors of capital flows are included as controls in the main regression. The destination-wise pull factors include real GDP growth, domestic inflation, financial openness index (proxy by Chinn-Ito Index), exchange rate regime and exchange rate. The exchange rate regime data is sourced from Ilzetzki,Reinhart and Rogoff (2021). Domestic macro variables are sourced from IMF International

Financial Statistics database and real exchange rate data is sourced from BIS. The global push factors are global risk aversion (proxy by global VIX) and 2 years Treasury yield (as proxy of global interest rate).

Lastly, the spatial weight matrix is derived from the correlation coefficient of gross capital inflows between two countries for the full sample as well as sub-samples. I consider two sub-samples 2000-2007 and 2012-2018 to incorporate time variation in correlation values prior to global financial crisis and in recent times.

5 Empirical Findings

5.1 Direct and spillover effect of capital control

The first set of findings are reported from BIS CBS data. Table 2 reports the coefficients estimates of spatial lagged term, direct effect, spillover effect and effect of macro-prudential policy. The first few rows of the estimates are derived by using absolute value of correlation coefficient, the middle portion of the table reports the coefficient value for countries with positive correlation coefficient (i.e. strategic complement countries) and the last portion reports the coefficients for strategic substitutes. Following the coefficient values, the direct effect of own capital account restrictions is found to be negative which implies that greater capital account restrictions, reduces capital inflows to destination countries. The spillover effect, on the other hand, is positive and weakly significant. This implies that the capital inflows increase in response to capital account restrictions in other countries. Another noticeable feature from the coefficient estimates is that the estimates are stable with respect to strategic complements and strategic substitutes which implies symmetric effect. Further, it justifies to use absolute value of correlation coefficient to define spillover shocks.

Table 2: Spatial Durbin Model Estimates using BIS CBS Data

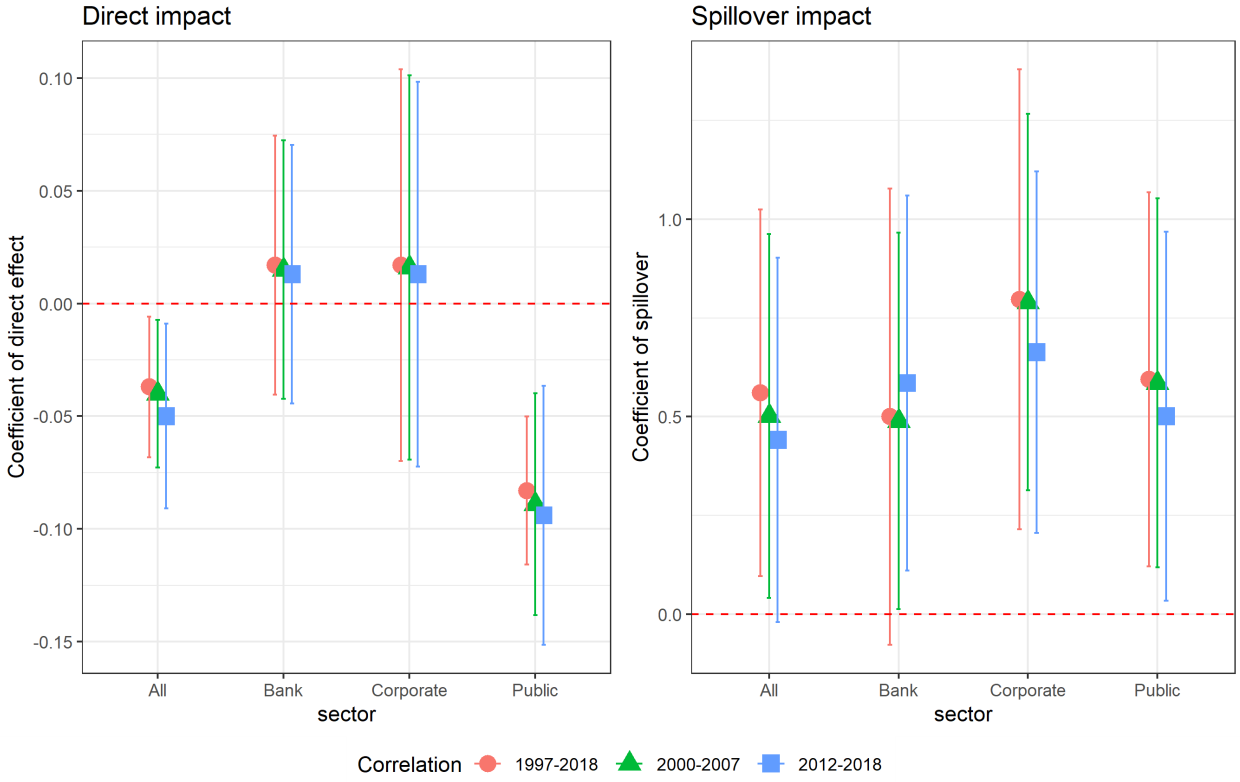
	ρ^S (Spatial AR)	γ_D (Cap. A/C Openness)	γ_S (Cap. A/C Openness)	$(\theta_D)_M$ (Macro-pru)
Absolute value of correlation coefficient				
Full sample	0.38***	-0.05	0.18***	-0.01
(1997-2018)	(0.00)	(0.11)	(0.00)	(0.44)
Latest Period	0.37***	-0.05	0.12*	0.01
(2012-2018)	(0.00)	(0.12)	(0.09)	(0.44)
Strategic complements				
Full sample	0.38***	-0.04	0.15***	0.01
(1997-2018)	(0.00)	(0.11)	(0.00)	(0.44)
Latest Period	0.37***	-0.05	0.11*	0.01
(2012-2018)	(0.00)	(0.15)	(0.08)	(0.44)
Strategic substitutes				
Full sample	-0.38***	-0.03	0.22***	0.01
(1997-2018)	(0.00)	(0.12)	(0.00)	(0.46)
Latest Period	-0.39***	-0.05	0.20*	0.01
(2012-2018)	(0.00)	(0.11)	(0.08)	(0.34)

(p-value in the bracket)

Next, we run similar regression on the portfolio flows and other investment flows data from Avdjiev et. al (2018). The coefficient estimates of direct effect and spillover effect along with 90% confidence bands are reported in Fig 2. The direct effect of capital control appears to moderate capital inflows to public sector whereas the inflows to banks and corporate remain unaffected due to the own-country capital controls. On the other hand, the spillover effect of capital control appears to be broad based compared to the direct effect. The portfolio inflow increases in response to the capital account restrictions in other countries. The spillover effect appears to be higher in case of portfolio flows to corporate sector. These results correspond to the absolute value of correlation

coefficient in the weight matrix [4]

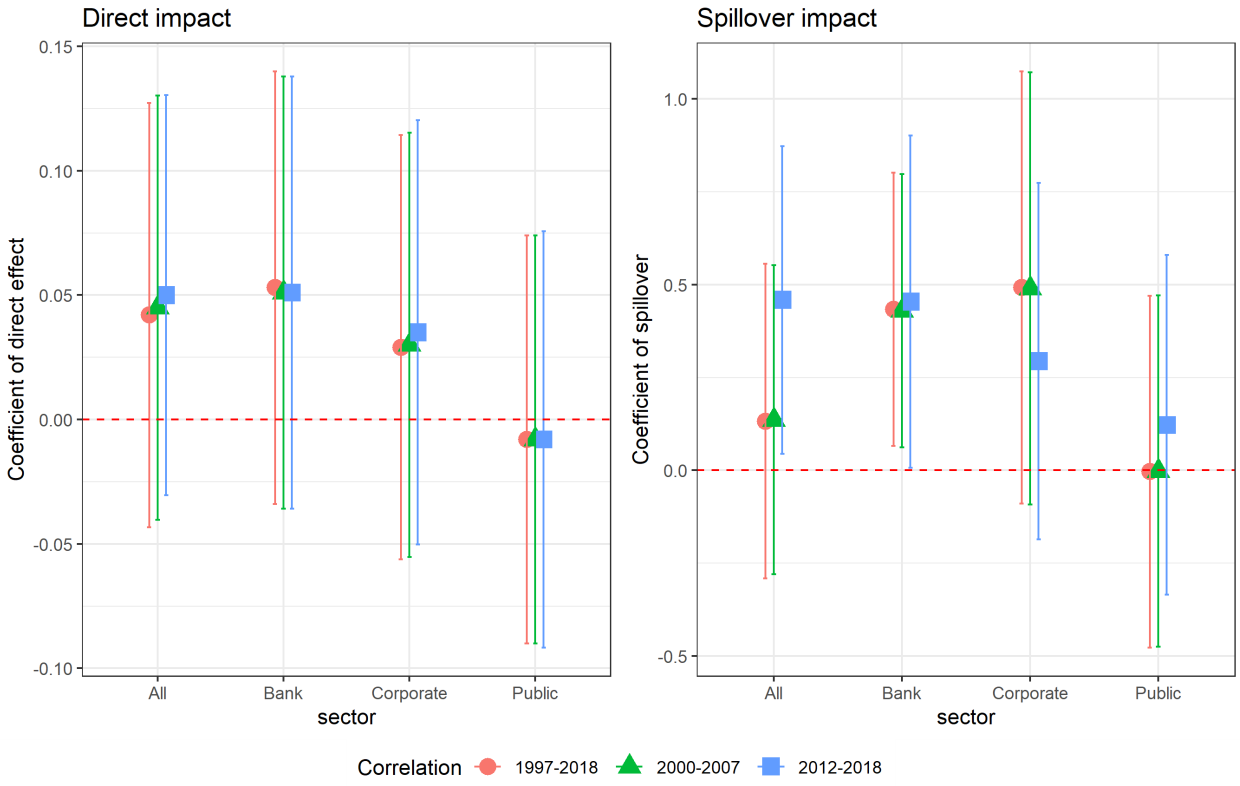
Figure 2: Direct and spillover effect on portfolio flows using Avdjiev et. al (2018)



Next, I analyze the coefficient plot of direct and spillover effect of capital control on other investment flows. The point estimates of direct effect indicates marginal negative effect of capital control on other investment inflows. However the effects appears to be statistically insignificant in nature. The spillover effect is found to be more pronounced in case the flows are directed towards corporate and banking sector. The spillover effect of capital control is almost in case of other investment flows going to public sector (refer to Figure 3).

[4]Separate regression is run for strategic complements and strategic substitute countries and results are found to be in similar lines

Figure 3: Direct and spillover effect on other investment flows using Avdjiev et. al (2018)



5.2 Direct and spillover effect of capital control with varying lags

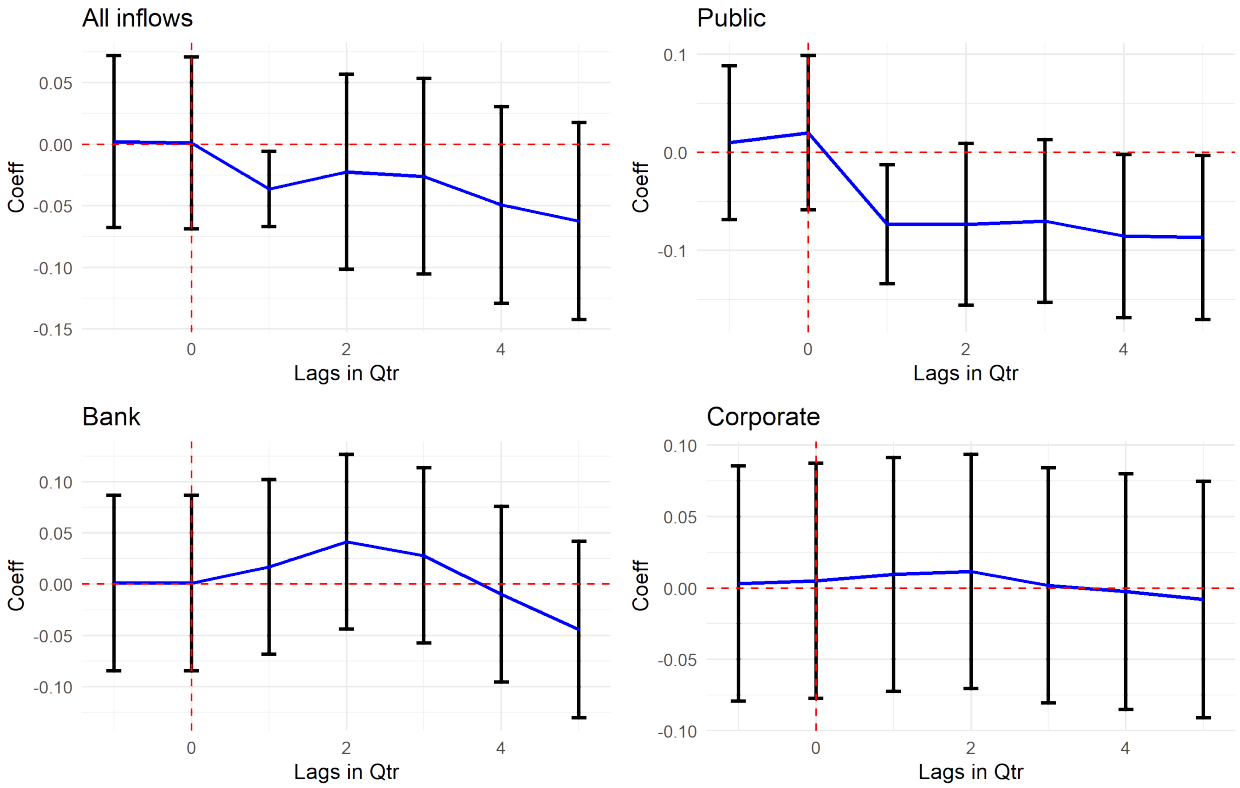
Next, the same SDM framework is estimated with varying lag structure. The effect of the capital control is represented in terms of coefficient plot with 90% confidence bands. The coefficient values along with confidence bands are plotted against the lag values for all inflows and inflows to different sectors. In the plots, the red vertical dotted line corresponds to lag value of 0 (i.e. current quarter). If the confidence bands of the coefficient estimates includes the zero line (red dotted horizontal line), the effect is considered to be insignificant in nature. I consider the correlation matrix from latest time period (i.e. 2012-2018) for the presentation of results. Similar findings were found using full sample correlation estimates also. Further we restrict our analysis on the portfolio flows only following the empirical findings from previous sub-section [5].

Following Figure 4, the direct effect of capital control appears to reduce overall portfolio inflows.

[5]The coefficient plots of lagged effect of capital control on other investment inflows is available in Appendix A1

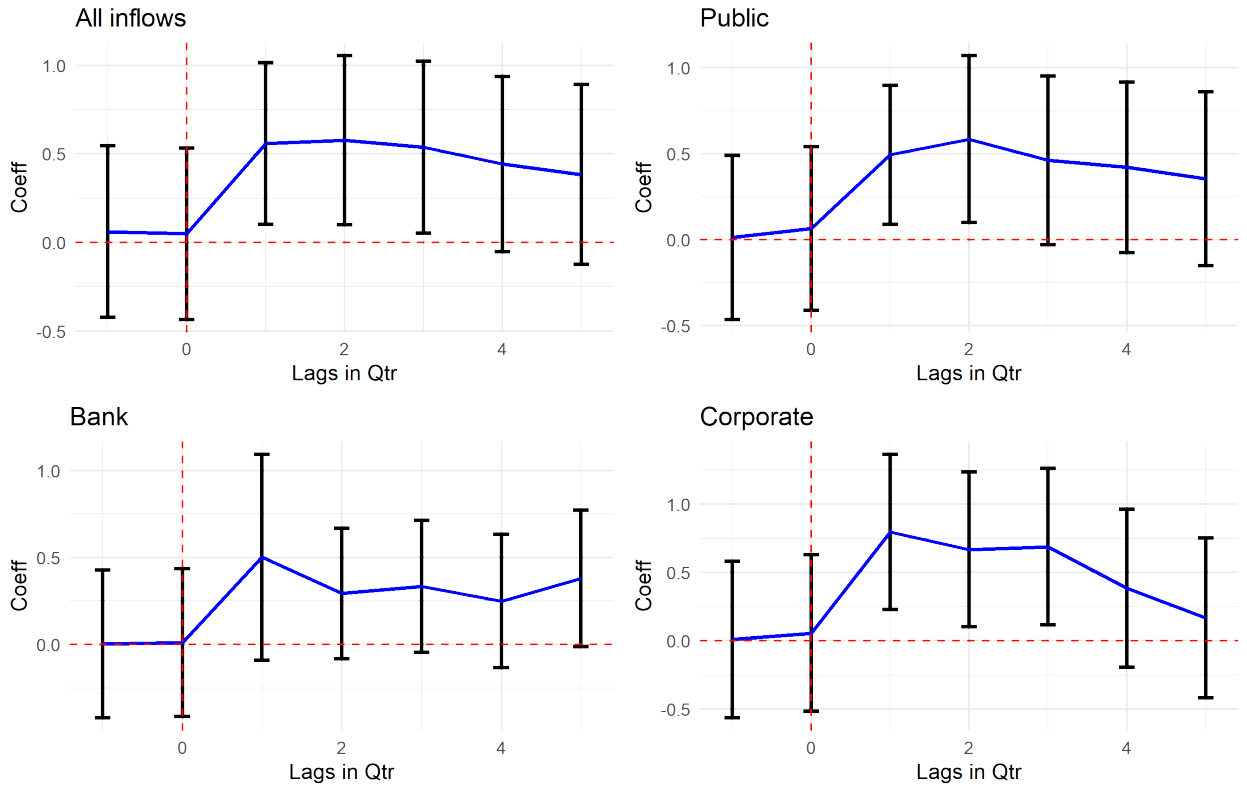
The rebalancing appears to immediate in nature as the direct effect dissipates with higher lags. The anticipation effect of capital control is also found to be muted in nature. Among the sectoral flows, the inflows to public sector adjusts in response to the capital control shock whereas inflows to banks and corporate does not demonstrate any statistically significant effect.

Figure 4: Lagged direct impact of capital control on portfolio inflows



The spillover effect, on the other hand, appears to be adjusting gradually and the effect persists over relatively longer horizon. Total portfolio inflows increase in response to capital account restrictions in other countries and the portfolio rebalancing effect continues till 3 quarters. The effect appears to be entirely driven by the flows going to the corporate sector and public sector. Similar effect is observed in the inflows to banks, However the effect is marginally insignificant in nature (refer to Figure 5).

Figure 5: Lagged spillover impact of capital control on portfolio inflows



5.3 Robustness checks

As indicated previously, the empirical specification heavily relies on the choice of spatial weight matrix w_{ij}. The choice of correlation coefficient in the weight matrix is based on well founded justification. In order to validate the robustness of empirical findings, some alternative choices are considered in the weight matrix. These alternatives include absolute distance measures between pair of countries. I use inverse of geo-distance of major populated cities and inverse of geo-distance between country capital cities for each pair of countries in the weight matrix. The distance data is sourced from CEPII. In order to standardize the distance measures, the spatial weights are normalized to the sum of 1 for each row i.e.

$$w_{ij} = \begin{cases} \frac{d_{ij}}{\sum_j d_{ij}} & \text{if } j \neq i \\ 0 & \text{if } j = i \end{cases} \tag{27}$$

where d_{ij} is the distance between country i and country j. The results appears to be resilient with respect to the distance measure in the choice of weight matrix.

Further, additional controls are introduced in the spatial regression model to factor in destination country heterogeneity. These additional controls are fiscal deficit as percentage of GDP and size of country (proxy by nominal GDP size). The results are found to be stable under these alternate specifications. Lastly, I exclude China from the collection of countries in the panel to check robustness. The results appears to be robust under alternate country choices also.

6 Concluding remarks

Global financial integration provided investors with easy access of financial market across countries. The search for higher returns lead to greater portfolio allocations to emerging market economies. However, the financial integration also exposed these countries to the risk of sudden stops and capital flight resulting in currency depreciation and balance of payment crisis. In this context, capital control emerged as possible policy tool for managing the flow of foreign capital into domestic market and thereby, safeguarded the domestic economy from the disturbances in global financial cycle. Capital control measures helped in safeguarding domestic economy but the signaling effect of the capital control left an adverse impact on the investors about the future state of domestic economy. On the other hand, the capital controls adopted by one country lead to portfolio adjustments of global investors which lead to greater capital inflow to other destination countries. In this background, this paper analyzes the effect of capital control on capital inflows to different sectors in terms of the direct effect and spillover effect. The advantage of using sectoral analysis lies in the fact that the drivers of capital inflows to different sectors vary widely. Further, the nature of different sector-wise capital inflows vary with respect to business cycle and the resulting effect of these inflows to sectors can be very different. Aggregate analysis of the effect of capital control does not provide enough insight about the sector-wise heterogeneity.

The paper evaluates the direct and spillover effect of capital control using spatial econometric model on quarterly data. The reduced form specifications analyze the direct effect and the spillover

effect of capital account restrictions on cross-border gross inflows of portfolio flows and other investment inflows using Spatial Durbin model. The spillover shocks are defined as spatial weighted shocks of capital account restrictions in other countries. The empirical findings indicates possible heterogeneity in the direct effect of capital control. Public sector inflows moderated whereas banks and corporate did not face any moderation of capital flows in response to capital control. The spillover effect of capital control was found to be broad-based as inflows to all sectors increased significantly in response to other country's capital account restrictions. The direct effect was found to be immediate in nature implying almost immediate adjustments of portfolios from public sector bonds in response to capital control. However the spillover effect appeared to be gradual in nature and the portfolio re-balancing persisted over 1-3 quarters after the change of capital account restrictions in other countries. The spillover effect was found to be marginally higher in case of inflows to corporate sector.

The paper, then provides an explanation of heterogeneity in the direct and spillover effect by extending the portfolio choice model in multi-country set up under the assumption of signaling effect. Inspired by the fund managers view about capital control from Forbes et. al. (2016), the paper introduces heterogeneous signaling effect of investors about the state of foreign country's economy when the foreign country imposes capital control measures. Using investor problem and the derived first order conditions, the analytical derivations of comparative statics provided a theoretical justification of the heterogeneity in the capital control effects as a change in private signal of the investors about the foreign economy. The private signal, derived from the investors' belief given capital control shock, modulates the wedge between tomorrow's expected return in the mind of the investors. The paper argues that the investors adjustment about future return from public sector accelerates their portfolio withdrawal from public sector bonds to a greater extent. The spillover effect, on the other hand, is purely driven by the change in private signal and the degree of hedging between two foreign country bonds.

The findings of the paper provides valuable insight for the policymakers. As capital control safeguards the domestic economy from foreign capital inflow fluctuations, the signaling effect moderates the investment sentiment of investors away from certain sectors. The portfolio re-balance

become greater as the investors change their perception about the future state of economy. The paper identifies the importance of sector-wise analysis of the effects of capital control and provides justification towards more targeted policy approach to manage the direct effect and spillover effect of capital control. The future scope of this research is enormous - the optimal policy design in view of the sectoral heterogeneity and the resultant welfare analysis will provide a greater insight to the policymakers.

7 Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Appendix A1. Direct ad spillover effect of capital control on other investment inflows

Figure 6: Direct effect of other investment inflows over lags

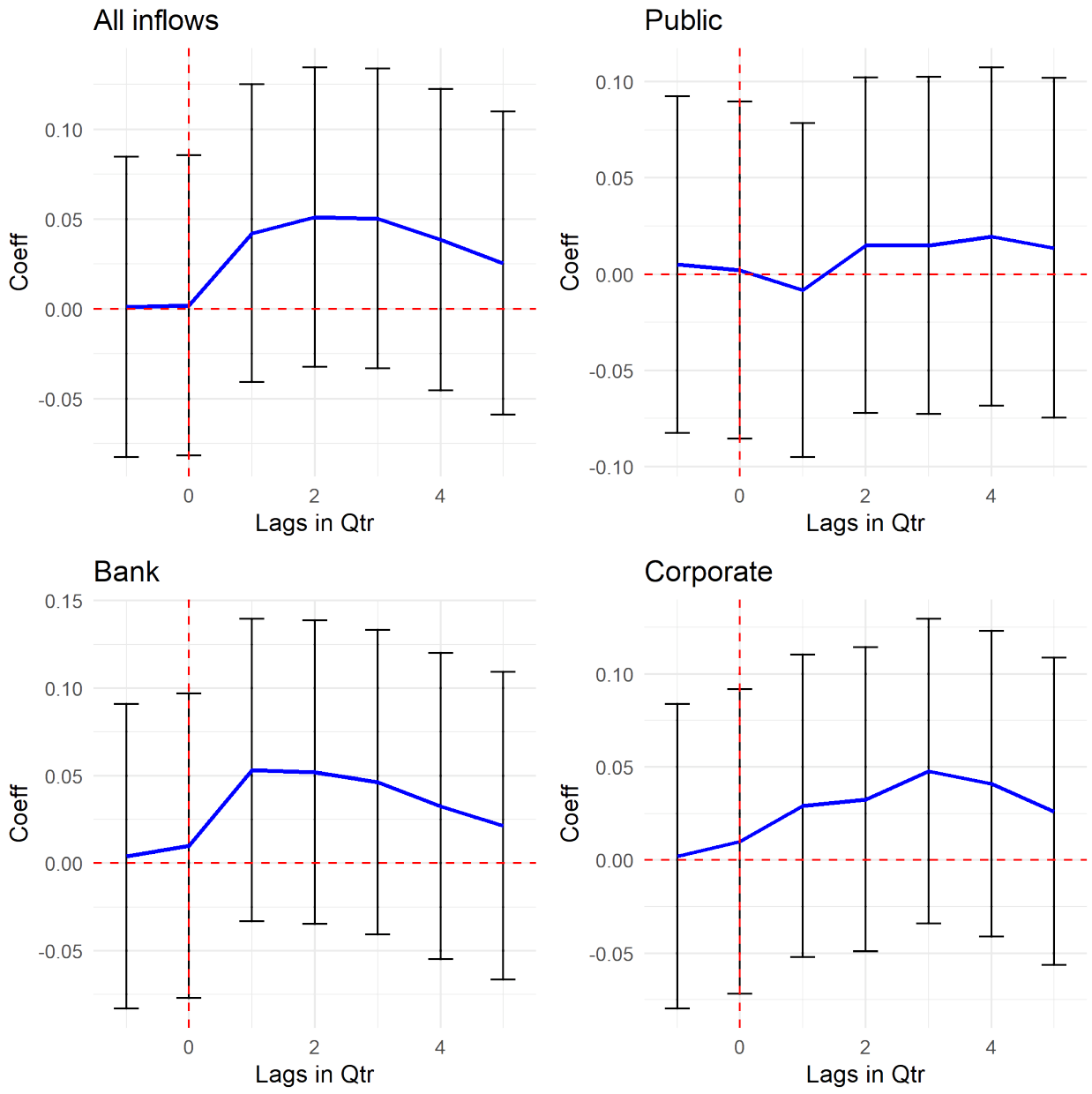


Figure 7: Spillover effect of other investment inflows over lags

