

Essays on Capital Flows and Capital Controls

by

Po-Hsin Tseng

B.A., National Cheng-Chi University, 2004

M.A., National Sun Yat-sen University, 2008

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Economics

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University of Victoria

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Supervisory Committee

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Abstract

This dissertation comprises four main chapters that examine issues surrounding capital flows and capital controls. Chapter 1 outlines the dissertation. Chapter 2 discusses several key themes in the literature on capital flows and capital controls. First, I discuss and compare the measures of capital flows and how they are commonly used. I show that net capital flows provide relevant information on investment-saving decisions. However, net capital flows may provide a false sense of security. Gross flows, on the other hand, provide information that is more relevant to financial stability. Second, I summarize various risks associated with capital flows into two broad categories and relate them to policy objectives against which the efficacy of capital controls is evaluated. I show that various macroeconomic risks associated with capital flows could be broadly grouped into (1) loss of export competitiveness and (2) increased financial instability. In terms of policy objectives, the main policy objectives are whether capital controls are able to (1) reduce real exchange market pressures, and (2) allow for a more independent monetary policy, (3) reduce the volume of capital flows, (4) alter the compositions of capital flows toward longer-maturity flows, and (5) reduce the frequency of disruptive adjustments such as currency crises and severe output loss. Third, I compare the framework used to document capital controls to the framework used to document capital flows. In doing so, I draw the *de jure* connections between measures of capital flows and measures of capital controls. Not only do the connections help one classify capital controls, but they also identify the exact types of capital flows that various types of capital controls intend to regulate. Fourth, I discuss major capital control indices in terms of the main considerations that are commonly involved to construct these indices, including (1) what to measure, (2) what asset categories to cover, (3) what data sources to use, and (4) what coding algorithms and weighting schemes to use to convert raw data to composite indices. Fifth, I compare and contrast major publicly-available capital control indices both at the world level and at a country level for selected countries (Brazil and South Korea). Finally, I synthesize studies on the effectiveness of capital controls and summarize possible factors that may have contributed to the inconclusiveness of the results from the existing studies. By surveying the literature, I find that possible factors include difficulties in (1) measuring capital controls, (2) obtaining capital flow data with high frequency, (3) standardizing the scope of capital flows, (4) addressing the selection bias problem, and (5) controlling for circumvention of capital controls and institutional quality.

Chapter 3 examines whether countries with capital controls are less likely to experience capital surges and capital stops. I use a propensity score matching method to address the issue of selection bias, which arises when observations with capital controls have distinct characteristics that influence both the probability of imposing capital controls and the probability of experiencing capital surges and stops. These

distinct characteristics, when not properly controlled for, can give rise to a biased estimate of the effect of capital controls. I use a propensity score matching method on a large data set of country-time observations. The data set encompasses both developed and developing countries and covers the period 1995-2016. The results of Chapter 3 show that capital controls may be effective, but only for observations that have not imposed capital controls. In addition, only capital controls that involve the use of inflow controls appear to be effective.

Chapter 4 addresses why some episodes of gross inflow surges ended in financial crises. Using a common set of 53 countries that include both advanced and emerging countries, I show that both global factors (such as investors' risk aversion) and domestic factors (such as domestic credit growth, foreign exchange reserves, institutional quality, and capital controls) play roles in explaining the endings of surge episodes. The effect of capital controls depends on a country's institutional quality. For countries with lower institutional quality, imposing capital controls does not decrease the probability of hard landing. Capital controls only start to contribute to a lower probability of hard landings when the institutional quality of a country is above a threshold.

Chapter 5 examines the spillover effects of foreign-implemented capital controls. I propose—from a domestic country's perspective—that foreign-implemented capital controls can affect domestic capital flows in the following ways. First, foreign-implemented inflow controls may reduce domestic outflows going into these foreign countries, due to the bilateral linkages between these foreign countries and the domestic country (the domestic-outflow-reduction hypothesis). Second, foreign-implemented outflow controls may reduce the domestic inflows from these foreign countries, again due to the bilateral linkages between these foreign countries and the domestic country (hereafter, the domestic-inflow-reduction hypothesis). Third, foreign-implemented inflow controls may deflect capital flows—originally going to these foreign countries—to the domestic country (hereafter, the deflection hypothesis). The findings of this chapter support the existence of spillover effects. For the three hypotheses, I find that tightening of foreign-implemented inflow controls—measured by increases in trade-weighted and geographic-proximity-weighted inflow control indices of other countries in the rest of the world—reduces domestic outflows, while tightening of foreign-implemented outflow controls—measured by increases in trade-weighted and geographic-proximity-weighted outflow control indices of other countries in the rest of the world—reduces domestic inflows. In addition, tightening of inflow controls implemented in foreign countries—measured by finance-weighted capital control indices of other countries in the rest of the world—divert capital inflows away from the domestic country. The results suggest that foreign-implemented capital controls have signaling effects on domestic capital flows via common lenders. When one country implements inflow capital controls, the policy actions prompt the common lenders to perceive that other countries with similar

borrowing patterns are likely to become less supportive of foreign investment. As such, global investors retreat their investment, leading to reductions in domestic inflows.

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Acknowledgments

I am greatly indebted to Dr. Graham M. Voss, my supervisor, for his generous support throughout my graduate study. He has shown me, by his example, what good economic research should entail. It is his continuous encouragement and patient guidance that have made the completion of this dissertation possible.

I would also like to thank Dr. Basma Majerbi and Dr. Paul H. Schure, my committee members, for their invaluable insights into my research work and for engaging me in various research projects.

I am grateful to Christine Voggenreiter, Beverly Wan, and Patrick Day, my employers, for their wholehearted encouragement, especially for granting me an educational leave so that I am able to finalize this dissertation.

I would like to thank my fellow students—Dan Vo, Jesse Yamaguchi, Christopher Yao, Dennis Chen, Sherri Makepeace, and Elizabeth Chan—for making my graduate student life memorable.

Finally, I would like to express my deepest gratitude to my family for their unconditional love and unfailing support. A special thanks goes to my wife, Shuang Yu, for always being there and for withstanding all the ups and downs throughout my academic journey.

Dedication

To my parents: Chien-Cheng Tseng and Feng-Ying Lee

Chapter 1 Introduction

Capital flows are international transactions in financial assets. While capital flows bring about potential economic benefits such as faster economic growth, improved intertemporal efficiency, and diversified risks, capital flows also bring about macroeconomic policy concerns such as loss of export competitiveness and increased financial instability. As part of the policy toolkit to manage international capital flows, the perception of the use of capital controls has evolved. Gallagher and Tian (2017) state that in the 1990s, the focus of the literature was on reaping the potential benefits of capital account liberalization. Prior to the 1997 Asian crisis, the International Monetary Fund (IMF) had strongly advocated free mobility of capital flows and seen capital controls as an unadvisable policy. The 1997 Asian crisis, however, saw countries which had made significant advances in liberalizing their capital accounts experience booms and busts of international capital flows as a consequence of foreign investors' herd behavior and excessive optimism. As a result of the crisis, the focus of the literature started to shift toward the sequencing of capital account liberalization that looks into the pre-conditions for orderly and successful capital account liberalization, although the IMF still largely maintained its official stand *against* capital controls.

The Global Financial Crisis provided an opportunity for the researchers and policymakers to reassess the role that capital controls played in managing volatile capital flows. During the Global Financial Crisis, countries such as Iceland imposed controls on capital outflows to prevent the collapse of the value of its currency. In the wake of the Global Financial Crisis, on the other hand, countries such as Brazil and South Korea imposed inflow controls to discourage excessive capital inflows (Fritz & Prates, 2014). Against this backdrop, the IMF launched a series of discussions on the use of capital controls and shifted its institutional view on *capital flow management measures* – a rebranded name for capital controls. This time, the IMF started to recognize that capital flows are associated with potential risks and that capital controls should form a legitimate part of the policy toolkit to prevent and mitigate financial instability (IMF, 2010, 2011a; Ostry et al., 2010; Ostry, Ghosh, Habermeier, et al., 2011). The IMF also began to publicly express support for the use of capital controls in its member countries. For example, Gallagher and Tian (2017) found that not only the IMF has changed its view on capital controls, there is also evidence that the IMF has also changed its actual behavior by making significantly more recommendations that are in supportive of capital controls.

This dissertation comprises four main chapters that examine issues surrounding capital flows and capital controls. Chapter 2 surveys the literature and provides a foundation for the subsequent chapters with an overview of international financial flows (i.e., *capital flows*) and financial market restrictions (i.e., *capital controls*) that policymakers use to manage these flows. In chapter 2, I discuss several key themes

in the literature, including the definitions, measurement, policy concerns of capital flows; and the classifications, indices, developments, and efficacy of capital controls.

Chapter 3 and Chapter 4 examine the domestic effects of capital controls. In Chapter 3, I revisit the issue of the efficacy of capital controls, of which the evidence in the literature is inconclusive. Using a propensity score methodology to address the issue of selection bias, I examine whether countries with capital controls are less likely to experience extreme capital flow movements such as capital surges or capital stops. In Chapter 4, I address why some episodes of gross inflow surges ended in financial crises. The literature has shown that surges lead to subsequent reversals of foreign capital inflows. Following a surge episode, capital inflows could reverse as global and domestic factors deteriorate. The reversals of capital flows can be accompanied by severe macroeconomic adjustments such as output loss. Not all episodes of capital surges, however, ended with hard landings. Chapter 4 examines the factors that might be relevant in explaining the differences.

In addition to domestic effects, it is possible that capital controls have spillover effects. In Chapter 5, I incorporate the spillover effects of capital controls into the analyses. I examine how foreign-implemented capital controls affect domestic capital flows through cross-country relationships such as trade linkages, geographic linkages, and financial linkages.

Chapter 2 Capital Flows, Capital Controls, and Capital Control Indices

2.1 Introduction

Chapter 2 examines key themes about international financial flows (hereafter *capital flows*), as well as financial market restrictions (hereafter *capital controls*) that are used by policymakers to manage these flows. The key themes identified by this chapter include the definitions, measurement, policy concerns of capital flows (Section 2.2 to Section 2.4); and classifications, indices, developments, and efficacy of capital controls (Section 2.5 to Section 2.8). The objective of this chapter is to tap into the existing literature and discuss the identified key themes in a cohesive way, providing a foundation for the subsequent chapters of the dissertation. In addition, the discussion will identify a number of unresolved issues concerning the assessment of capital controls, in particular the use of broad indices to capture variation in financial market restrictions.

Capital flows and capital controls have been the focus of much research. The rich literature has naturally given rise to different measures of capital flows and capital controls. As well, studies that look at similar topics have yielded different results. As the literature has developed, however, several research challenges and opportunities have emerged. It is these challenges and opportunities that motivate each section of this chapter. First, capital flows – or more precisely, international trade in financial assets – have been measured in different ways. The two measures are net capital flows and gross capital flows. Some studies use net capital flows as the variable of interest while others use gross capital flows. The two measures are likely to embody different information. Yet, the differences between the information embodied by the two measures of capital flows have been insufficiently discussed in the literature. One theme of this chapter is that the question of interest must dictate the appropriate measures of capital flows of interest, the most important distinctions being the types of financial assets of interest and whether net capital flows or gross capital flows are appropriate. While the distinction between net and gross flows is well understood and featured in much research (see Forbes & Warnock (2012), for example), the distinction is not always discussed in much of the literature on capital flows and capital controls. The construction of the two measures, their implications, and how they can be used to depict global developments of capital flows all warrant further discussion.

Second, although capital flows bring about economic opportunities such as faster output growth and better risk sharing, they may also bring about risks that then motivate the use of capital controls to manage these risks. The literature has discussed different types of macroeconomic risks that are associated with

capital flows, as well as various objectives against which the efficacy of capital controls is evaluated. Although individual studies that aim to identify specific macroeconomic risks and policy objectives could allow us to examine these risks and objectives more thoroughly, the results from these individual studies—when taken in isolation—may prevent us from seeing the forest for the trees. An overview that groups these risks into broader categories along with their commonalities and link them to the respective policy objectives enables us to assess the macroeconomic risks associated with capital flows and their corresponding management from a broader perspective.

Third, the practice and configurations of capital controls can be complex, making cross-country comparisons challenging. Most studies in the literature rely on the information reported by the International Monetary Fund's (IMF's) Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) due to its comprehensiveness and public availability. However, the framework that AREAER uses to document capital controls and the framework that countries use to report capital flows are rarely compared. An understanding of both frameworks and a comparison between them is a helpful way to understand the relationships between documented capital controls and documented capital flows. An understanding of these relationships will be particularly useful in modeling the impact of capital controls on capital flows, one of the objectives in the subsequent chapters. In addition, the explicit comparison also provides a clear guideline on how to classify capital controls.

Fourth, assessing the efficacy of capital controls requires proper measures of capital controls. While the literature has constructed various capital control indices, the differences among these indices are not immediately clear. A summary of the major indices, the common decisions involved to construct them, and the various dimensions that distinguish one index from another all warrant further discussion. A better understanding of these indices in these regards would help one properly choose one index from another to suit their purpose of research.

Fifth, since the Global Financial Crisis, there has been a renewed interest in using capital controls to manage capital flows. Countries such as Brazil and South Korea—among other countries—have imposed series of capital controls to manage capital inflows that were driven by investors seeking higher yields during a time when interest rates in most advanced countries were relatively low (IMF, 2011a). The International Monetary Fund (IMF) also shifted its institutional view toward the use of capital controls, from opposing the use of them to recognizing that capital controls—which the IMF rebranded as Capital Flow Management Measures, CFMs—could at times be appropriate to prevent and mitigate financial instability (Arora et al., 2013). The increasing use of capital controls among countries presents an opportunity to assess how much of these developments are captured by capital control indices. Evaluating

chronological events of capital controls in selected countries commonly cited in the literature against the constructed capital control indices could shed light on how these indices work as well as their limitations.

Sixth, while there has been a renewed interest in using capital controls to manage capital flows, the efficacy of these capital flow management measures is yet to be assessed. While many studies in the existing literature have been devoted to evaluating the effectiveness of capital controls, the results from the existing studies, however, are not conclusive, suggesting that the jury is still out and further improvements may be made. To further the research on the efficacy of capital controls in possible directions, it would be useful to review the factors that may have influenced the inconclusiveness among existing studies.

Motivated by these challenges and opportunities, this chapter makes several contributions to the literature. First, I discuss and compare what constitutes capital flows and how they are commonly used. Starting from basic Balance of Payments accounting, I highlight the fact that cross-border capital flows are international transactions between residents and non-residents of a country through importing or exporting a combination of current and future consumption. In the aggregate, these international transactions can be expressed either as a measure of *net* capital flows or as a measure of *gross* capital flows. Net capital flows capture *inter-temporal* transactions (trade-related transactions); gross capital flows mostly capture *intra-temporal* transactions (pure financial transactions). From the perspective of the Balance of Payments statistics, net capital flows are measured by the balance of the financial account; gross inflows are measured by the net changes in occurrences of liabilities; and gross outflows are measured by the net changes in acquisitions of foreign assets. I show that net capital flows provide relevant information on investment-saving decisions. However, net capital flows may provide a false sense of security. Gross flows, on the other hand, provide information that is more relevant to financial stability.

Second, I summarize various risks associated with capital flows into two broad categories and relate them to policy objectives against which the efficacy of capital controls is evaluated. I show that various macroeconomic risks associated with capital flows could be broadly grouped into (1) loss of export competitiveness and (2) increased financial instability. In terms of policy objectives, the main policy objectives are whether capital controls are able to (1) reduce real exchange market pressures, and (2) allow for a more independent monetary policy, (3) reduce the volume of capital flows, (4) alter the compositions of capital flows toward longer-maturity flows, and (5) reduce the frequency of disruptive adjustments such as currency crises and severe output loss (Magud et al., 2018). When it comes to linking the risks to the policy objectives, loss of competitiveness is related to exchange rate stability and monetary autonomy due to the trilemma constraint, while financial instability is related to the rest of the policy objectives.

Third, I compare the framework used to document capital controls with the framework used to document capital flows. In doing so, I draw the *de jure* connections between measures of capital flows and

measures of capital controls. Not only do the connections help one classify capital controls, but they also identify the exact types of capital flows that various types of capital controls intend to regulate. For example, controls on purchases of (domestic debt assets) locally by non-residents would—by definition—impose restrictions on non-residents who buy domestic debt assets from residents. The transactions, in this case, would be captured by the Balance of Payments under net incurrences of liabilities (i.e., inflows, to be explained in Section 2.2). So, these restrictions should be classified as inflow controls. More importantly, the connection enables one to identify debt inflows as the exact type of capital flows that this type of restrictions intends to regulate, even though the effect of these restrictions remains an empirical question yet to be assessed. When one models the relationships between capital controls on capital flows, the de jure connections between the two provide useful prior expectations.

Fourth, I discuss major capital control indices in terms of the main decisions that are commonly involved to construct these indices, including (1) what to measure, (2) what asset categories to cover, (3) what data sources to use, and (4) what coding algorithms and weighting schemes to apply to convert raw data into composite indices. Against these decisions, I synthesize the literature on capital control indices by the following four dimensions. On the first dimension, the indices differ among themselves by whether they intend to measure only the presence of the capital controls (de jure), a country's degree of financial integration into the rest of the world (de facto), or a combination of both (hybrid). On the second dimension, the IMF's AREAER has served to be the main data source for many capital control indices due to its comprehensiveness. So, it is helpful to dichotomize the data sources into AREAER and non-AREAER information. On the third dimension, the weighting schemes include averaging and the use of principal component analysis (CPA). On the fourth dimension, the indices differ among themselves by the extent to which they are able to pick up changes within the same asset categories—the so-called extensiveness versus intensity. These four dimensions allow one to conveniently structure the large literature on capital control indices along with their strengths and limitations, most of which are determined by the way the indices are constructed.

Fifth, I compare the main publicly available capital control indices both at the world level and at a country level for selected countries. At the world level, I discuss the increased use of capital controls after the Global Financial Crisis. I use various publicly-available capital control indices to depict the evolution of capital controls since the early 2000s. I show that while the de facto capital control index measured by the Lane and Milesi-Ferretti index shows that countries on average continue to increase their degree of financial integration into the rest of the world by increasing their holdings of external assets and liabilities, the speed has slowed down. Meanwhile, the trajectory of the de jure capital control indices measured both by Chinn-Ito and Schindler indices shows that on average, countries have raised their levels of capital

controls by extending financial market restrictions into more asset categories. The slowdown of the de facto financial integration and the increased levels of the de jure capital controls are in contrast with the global developments in the early 2000s—a time when countries on average accelerated the speed at which they accumulated their stocks of external assets and liabilities and liberalized their financial accounts. Breaking down the trajectory of the de jure capital control indices by income groups, I show that the increased levels of capital controls come mostly from countries that are in the middle-income group. At the country level, I conduct case studies on selected countries (i.e., Brazil and South Korea) and collect chronological events of capital controls in these selected countries. I compare the capital control indices to the collected events of capital controls and discuss the differences among them. I show that one could interpret these differences from the various dimensions that separate one index from another, a key theme of this chapter.

Finally, I synthesize studies on the effectiveness of capital controls and summarize possible factors that may have contributed to the inconclusiveness of the results from the existing studies. By surveying the literature, I find that possible factors include difficulties in (1) measuring capital controls, (2) obtaining capital flow data with high frequency, (3) standardizing the scope of capital flows, (4) addressing the selection bias problem, and (5) controlling for circumvention of capital controls and institutional quality.

The rest of this chapter is organized as follows. The next section introduces the Balance of Payments and discusses what constitutes capital flows. Section 2.3 discusses net capital flows versus gross capital flows. Section 2.4 discusses the macroeconomic risks of capital flows. Section 2.5 discusses the classifications of capital controls. Section 2.6 compares different capital control indices. Section 2.7 examines the main publicly available capital control indices both at the world level and at a country level for selected countries. Section 2.8 reviews studies on the effects of capital controls. Section 2.9 concludes.

2.2 Balance of Payments Statistics and Measures of Capital Flows

The Balance of Payments (BOP) statistics closely relates to measures of capital flows and their interpretations. This section aims to (1) provide an overview of the BOP accounts, (2) review the double-entry recording system, and (3) illustrate how BOP accounts relate to measures of capital flows. The overview of the BOP accounts will go over the main accounts and discuss the types of transactions each main account captures; the double-entry recording system will provide an understanding on how different BOP accounts are connected; lastly, the illustration of how capital flows are measured will shed light on the relationship between BOP statistics and measures of capital flows and what information different measures of capital flows embody.

2.2.1 Overview of the Balance of Payments

I begin by looking at the main part of the Balance of Payments. Table 2-1 shows a standard presentation of the Balance of Payments. The Balance of Payments and International Investment Position Manual (2009) provides descriptions for each of the main accounts, which I summarize below.

Current Account

The main components of the current account are receipts and payments for international trade in goods and services; these are exports (receipts) and imports (payments). For example, when a Canadian company exports 10,000 CAD worth of lumber to the United States, this transaction will be captured by the Canadian current account.

Capital Account

The capital account captures entries for nonproduced nonfinancial assets and capital transfers between residents and non-residents. The capital account is a small component of the balance of payments. For simplicity, it will be treated as zero in the rest of this dissertation.

Financial Account

As the focus of this chapter, the financial account warrants more explanation. Before discussing the details, it is helpful to first look at the financial account at a high level. In essence, the financial account records the international purchase and sale of financial assets. More specifically, the financial account records the net changes in acquisitions of assets and net changes in incurrences of liabilities by the residents of the reporting country. Both net changes in acquisitions of assets and net changes in incurrences of liabilities are broken down further into their underlying assets: mainly direct investment and portfolio investment. Lastly, the acquisitions of external assets by the domestic central bank are gathered into a separate assets category named official reserves. With the knowledge of the financial account at a high level, here are the breakdowns and the details.

Assets and Liabilities

The first layer of the breakdown of the financial account is assets versus liabilities. The *assets* category captures the transactions involving the purchase (denoted as A^+) or sale (denoted as A^-) of foreign assets by residents. For example, when a Canadian resident purchases shares of Microsoft from an American resident on the New York Stock Exchange (NYSE), this transaction will be captured by the Canadian financial account under the assets category. From the perspective of domestic residents, transactions under the asset category are lending to non-residents.

On the other hand, the *liabilities* category captures the transactions involving the purchase (denoted L^+) or sale (denoted as L^-) of domestic assets by non-residents. For example, when a non-resident purchases a Canadian financial asset, the transaction will be captured by the Canadian financial account under the liabilities category. From the perspective of domestic residents, transactions under the liabilities category are related to borrowing from non-residents.

Direct Investment, Portfolio Investment, Financial Derivatives, Other Investment, and Reserve Assets

In addition to assets versus liabilities, the second layer of the breakdown of the financial account is the types of underlying assets associated with each transaction, including direct investment, portfolio investment, financial derivatives, other investment, and official reserves. Note that the official reserves account is an assets account.

Direct investment refers to cross-border investment in an enterprise by a resident (individual or business) which has control of or significant influence over the enterprise. The key feature here is control over the enterprise. So, for example, if a resident of Canada purchases equity in a US firm and that same resident has ten percent or more voting power, then this is a direct investment by a Canadian resident into the United States and would contribute to the line item direct investment assets in the financial account for Canada.

Portfolio investment is defined as cross-border transactions and positions involving debt or equity securities, other than those included in direct investment or official reserve assets (discussed below). In other words, they are financial investments that are not sufficiently large to exercise any control over the target enterprises. The two principal components of portfolio investment are equity and debt securities. Securities is a general term for an easily marketed asset. Examples of portfolio investment are shares in a publicly-traded company (equity) and Canadian government treasury bills (debt security).

Financial derivative captures the emergence and growth of new financial instruments and arrangements among institutional units. Examples of instruments covered include financial derivatives, securitization, index-linked securities, and gold accounts. An example of institutional arrangements is special purpose entities and complex, multi-economy corporate structures.

Other investment is a residual category which includes: (a) other equity; (b) currency and deposits; (c) loans (including the use of IMF credit and loans from the IMF); (d) nonlife insurance technical reserves, life insurance and annuities entitlements, pension entitlements, and provisions for calls under standardized guarantees; (e) trade credit and advances.

Reserve assets are the external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect

the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing). The behavior of the central banks is of particular interest because they provide useful information on the exchange rate policies. Therefore, a standard presentation of Balance of Payments would break these transactions out of the assets category and treat them as separate accounts. For example, China is known to have accumulated a sizable amount of official reserves.

Net errors and omissions account captures any potential omissions. It is an artificial account that is created to ensure the balances of all accounts in the BOP sum up to zero. The concept that all accounts in the Balance of Payments must sum up to zero follows from the practice of a double-entry recording system, which is explained below.

2.2.2 Double-Entry Recording System

All accounts in the Balance of Payments described above are linked together by a double-entry recording system. The double-entry recording system in the Balance of Payments reflects an important aspect of economic transactions in general: an economic transaction is an exchange of two items that are deemed to be of equal value. That is, when something is provided, something else of equal value is received. The double-entry recording system embodies this spirit by ensuring that each transaction in the Balance of Payments is recorded as two matching entries, one credit entry and one debit entry. Table 2-2 summarizes how the double-entry recording system matches the credit and debit entries.

- For trade-related transactions (inter-temporal exchanges)
 - $EX_{i,t}$ matches either $A_{i,t}^{T+}$ or $L_{i,t}^{T-}$
 - $IM_{i,t}$ matches either $A_{i,t}^{T-}$ or $L_{i,t}^{T+}$:
- For pure financial transactions (intra-temporal exchanges)
 - $A_{i,t}^{F+}$ matches $L_{i,t}^{F-}$
 - $A_{i,t}^{F-}$ matches $L_{i,t}^{F+}$

Despite the complexity of the paired entries between accounts, the double-entry recording system—by construction—ensures that all entries sum up to zero. That is,

$$\sum_{t=0}^T \{ (EX_{i,t} - IM_{i,t}) - \underbrace{[(A_{i,t}^{T+} - A_{i,t}^{T-}) + (L_{i,t}^{T+} - L_{i,t}^{T-})]}_{\text{trade-related transactions}} + \underbrace{(A_{i,t}^{F+} - A_{i,t}^{F-}) + (L_{i,t}^{F+} - L_{i,t}^{F-})}_{\text{pure-financial transactions}} \} + Error \equiv 0 \quad (2.1)$$

For a country i from time 0 to time T , $EX_{i,t}$ is the entry regarding exports, $IM_{i,t}$ is the entry regarding imports. $A_{i,t}^{T+}$, $A_{i,t}^{T-}$, $L_{i,t}^{T+}$, and $L_{i,t}^{T-}$ are entries regarding the payments associated with trade (i.e., exports or imports). $A_{i,t}^{F+}$, $A_{i,t}^{F-}$, $L_{i,t}^{F+}$, and $L_{i,t}^{F-}$ are entries regarding pure-financial transactions.

Equation (2.1) serves as an important basis for tracing the connections between accounts. It captures *all* possible entries in the Balance of Payments during a period and summarizes the complex interactions among Balance of Payments accounts. When it comes to reporting, however, some sort of aggregation needs to be made. It would not be feasible to report *every* single transaction. Two common ways of aggregating entries are as follows: (1) current account and financial account, and (2) current account, net assets, and net liabilities.

2.2.2.1 Expression 1: Current Account and Financial Account

One way is to aggregate entries among the current account and the financial account. That is,

$$\sum_{t=0}^T (EX_{i,t} - IM_{i,t}) - \sum_{t=0}^T \left[(A_{i,t}^{T+} - A_{i,t}^{T-}) + (L_{i,t}^{T+} - L_{i,t}^{T-}) + \underbrace{(A_{i,t}^{F+} - A_{i,t}^{F-}) + (L_{i,t}^{F+} - L_{i,t}^{F-})}_{=0} \right] + \text{Error}_{i,t} \equiv 0 \quad (2.2)$$

In the process of aggregating entries, pure-financial related entries would cancel themselves out, so Equation (2.2) reduces to:

$$\sum_{t=0}^T (EX_{i,t} - IM_{i,t}) - \sum_{t=0}^T [(A_{i,t}^{T+} - A_{i,t}^{T-}) + (L_{i,t}^{T+} - L_{i,t}^{T-})] + \text{Error}_{i,t} \equiv 0 \quad (2.3)$$

Or

$$CA_{i,t} - FA_{i,t} + \text{Error}_{i,t} \equiv 0 \quad (2.4)$$

For a country i from time 0 to time T , $CA_{i,t}$ is the balance of the current account, $FA_{i,t}$ is the balance of the financial account, and $\text{Error}_{i,t}$ is the net errors and omissions.

In Equation (2.3), we now see the first term collects all of the entries related to current consumption, while the second term collects all of the matching entries related to future consumption that is being traded for the current consumption. This underlines the reason why the balance of the current account is interpreted as inter-temporal trade. Alternatively, we say that the balance of the current account represents the net increase in the domestic residents' claims on foreign residents' future production.

Equation (2.4) formulates an important relationship between the current account and the financial account. That is, setting aside the statistical discrepancy, *the balance of the current account and the balances of the financial account mirror each other*. The fact that the balance of the current account and

the balance of the financial account are two sides of the same coin is a useful identity. It means that one could approach the same issue either from a *trade* perspective or a *financial* perspective. Each perspective provides a useful lens for examining the issue. The choice of perspective usually depends on the issue that is being analyzed at hand, a topic that Section 2.3 will further discuss.

2.2.2.2 Expression 2: Current Account, Net Change in Assets, and Net Change in Liabilities

As illustrated above, entries regarding pure financial transactions cancel themselves out in the process of aggregating. The second common way of aggregating entries would preserve more information on pure financial trade. That is,

$$\sum_{t=0}^T \{ (EX_{i,t} - IM_{i,t}) - [\underbrace{(A_{i,t}^{T+} - A_{i,t}^{T-}) + (A_{i,t}^{F+} - A_{i,t}^{F-})}_{\text{net change in assets}} + \underbrace{(L_{i,t}^{T+} - L_{i,t}^{T-}) + (L_{i,t}^{F+} - L_{i,t}^{F-})}_{\text{net change in liabilities}}] + Error \} \equiv 0 \quad (2.5)$$

or

$$CA_{i,t} - (Net\ Change\ in\ Assets_{i,t} - Net\ Change\ in\ Liabilities_{i,t}) + Error_{i,t} \equiv 0 \quad (2.6)$$

In this form, the balance of the current account (the first term) is presented along with the net change in acquisitions of foreign financial assets (the second term) and the net change in incurrences of foreign liabilities (the third term). In Equation (2.5), we see that change in assets and change in liabilities contain information on intra-temporal exchanges, although they also capture the matching entries from trade-related transactions.

2.2.3 Measures of Net and Gross Capital Flows

With the knowledge on the Balance of Payments accounts and the operation of the double-entry recording system, one is ready to measure capital flows. The literature measures capital flows by *net capital flows* and *gross capital flows*.

2.2.3.1 Net Capital Flows

For a given country i in a given period t , the balance of the financial account is referred to as *net capital flows*:

$$NI_{i,t} \equiv FA_{i,t} \quad (2.7)$$

where $NI_{i,t}$ represents the net capital flows. Recall that the balance of the financial account mirrors that of the current account. It follows that net capital flows also mirror the balance of the current account. A country

that runs current account deficits experiences *net capital inflows*, while a country that runs current account surpluses experiences *net capital outflows*.

The benefits of net capital flows can be best understood by the framework of Obstfeld and Rogoff (1996). Obstfeld and Rogoff use an inter-temporal approach to illustrate the implications associated with net capital flows. In this approach, net capital flows are viewed as an exchange of assets in return for goods and services. Assets entitle their owner to future consumption, while goods and services are used for present consumption. Hence, in this framework, net capital flows are interpreted as *inter-temporal trade*. That is, present consumption is traded against future consumption. Net capital flows thus allow domestic consumption and saving to differ from domestic investment. In theory, countries with high returns on capital will receive net capital flows from abroad to finance investment until their rate of return equals the world rate of return. Therefore, the benefit associated with net capital flows is that resources can flow from countries with low returns on capital to countries with high returns on capital, resulting in a more efficient allocation of global capital.

2.2.3.2 Gross Capital Inflows and Gross Capital Outflows

The net change in acquisitions of assets (denoted as $\Delta A_{i,t}$) are referred to as gross capital outflows, while the net change in incurrences of liabilities (denoted as $\Delta L_{i,t}$) are referred to as gross capital inflows. By definition, gross inflows represent the net of purchases and sales of domestic assets by non-residents, gross outflows represent the net of purchases and sales of foreign assets by residents. Net capital flows are the sum of gross capital inflows and gross capital outflows. That is,

$$\text{Gross Outflows} \equiv \Delta A_{i,t} = A_{i,t}^+ + A_{i,t}^- \quad (2.8)$$

$$\text{Gross Inflows} \equiv \Delta L_{i,t} = L_{i,t}^+ + L_{i,t}^- \quad (2.9)$$

$$NI_{i,t} \equiv FA_{i,t} = \Delta A_{i,t} + \Delta L_{i,t} \quad (2.10)$$

For country i during period t , $A_{i,t}^+$ and $A_{i,t}^-$ represent the purchase and sale of external financial assets by residents, respectively; and $L_{i,t}^+$ and $L_{i,t}^-$ represent the purchase and sale of domestic financial assets by non-residents, respectively.

Gross capital flows have their own benefits. Recall that net capital flows are viewed as inter-temporal trade. In contrast, here gross capital flows are viewed as *intra-temporal trade*. That is, trade in assets for other assets. With intra-temporal trade, gross capital flows enable international risk-sharing by making it

possible to allocate capital to projects with higher risks and returns than if all the associated risks had to be borne by a narrower set of investors located within a particular country. This allows a riskier allocation of global capital that is more productive on average. The resulting welfare gains benefit both the providers of capital (via higher returns) and the recipients of capital (via faster economic growth). For example, Obstfeld and Rogoff (1994) show in a theoretical model how international risk sharing can produce significant welfare gains through a world portfolio shift towards riskier assets.

2.3 Comparing Net Capital Flows and Gross Capital Flows

The literature on capital flows and capital flow management has used both net capital flows and gross capital flows to conduct studies. In the 1980s and 1990s, there was considerable interest in capital flight (i.e., large net capital outflows), sudden stops (i.e., an abrupt reversal in net capital inflows), and patterns of current account deficits (i.e., patterns of net capital flows); see, for example, Cuddington (1986), Dooley (1988), Calvo and Reinhart (1999), and Bernanke (2005). These studies all focus on analyzing the role that net capital flows play in the macroeconomy. On the other hand, other studies focus on analyzing the patterns of gross capital flows. For example, Forbes and Warnock (2012) analyze extreme capital flow movements using gross capital flows instead of net capital flows. The considerations in choosing the two measures of capital flows for analyses, however, are insufficiently discussed. In Section 2.3, I compare the use of net capital flows to the use of gross capital flows in the context of global saving glut, global financial crisis, and sudden stops.

2.3.1 Net Capital Flows and the Global Saving Glut

Bernanke (2005) proposes a celebrated *global saving glut* hypothesis that aims to explain, from a global perspective, the large current account deficits of the United States in the early 2000s. Bernanke's work showcases how the measure of net capital flows can be helpful in understanding the global patterns of saving-investment behaviour. Bernanke's work proceeds through several main steps, which I summarize below.

First, Bernanke (2005) evoked the basic Balance of Payments accounting identity that this chapter has established previously in Equation (2.4): the balance of the current account mirrors that of the financial account. Bernanke argued that from *the trade perspective*, one could only limit the discussion on current account deficits to trade-specific factors such as unfair foreign competition. But it was likely that the trade imbalance was just *the tail of a dog*. That is, the current account deficits have been passively determined by what had occurred to the financial account through macroeconomic variables such as foreign and domestic incomes, asset prices, interest rates, and exchange rates. These variables, in turn, were the products

of more fundamental driving forces that could only be explained from *the financial perspective*. Bernanke hence based his analysis on the financial perspective, which effectively transformed the balance of the current account to the gap between the demand and supply of savings. When a country runs current account deficits, its demand for saving was greater than the supply of domestic savings. The country was able to spend more resources than it produces because it borrowed from countries whose demand for saving was less than the supply of domestic savings.

Second, Bernanke (2005) noted that the pattern of the US current account had shifted from surpluses in the late 1990s to deficits in the early 2000s. The US current account deficits also showed up in the US declining national saving rate, which fell from 18% of its GDP in 1985 to 14% of its GDP in 2004. According to the demand-and-supply framework, something must have changed to cause the shift. While many other reasons were possible (such as the burgeoning U.S. federal budget deficit), Bernanke argued that a more satisfying explanation to the shift lied in the abundance of excess saving originating from emerging markets that pushed down the world real interest rate. *Ceteris paribus*, a declining real interest would encourage more investment and less saving, which inevitably led to US current account deficits. This hypothesis was known as the *global saving glut* hypothesis.

Third, Bernanke (2005) showed that developments of the current accounts of the emerging-market economies have had evolved in the opposite direction to that of the US current account. In the early 2000s, the current account balances of the emerging-market economies swung from deficits to surpluses, a shift that effectively transformed these countries from net borrowers on the international capital market to net lenders. A key reason that underlay the change in their borrowing patterns was a series of financial crises (Mexico in 1994, East Asian Countries from 1997 to 1998, Russia in 1998, Brazil in 1999, and Argentina in 2002) that occurred to these countries. A common theme among these crises was the involvement with foreign capital inflows. As mentioned, these countries were once net borrowers on the international capital in the mid-1990s. Unfortunately, the capital inflows these countries took in were not always channeled to the most productive use. In some cases, for example, developing-country governments borrowed to avoid necessary fiscal consolidation; in other cases, opaque and poorly governed banking systems failed to allocate those funds to the projects promising the highest returns. Loss of lender confidence, together with other factors such as overvalued fixed exchange rates and debt that was both short-term and denominated in foreign currencies, ultimately resulted in painful adjustments that were labeled financial crises. The effects of these crises included rapid capital outflows, currency depreciation, sharp declines in domestic asset prices, weakened banking systems, and recession.

Fourth, Bernanke (2005) drew a close link between the current account surpluses and increases in official reserves in the emerging-market economies. In response to these crises, emerging-market nations

either chose or were forced into new strategies for managing international capital flows. In general, these strategies involved shifting from being net importers of financial capital to being net exporters, in some cases very large net exporters. For example, in response to the instability of capital flows and the exchange rate, some East Asian countries, such as Korea and Thailand, began to build up large quantities of *official reserves*. Increases in official reserves (an asset category) necessarily involved either a shift toward surplus in the country's current account, increases in gross capital inflows, reductions in gross private capital outflows, or a combination of these elements.¹ Although China had escaped the worst effects of the crisis, it too remained concerned about future crises and built up a sizable amount of foreign reserves for precautionary purposes. In these countries, these foreign reserves have been used as a buffer against potential capital outflows. The reserves were also accumulated in the context of foreign exchange interventions intended to promote export-led growth by preventing exchange-rate appreciation. Countries typically pursue export-led growth because domestic demand is thought to be insufficient to employ fully domestic resources.

Fifth, Bernanke concluded his analysis by linking the US intake of capital flows to low saving rates, low interest rate, high housing prices, and an increase in the interest in risky assets. Bernanke's global saving glut has provided one of many reasons behind the 2007-2008 Global Financial Crisis.

2.3.2 Gross Capital Flows and the Global Financial Crisis

Although patterns of net capital flows that underlie the global saving glut hypothesis is widely used to understand reasons that might have caused the Global Financial Crisis, it does not present a full picture. One notable example is the role that European banks played in the Global Financial Crisis. They were never part of the analysis because most of their current accounts were roughly in balance. Yet the European countries were severely affected.

Borio and Disyatat (2015) and Obstfeld (2012b) both pointed out that net capital flows did not fully reflect cross-border borrowing patterns. A balanced or even positive current account on the basis of net capital flows may have actually provided a false sense of security (Tarashev et al., 2016). The role that the European banks played during the Global Financial Crisis was a good illustration of this point. In great detail, Acharya and Schnabl (2010) documented how European banks borrowed from risk-averse investors in the US money-markets by selling to these investors short-term asset-back-money commercial paper (ABCP) and then used the proceeds to buy long-term asset-backed securities. As Acharya and Schnabl documented, the European banks set up conduits while sponsoring these conduits conditionally. The

¹ Equation (2.6) establishes this relationship.

conditional nature of the guarantee, however, allowed the banks to reduce or avoid altogether the regulatory capital held against the conduit's assets. The conduits, however, were still effectively guaranteed by the sponsoring banks. With explicit or implicit government guarantees, the conduits issued short-term debts (i.e., ABCP) to risk-averse investors in the money markets in the US, who believed that their holdings of ABCP were safe. These assets later become toxic. And the conduits suddenly found themselves unable to roll over their debts. Germany's Landesbanken was a well-known case.

Obstfeld (2012b) pointed out that when a German conduit financed the purchase of U.S. assets by issuing ABCP to a U.S. money-market fund, U.S. gross foreign assets and liabilities, and German gross foreign assets and liabilities, both rose by the amount of the transaction. No net financial flow took place. So contrary to the view that the US credit boom in the earlier 2000s was driven by the emerging markets' thirst for safe assets, the example here showed that banks outside the U.S. were issuing plenty of seemingly safe assets while investing the proceeds in less liquid and less safe assets located primarily in the U.S. When the adjustments began, inevitably the European banks were severely affected.

Thus, the role of European banks during the 2007-2008 Global Financial Crisis highlights that net flows could be silent about cross-border borrowing patterns and provide a false sense of security. The experience suggests that one should look beyond net capital flows to identify sources of financial instability.

2.3.3 Gross Capital Flows and Sudden Stops

A sudden stop episode—originally discussed by Calvo and Reinhart (2000)—is a scenario when capricious foreign lenders suddenly become unwilling to provide that finance. If only limited liquidity can be generated through domestic residents' sale of their foreign assets, then the current account must adjust abruptly through a collapse in domestic demand, which inevitably entails sharp and painful adjustments. When capital inflows reverse themselves suddenly, they could deplete foreign reserves or cause sharp currency depreciation. It is mainly against this crisis risk that many countries in Asia have accumulated large foreign exchange reserves as a form of self-insurance.

So far, most studies on sudden stops implicitly assume that countries with persistent negative capital inflows (i.e., current account deficits) are more vulnerable to sudden stops than countries with persistent positive capital inflows (i.e., current account surpluses). These studies emphasize the role that net capital flows have during a sudden stop episode. As is illustrated, a balanced current account could actually provide a false sense of security. Accordingly, recent discussions on sudden stops have begun to shift the heavy focus away from net capital flows to gross capital flows (Blanchard & Milesi-Ferretti, 2012; Borio & Disyatat, 2015; Obstfeld, 2012a, 2012b).

Borio and Disyatat (2015), for example, question whether the overwhelming attention to net capital flows in studying sudden stops is warranted. They argue that both current account surplus and deficit countries are exposed to the same risk of foreign capital reversal. Sudden stops arise when foreign lenders cease lending because they perceive risks that domestic borrowers may become unable to meet their debt obligations. Aside from market perceptions, they argue that there is no reason why current account deficits *in and of themselves* imply such greater exposure. Current account reversals reflect the macroeconomic *result* that accompanies sudden stops, not the *reason* that causes sudden stops. A sudden stop crisis ends not because the current account deficits are reduced, but when the funding gap is eliminated through either new financing or debt restructuring.

Blanchard and Milesi-Ferretti (2012) make a similar point, suggesting that gross capital flows—not just net capital flows—should be included as part of the indicators for global financial stability surveillance. When it comes to sudden stops, net flows *may* provide relevant information if domestic entities have external assets and liabilities with similar liquidity characteristics among themselves. If this is true, the different domestic entities reduce to one country as a whole, and net capital flows can be used to gauge whether the country could appropriately respond to sudden stops of foreign financing by drawing down its external assets. However, net flows will no longer be relevant when (1) the external assets and liabilities are held by different sectors, and (2) the external assets and liabilities have different liquidity characteristics. For example, a country's public sector may hold external debts while the private sector holds external assets. In this case, it is unlikely that the rolling over of external debts can be offset by the private sectors selling external assets. As another example, a country's official foreign exchange reserves may match or exceed the foreign-currency-denominated debt of its corporate sector. When non-financial corporates face pressure from capital outflows, however, there may be no easy way for the authorities to deploy their reserves to alleviate this pressure. Distressed companies could reduce investment expenditure or hiring – thus hurting economic activity – even though the central bank has large foreign-exchange reserves. In the latter two examples, it is the gross capital flows that matter.

2.4 Macroeconomic Risks about Capital Flows

While capital flows could potentially generate economic benefits of higher levels of economic growth and greater risk-sharing, they also bring about macroeconomic policy concerns, most of which are related to large capital inflows over a short period of time. I argue that the main policy concerns can be generally structured into (1) loss of export competitiveness and (2) increased financial instability.

2.4.1 Loss of Export Competitiveness

Large capital inflows over a short period of time could lead to currency appreciation pressures, either through inflation under fixed exchange rates, or through nominal appreciation under more flexible exchange rate regimes. Both mechanisms equivalently result in real exchange rate appreciation of the domestic currency, which could then undermine the competitiveness of the domestic export (Magud & Sosa, 2013). The negative impact of real exchange rate appreciation on the export sector could be long-lasting even after the capital inflows stop, a scenario that has been referred to as *Hysteresis Effects* or *Dutch Disease*.²

To prevent real exchange rate appreciation, some policy options are available, including *reserve accumulation without sterilization* and *reserve accumulation with sterilization* (Cardarelli et al., 2010). First, when facing large capital inflows, countries could intervene in the foreign exchange market by accumulating foreign reserves *without* sterilization. Accumulating foreign reserves without sterilization, however, increases the domestic money supply and creates the potential for overheating and financial system vulnerability. More importantly, when inflation occurs, the real appreciation would simply take place through a higher domestic price level instead of an increase in the nominal exchange rate. Second, intervention in the foreign exchange market could also be implemented through accumulating foreign reserves *with* sterilization. In this case, an increase in foreign reserves is offset by a decrease in domestic money supply via open market operations, leaving the domestic monetary condition unchanged and thereby mitigating the inflation pressure. However, sterilization entails costs due to the interest differential between the interest paid on domestic bonds and interest earned on foreign reserves. More importantly, as sterilization is designed to prevent a decline in the domestic interest rate and to prevent a loose monetary condition, the relatively high domestic interest rate would only perpetuate the large inflow problem.

The difficulty in simultaneously managing the exchange rate and the interest rate when capital flows move freely internationally is consistent with the *trilemma* constraint, which states that it is not possible to achieve all of the following three the same time: a fixed exchange rate regime, monetary autonomy, and free capital movement. In this context, the trilemma constraint provides theoretical support for the use of capital controls to prevent their real exchange rate appreciation.

² Hysteresis effects refer to effects that persist after the initial causes giving rise to the effects are removed. The term Dutch Disease was first coined by The Economist in 1977 to describe the poor performance of the Dutch economy after a major natural gas discovery in 1959 that led to high value of the guilder, then the Dutch currency (The Economist, 2014).

2.4.2 Increased Financial Instability

Aside from loss of export competitiveness, capital inflows also expose countries to greater risks of financial instability. The build-up of financial instability associated with large capital inflows could come from various sources, which broadly include *economy overheating* and *sudden stops*.

Economy Overheating

The economy overheating is a general term that broadly covers issues such as (1) excessive lending and borrowing, (2) asset market bubble, (3) domestic credit booms, and (4) maturity and currency mismatches (Ostry, Ghosh, Chamon, et al., 2011).

First, excessive lending could result from herd behaviour and excessive optimism on the part of foreign lenders. When capital inflows are intermediated through a domestic banking system, the easy availability of external financing could induce domestic banks to loosen lending standards, reduce loan quality, and fuel rapid domestic credit booms. With a weak domestic regulatory framework, large capital inflows can exceed the absorptive capacity of a country's banking system, leading to inappropriate lending decisions and a subsequent buildup of financial system fragility that ultimately proves unsustainable.

Second, capital inflows could unsustainably push up equity and other asset prices. Schadler (2010), for example, suggest that the impact of capital inflows on asset prices has been particularly significant. High asset prices could lead to a decline in the local savings rate, as individuals discover that their asset accumulation objectives are being achieved without the need for saving. Unsustainable asset prices could also lead to financial crises and severe output loss when adjustments occur.

Third, capital inflows could contribute to greater levels of financial instability by adversely affecting the maturity and currency composition of the balance sheets of banks and corporations, which are referred to as maturity mismatches and currency mismatches, respectively. A maturity mismatch refers to a gap between the maturity structure of assets and liabilities, while a currency mismatch arises when assets and liabilities are denominated in different currencies without a hedge. Both types of mismatches expose countries to financial instability, especially when the capital inflows suddenly stop and the currency depreciates.

Fourth, capital inflows could be destabilizing when they come in the form of debt, particularly in the form of short-term debt. Obstfeld (2012b) points out that unlike equity flows or direct investment flows that involve a greater degree of risk-sharing, debt inflows feature a predetermined contractual payment that is subject to default. Borrowers are subject to default risks when they find difficulty in continuing to service on the contractually agreed terms. In addition, lenders may refuse to roll over their credits at the time of

maturity, making countries with a large amount of short-term external debts particularly vulnerable to a run when a negative macroeconomic shock occurs and insufficient liquid foreign assets are available to pay off the foreign debts (Setser et al., 2002). Obstfeld argues that the prevalence of debt or debt-like instruments is therefore potentially worrisome. When many financial players are themselves leveraged, the phenomenon raises a significant concern both domestically and internationally.

Sudden Stops

The various risks about economy overheating combine into the concept of a sudden stop, a macroeconomic phenomenon that I have discussed in Section 2.3.3

Overall, the risks discussed in Section 2.4 motivate countries to impose capital controls. The corresponding policy objectives and their efficacy will be further discussed in Section 2.10.

2.5 Capital Controls and Their Classifications

Capital controls are restrictions imposed on transactions of financial assets. In Section 2.5, I discuss capital controls along two dimensions: (1) inflow controls versus outflow controls and (2) price-based controls versus quantity-based controls. For the first dimension, a generic demand-and-supply framework is first set up to discuss the eight possible ways in which capital controls can be imposed. With examples of capital controls discussed along the way, the demand-and-supply framework is then compared to the capital controls that are comprehensively documented by the IMF. After that, I discuss capital controls along the price-versus -quantity dimension.

2.5.1 Inflow Controls versus Outflow Controls

Both residents and non-residents can participate in the supply and demand for domestic and foreign financial assets. Therefore, there are eight possible types of transactors. Consider, for example, the market of domestic assets. There are four types of transactors in the market of domestic assets:

demand for domestic assets

1. non-residents who buy domestic assets (D, NR)
2. residents who buy domestic assets (D, R)

supply of domestic assets

3. residents who sell domestic assets (S, R)

4. non-residents who sell domestic assets (S, NR)

For the above transactions to be captured by Balance of Payments, they must come in pairs: (1) must be paired with (3); and (2) must be paired with (4). (1) paired with (3) represents a transaction when a non-resident purchases a domestic asset from a resident. From the perspective of BOP, the transaction would be considered an increase in a country's external liabilities ($L_{i,t}^+$). Similarly, (2) paired with (4) represents a transaction where a non-resident sells a domestic asset back to a resident. From the perspective of BOP, the transaction would be considered a decrease in a country's external liabilities ($L_{i,t}^-$).

The same logic applies to transactions of foreign assets. There are four other types of transactors in the market of foreign assets.

demand for foreign assets

1. non-residents who buy foreign assets (D, NR)
2. residents who buy foreign assets (D, R)

supply of foreign assets

3. residents who sell foreign assets (S, R)
4. non-residents who sell foreign assets (S, NR)

For the transactions listed above to be captured by Balance of Payments, they must come in pairs: (5) must be paired with (7); and (6) must be paired with (8). (6) paired with (8) represents a transaction when a resident purchases a foreign asset from a non-resident. From the perspective of BOP, this transaction would be considered an increase in a country's external assets ($A_{i,t}^+$). Similarly, (7) paired with (5) represents a transaction where a resident sells a foreign asset back to a non-resident. From the perspective of BOP, the transaction would be considered a decrease in a country's external assets ($A_{i,t}^-$). Table 2-3 summarizes the above discussion.

Now we can apply the demand-and-supply framework to the way the International Monetary Fund (IMF) documents capital controls. On an annual basis, the IMF publishes the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The AREAER comprehensively documents the capital account restrictions among member countries of the IMF. The AREAER categorizes capital account restrictions into the following four categories:

controls on residents:

1. Category (a): Purchase (foreign assets) abroad by residents

2. Category (b): Sale or issue (domestic assets) abroad by residents

controls on non-residents:

3. Category (c): Purchase (domestic assets) locally by nonresidents
4. Category (d): Sale or issue (foreign assets) locally by nonresidents

According to this classification, capital controls are first grouped into two categories: capital controls on residents and capital controls on non-residents. Within the two groups, capital controls are then further broken down into (1) restrictions on purchases of financial assets and (2) restrictions on sales or issues of financial assets. The four-category classification then applies to the various types underlying assets (i.e., equity market, debt market, direct investments, etc.)

Comparing the four categories to the demand-and-supply framework is a useful way to understand the potential impact on capital flows of capital controls documented by AREAER. Table 2-4 shows the comparison.

Restrictions under Category (a) are those imposed on purchase (of foreign assets) abroad by residents. From the perspective of the demand-and-supply framework, these are restrictions imposed on the demand of foreign assets by domestic residents, which corresponds to an increase in gross capital outflows ($A_{i,t}^+$) in the BOP when the transaction is completed. Hence, restrictions under Category (a) should be classified as **outflow controls**. Consider the case of Iceland in 2008 when it was severely affected by the Global Financial Crisis. To curb the capital outflows, the government imposed several measures of outflow controls. One of them was to prohibit residents from buying foreign securities. According to the 2009 edition of AREAER, effective November 28, 2008, the purchase of (foreign) shares for foreign currency is not permitted in Iceland.

Restrictions under Category (b) are those imposed on sale or issue (of domestic assets) abroad by residents. From the perspective of the demand-and-supply framework, these are the restrictions that are imposed on the supply of domestic assets by domestic residents to non-residents, which would increase a country's capital inflows ($L_{i,t}^+$) in the BOP when the transaction is completed. Hence, restrictions under this category should be classified as **inflow controls**. For example, South Korea imposed inflow controls to limit its short-term inflows. See box B for a case study of capital controls in South Korea.

Restrictions under Category (c) are those imposed on purchase (of domestic assets) locally by non-residents. From the perspective of the demand-and-supply framework, these are the restrictions imposed on the supply of domestic assets by domestic residents to non-residents, which would increase a country's capital inflows ($L_{i,t}^+$) in the BOP when the transaction is completed. Hence, restrictions under this category

should be classified as *inflow controls*. The tax imposed on foreign investors in Brazil in 2009 was a well-known example of inflow controls. In the year of 2009, Brazil experienced large volumes of capital inflows that were deemed speculative. To curb the inflows, in October 2009 the government instituted an inflow capital control that levied a 2% tax on any capital inflows from abroad that went into equities or fixed-income securities. The tax was formally known as I.O.F. (financial transaction tax). In 2010, the tax was raised to 4% for transactions related to fixed income. In the same year, the tax is hiked further to 6%. The intention of tax was to discourage non-residents from investing in the domestic economy that was deemed overly exuberant. See Box A for a case study of the capital controls in Brazil.

Restrictions under Category (d) are those that are imposed on sale or issue (of domestic assets) abroad by non-residents. From the perspective of the demand-and-supply framework, these are the restrictions imposed on the supply of domestic assets by domestic residents to non-residents, which would increase a country's capital inflows ($A_{i,t}^+$) in the BOP when the transaction is completed. Hence, restrictions under this category should be classified as *outflow controls*. Outflow controls are used to prevent capital from leaving domestic countries. For example, Cyprus in 2013 imposed outflow controls to cope with its financial crisis. The 2014 AREAER reported that residents in Cyprus in that year could only transfer funds abroad up to a controlled limit.

Comparing the way AREAER documents capital controls to the demand-and-supply framework reveals an interesting finding. That is, an inflow restriction may also have an effect on outflows; when non-residents are unable to purchase domestic assets (capital inflows), all other things equal, the sales of domestic assets should decrease (capital outflows). The same logic applies to outflow restriction. An outflow restriction may also have an effect on inflows; when residents are unable to purchase foreign assets (capital outflows), all other things equal the sales of foreign assets should decrease (capital inflows). Whether the symmetric relationship is borne out by data is an interesting empirical question.

2.5.2 Price-Based Controls versus Quantity-Based Controls

Capital controls can also be classified into *price-based controls* versus *quantity-based controls*. Price-based controls limit asset transactions through price mechanisms, while quantity-based controls do so by quotas or outright prohibitions. Price-based controls usually take the form of some types of taxes, such as taxes on returns to international investment or taxes on international transactions. The taxes impose additional costs on financial transactions and hence discourage capital movements. The Brazilian I.O.F tax (mentioned previously), for example, was a price-based control. It applied a percentage (2% initially, and 4% and 6% subsequently) to non-residents' investment returns. Price-based controls can also be tax equivalent. For example, a mandatory unremunerated reserve requirement (URR) is a price-based capital

control that has commonly been implemented to reduce capital inflows. The requirement typically obligates non-residents who wish to deposit money into a domestic bank account to deposit some percentage of the inflow with the central bank for a minimum period without earning interests. For example, from 1991 to 1998, Chile required foreign investors to leave a fraction of short-term bank deposits with the central bank without earning interest. As the deposits earned no interest and allowed the central bank to buy foreign money market instruments, the reserve requirement effectively functioned as a tax on short-term capital inflows (De Gregorio et al., 2000).

Quantity-based capital controls involve the use of quotas, special permissions, or outright prohibitions. For example, in 2003, Thailand used quotas to limit short-term capital inflows. Borrowing from non-residents in total was limited to a quota of 30 million Thai baht. In 2007, in an attempt to reduce Colombian banks' ability to take a position against the Colombian peso, the Colombian central bank required that the banks' gross exposures in the foreign exchange derivative market be limited to 500 % of capital. Pushing a quota to a zero limit becomes an outright prohibition. In 2006, banks in Thailand were not allowed to issue or sell bills of exchange in Thai baht of any maturity to non-residents. Forbidding or requiring special permission for repatriation of profits by foreign enterprises operating domestically can be used to restrict capital outflows.

2.6 Capital Control Indices

In Section 2.6, I use the four dimensions that I have discussed in the introduction of this chapter to review major capital control indices. To reiterate, the four dimensions are (1) what to measure (de jure, de facto, or hybrid), (2) what data input to use (AREAER or non-AREAER information), (3) what weighting scheme to use, and (4) the extent to which the indices are able to pick up changes within the same asset categories (extensiveness versus intensity). Table 2-8 summarizes the major capital control indices I review.

2.6.1 De Jure Indices

2.6.1.1 AREAER overview

An overview of what information AREAER contains and its format helps one understand AREAER-based indices. The AREAER contains information on capital controls, as well as other information such as exchange rate arrangements and structure, arrangements for payments and receipts, and procedures for resident and non-resident accounts. It presents information through (1) *a summary table* that only contains binary values and (2) *text* that contains further details. Some of the AREAER-based indices use the

information summarized in the table part of the report, while other AREAER-based indices use the information contained in the text part of the report.

The AREAER started to report much granular information after volume 1997. For example, prior to volume 1997, the table part of the report had only one line (with a binary value) related to capital controls: one stood for completely open and zero stood for not completely open. Since volume 1997, the AREAER began to contain much finer details. For example, the table part of the report began to have 13 subcategories for capital controls (see Table 2-5). For the text part of the report, it began to have the same 13 subcategories for capital controls and further began to break each subcategory into the four types of transactions that I have discussed in Section 2.5. For ease of discussion, they are repeated here:

controls on residents:

1. Category (a): Purchase (foreign assets) abroad by residents
2. Category (b): Sale or issue (domestic assets) abroad by residents

controls on non-residents:

3. Category (c): Purchase (domestic assets) locally by nonresidents
4. Category (d): Sale or issue (foreign assets) locally by nonresidents

2.6.1.2 AREAER Table-Based Indices

Some early AREAER table-based indices are constructed from the old format of the summary table. For example, Milesi-Ferretti and Gian Maria (1995) use the binary values captured by the first version of the table to study the effects and determinants of capital controls for 61 countries. They find that capital controls are more likely to be implemented in countries with lower income, a large government, and a central bank with limited independence. Capital controls are found to be associated with higher inflation and lower real interest rates. No robust correlation is found between our measures of controls and economic growth.

A clear drawback of these binary indices includes the binary nature of the AREAER. Another limitation is the period coverage because the old table is published up until volume 1996.

This new enriched tabular format in volume 1997 spurs a series of table-based capital control indices. These indices use different methods to convert the binary scores from the new table into composite indices. Common techniques include summing, averaging, and the principal component analysis (CPA). For example, Tamirisa (1999) and Johnston and Tamirisa (1998) sum the binary scores for the 13 categories under capital controls for 40 countries in 1996. Miniane (2004) averages the scores in the categories and

extended the time period from 1983 to 2000. Brune and Guisinger (2007) extend Johnston and Tamirisa's (1998) data from 1970 to 2004 for 187 countries by coding the qualitative descriptions (the text) in the pre-1997 volumes. The index of Brune and Guisinger represents the cumulative total of the binary score for 12 categories and distinguishes between inward and outward flows. Unfortunately, the data and details on the mapping from qualitative text to binary scores are not publicly available (Quinn et al., 2011).

Some indices use the information outside the 13 categories. For example, Mody and Murshid (2005) use the information on financial account restrictions, as well as the information on current account restrictions, export proceeds surrender requirements, and the presence of multiple exchange rates. Their index takes a simple average of the binary values.

Chinn and Ito's (2008) index is one of the most widely-used capital control indices. The main feature of Chinn-Ito index is the use of the principal component analysis (PCA). The PCA—a variable reduction technique—aims to find out a dimension that captures the most variations. With this dimension, the raw data with multiple dimensions are transformed into a composite index that only has one dimension. The Chinn-Ito index is based on selected information from the table part of the AREAER, which includes (1) a variable indicating the presence of multiple exchange rates, (2) a variable indicating restrictions on current account transactions, (3) a variable indicating restrictions on financial account transactions, and (4) a variable indicating the requirement of the surrender of export proceeds. Note that the data input of the Chinn-Ito index contains information broader than just restrictions on financial account transactions. The Chinn-Ito index is publicly available and covers a broad range of countries and a wide time period.

The AREAER table-based indices have their own advantages and limitations (Quinn et al., 2011). In terms of advantages, the main one is that they are all based on the same coding system the IMF has established. A similar coding system enables comparisons between different types of AREAER table-based indices. It also eliminates the need to create a new coding system, which could be time-consuming. In terms of limitations, it is unclear how the IMF defined methodologically the switch point from open to closed or vice versa. Second, AREAER table-based indices suffer from a structural break between 1995 and 1996. The table from volume 1997 onward has properties incommensurable with those in prior editions. Third, the data summarized in the table are point-in-time measures, usually 31st December of each year in question. As a result, the indices fail to capture variations that occurred within the year. Most importantly, due to the binary nature of the information that the summary table contains, it is argued that the table-based indices only reflect the *extensiveness* of the capital controls (i.e., the number of categories that have controls in place), not the *intensity* of the capital controls (i.e. the cumulative number of policy actions being taken), an issue that I will further discuss in Section 2.6.4.

2.6.1.3 AREAER Text-Based Indices

Another strand of AREAER-based indices uses the text part of the report. For example, Quinn (1997) constructs two capital control indices by coding up the information that is contained in the text part of the report. These categories include (1) payment for imports, (2) receipts from exports, (3) payment for invisibles, (4) receipts from invisibles, (5) capital flows by residents, and (6) capital flows by non-residents. Quinn evaluates the details of the controls that are in place within the six categories. They then assign a value that ranges from 0 to 6 to each category to reflect the magnitude of the controls. Thus, rather than being binary as is the case for the table-based indices, these scores are now ordinal. In this way, the indices of Quinn captures the intensity of the controls more closely.

Schindler's (2009) indices are a group of AREAER-based indices that are also widely used. The main feature of Schindler's indices is their fine division and flexibility. Schindler indices derive from the text part of the AREAER which classifies countries' capital controls by 13 categories with inflow-outflow as well as asset types sub-categories. For each combination, the AREAER reports a binary value that indicates whether or not capital controls are in place. Schindler's indices are simple averages of these binary values. For example, an overall capital control index is a simple average on of all binary values; an inflow controls index is a simple average of the binary values related to capital inflows; an outflow controls index is a simple average of the binary values related to capital outflows. Publicly available, Schindler's indices cover 91 countries from 1995 to 2015 and has been recently updated by Fernández et al. (2016).

2.6.1.4 Non-AREAER-Based Indices

Examples of non-AREAER-based indices include Kaminsky and Schmukler (2007) and Kastner and Rector (2003). Kaminsky and Schmukler's (2007) study the financial liberalization from 1973 to 2005. They use a wide range of sources from both international and domestic institutions to construct measures of financial liberalization from 1973–2005 in 28 countries. The international institutions include data from publications of the Bank for International Settlements (BIS), the International Finance Corporation, the International Monetary Fund, the Organization for Economic Cooperation and Development (OECD), and the World Bank. The domestic institutions include data from annual reports of central banks, finance ministries, and stock exchanges of all the countries in our sample. Reports by the Economist's Intelligence Unit are also used. Their indices cover the financial account, the domestic financial system, and the stock market. Each category is coded into three levels: fully liberalized, partially liberalized, or repressed. The monthly frequency of the indices can be useful for analyzing higher-frequency variables such as stock prices. Kaminsky and Schmukler's indices are no longer updated.

Kastner and Recto (2003) offer a chronology of policy changes for 19 OECD countries from 1951 to 1988. The daily frequency of the data has the advantage of offering specific dates for policy shifts. Kastner and Recto's data is not publicly available.

2.6.2 De Facto Indices

In contrast with de jure indices that are constructed to reflect only the presence of capital controls, de facto indices aim to capture a country's degree of financial integration into the rest of the world. The de facto capital control indices can be divided into two categories: quantity-based and price-based de facto indices.

2.6.2.1 Quantity-Based Indices

One example of the quantity-based capital control indices is Lane and Milesi-Ferretti's index (hereafter LMF index). The LMF index derived from Lane and Milesi-Ferretti's (2007) database on countries' stocks of external assets and liabilities over time. It measures a country's exposure to the international financial markets by the sum of the country's external assets and external liabilities over its gross domestic product. In its updated version, the database covers 213 countries from 1970 to 2015.

2.6.2.2 Price-Based Indices

Examples of price-based indices include Levy Yeyati et al. (2009) and Dooley et al. (1997). Price-based capital control indices consider the differences between the external prices and the domestic prices, under the assumption that among financially integrated economies, price differentials of similar assets in different locations should vanish due to arbitrage.

De facto capital control indices also have their own limitations. In particular, the de facto indices are only imperfectly correlated to a government's policy stance on capital controls. A de facto index indicating a lower degree of de facto financial restrictiveness may be a result of either a lower degree of capital controls or a result of poor implementation. This point is particularly relevant when it comes to evaluating the effectiveness of capital controls using capital control indices. In order for the de facto indices to be the legitimate proxies for capital controls, one has to make the assumption that capital controls are effective. However, the effectiveness of capital controls is the very argument one wants to find evidence on. As a result, using the de facto indices as the proxies for capital controls in this case will obviously run into the problem of circular reasoning. For example, France, Germany, and the Netherlands saw their values of indices increase from about 100 percent to about 300 percent from 1994 to 2004 without significant changes in capital account openness (Quinn et al., 2011).

2.6.3 Hybrid Indices

The third category of capital control indices is hybrid indices. The indices under this category have both the de facto and the de jure elements of the capital controls. For example, Edison and Warnock (2003) use the Standard and Poor's Global Index (de facto) and Investable Index (de jure) to create a measure of capital account restrictions. The Global Index is a de facto measure because it represents the degree of a country's capitalizations, and the Investable Index is a de jure measure because it represents the portion of the market that is available to foreigners according to the domestic regulations. Edison and Warnock's index for each country is simply one minus the ratio of the Investable Index to the Global Index. A larger value represents a higher degree of capital controls.

The KOF index by Gygli et al. (2019) is another example of hybrid capital control indices. The de facto elements of the KOF index are countries' capital flows, while the de jure elements are as follows: (1) the prevalence of foreign ownership and regulations to international capital flows, (2) de jure financial account openness by the Chinn-Ito index, and (3) the number of bilateral investment agreements and treaties with investment provisions by Gwartney et al. (2017). The KOF index derives from a principal component analysis of these elements. The KFO index is available on a yearly frequency for 207 countries from 1970 to 2016. The KOF index is a sub-index of the KOF Globalisation Indices, which measure the economic, social, and political dimensions of globalization.

2.6.4 Extensiveness versus Intensity indices

The literature has referred to the capital control indices discussed so far as *extensiveness* indices, on the basis that these indices are aggregated along the extensiveness margin. Conceptually, one can think of the levels of capital controls as having two margins: (1) the extensiveness margin being the number of asset categories to which capital controls apply, and (2) the intensiveness margin being the magnitude of capital controls being applied. A feature of the extensiveness indices is that they do not reflect the intensity of capital controls. Consider Schindler's indices for the case of Brazil from 2009 to 2010. In 2009, Brazil implemented a 2% tax on capital inflows from abroad that went into equities or fixed-income securities. The tax initially changed the binary values of affected financial accounts from 0 to 1. However, in 2010, the tax was further raised to 4% for transactions related to fixed income. In the same year, the tax was hiked further to 6%. Due to the binary feature, Schindler's indices would not pick up the subsequent changes. To address this issue, some indices are designed to capture cumulative changes in a more granular way (Ahmed & Zlate, 2014; Bruno et al., 2017; Forbes et al., 2015; Pasricha et al., 2018).

A prominent example is Pasricha et al. (2018). Their indices aim to reflect the intensity of capital controls. They first collect *policy actions* related to capital controls from multiple sources: AREAER, press release, news sources, and research papers. Each policy action is grouped into different categories: by inflows and outflows, and by asset categories. To measure the degree of financial openness, they then code each change as an easing action (with a value of 1) or a tightening action (with a value of -1). Finally, each policy action is aggregated into a composite index according to their relative importance to a country's total external assets and external liabilities. The indices cover 17 countries from 2001 to 2015.

Comparing the construction of the extensiveness indices to that of the intensiveness indices reveals the main factor that distinguishes one type of indices from the other. Since both types of indices rely largely on the information that AREAER reports, the data sources behind both types of indices are largely similar. However, the two types of indices process differently the policy actions reported by AREAER. For extensiveness indices, the basic unit is an *asset category*. Policy actions are first grouped into different asset categories. A coding system then assigns a binary value to reflect *two* levels of capital controls for each asset category such that the two levels of capital controls are comparable between asset categories, time, and countries. This is already not an easy task, considering the sheer volumes and complexities of policy actions. Most extensiveness indices rely on the framework established by AREAER to ensure comparability. For intensiveness indices, the basic unit is *the policy action itself*. Policy actions are also grouped into different asset categories. A coding system then assigns an *ordinal*—instead of binary—value on the levels of capital controls within each asset category. In other words, each policy action is compared against each other. This adds another layer of complexity when it comes to comparability, especially when more countries are included in the dataset. This explains why the country coverage of the intensiveness is usually smaller compared to extensiveness indices. Ultimately, the choice of the basic unit may be just a choice between *granularity* and *comparability*, which depends on the purpose of the study at hand. If the goal is to capture variations stemming from some specific events, the intensiveness indices may suit that purpose better. On the other hand, if the goal is to ensure comparability among as many countries as possible over a long period of time, the extensiveness indices may be more appropriate.

2.6.5 Classifications of Capital Control Regulations and Capital Control Indices

Here, I elaborate on the relationship between (1) the classification of capital control regulations and (2) the classification of capital control indices. Several points merit further discussion. First, capital control indices can either be de jure or de facto. On the other hand, capital control regulations—by definitions—are always de jure. Second, while it is conceptually possible to further separate de jure capital control indices into those that only capture price-based capital control regulations (e.g., a tax on foreign investments)

and those that only capture quantity-based capital control regulations (e.g., an outright prohibition on foreign investments), the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)—which most de jure capital control indices builds upon—does not report data at that level of granularity. Third, the two qualifiers—i.e., quantity-based or price-based—have different meanings when they are used to describe capital control regulations than when they are used to describe capital control indices. When used to describe capital control regulations, price-based and quantity-based capital control regulations refer to the restrictions that are imposed on the prices and quantities of foreign investments, respectively. When used to describe capital control indices, price-based indices measure countries' degree of market efficiency (e.g., to what extent interest rate parity holds), while quantity-based capital control indices measures countries' exposure to international financial markets (e.g., to the sizes of external assets and liabilities relative to their domestic GDP). Accordingly, quantity-based capital control indices do not limit their scope only to quantity-based capital control regulations; price-based capital control indices do not limit their scope only to price-based capital control regulations.

2.7 Comparing Capital Control Indices

In Section 2.7, I compare the main publicly available capital control indices both at the world level and at a country level for selected countries (i.e., Brazil and South Korea).

2.7.1 Trends of World Capital Controls

Figure 2-1 shows the evolutions of levels of world capital controls measured both by de facto (LMF) and de jure (Chinn-Ito and Schindler) capital control indices. All indices are publicly available and are normalized to their values in the year of 1995. The LMF indices show that the world as a whole experienced a long period of financial liberalization from the late 1990s to 2007, after which the global financial integration appeared to have slowed down. The Chinn-Ito and Schindler indices present a similar pattern. The increase in the levels of world capital controls after the Global Financial Crisis is particularly noticeable.

Figure 2-2 shows the levels of world capital controls weighted by each country's relative shares of world GDP. Compared to Figure 2-1, Figure 2-2 shows a more noticeable upward trend—which started even before the Global Financial Crisis—of the levels of de jure capital controls, suggesting that countries that have increased their levels of capital controls in the post-crisis era were those that had more influence on the world economy terms of their relative shares of world GDP.

The increased levels of world capital control shown by Figure 2-1 and Figure 2-2 are broadly in line with the dynamics of views towards the use of capital controls, including the shifting position in the IMF.

Gallagher and Tian (2017) summarize such evolution. In the 1990s, the focus of the literature was on reaping the potential benefits of capital account liberalization, including increased growth, improved intertemporal efficiency, and diversified risks. Prior to the 1997 Asian crisis, the IMF had strongly advocated free mobility of capital flows and seen capital controls as an unadvisable policy. The 1997 Asian crisis, however, saw countries—which had made significant advances in liberalizing their capital accounts—experience booms and busts of international capital flows as a consequence of foreign investors’ herd behavior and excessive optimism. As a result of the crisis, the focus of the literature started to shift toward the sequencing of capital account liberalization that looks into the pre-conditions for orderly and successful capital account liberalization, although the IMF still largely maintained its official stand *against* capital controls.

The Global Financial Crisis provided an opportunity for the researchers and policymakers to reassess the role that capital controls played in managing volatile capital flows. During the Global Financial Crisis, countries such as Iceland, imposed controls on capital outflows to prevent the collapse of the value of its currency. In the wake of the Global Financial Crisis, on the other hand, countries such as Brazil and South Korea imposed inflow controls to discourage excessive capital inflows. Against this backdrop, the IMF launched a series of discussions on the use of capital controls and shifted its institutional view on *capital flow management measures* – a rebranded name for capital controls. This time, the IMF started to recognize that capital flows are associated with potential risks and that capital controls should form a legitimate part of the policy toolkit to prevent and mitigate financial instability. The IMF also began to publicly express support for the use of capital controls in its member countries. For example, Gallagher and Tian (2017) found that not only did the IMF change its view on capital controls, there is also evidence that the IMF has also changed its actual behavior by significantly making more recommendations that are supportive of capital controls.

Figure 2-3 breaks the de jure capital control indices by income groups. It shows that it is the countries in the middle-income group that have contributed to the increased levels of world capital controls after the Global Financial Crisis. Moreover, it shows that countries in the high-income group on average have been having lower levels of capital controls, while countries in the low-income groups on average have higher levels of capital controls. Countries in the middle-income group on average are in between. The relativity stays the same throughout the entire period.

Figure 2-4 and Figure 2-5 further explore what countries—instead of what groups of countries by their incomes—were the driving force behind the recent upward trend of the levels of world capital controls. At the country level, Figure 2-4 and Figure 2-5 compare the degrees of capital controls between 2005 and 2015 measured by the Chinn-Ito index and Schindler’s index, respectively. In each figure, the sizes of the dots

are scaled by each country's share of world GDP to represent their relative importance to the world economy. The shapes of the dots correspond to the income group of a country. Each dot is a pair of a country's levels of capital controls before and after the Global Financial Crisis measured in the year of 2005 (on the horizontal axis) and in the year of 2015 (on the vertical axis), respectively. The diagonal line is a reference line that represents that a scenario when the levels of capital controls were unchanged between the two points in time. Countries above the reference line are those that had raised their levels of capital controls after the Global Financial Crisis, while countries below the reference line are those that had lowered their levels of capital controls after the Global Financial Crisis.

Consistent with Figure 2-3, both Figure 2-4 and Figure 2-5 show that the increased levels of capital controls come mostly from countries that are in the middle-income group. Moreover, the relatively large sizes of the dots above the reference line suggest that these countries that had raised their levels of capital controls have relatively large shares of world GDP, which explains the more noticeable upward trend in Figure 2-2 (GDP weighted) than in Figure 2-1 (unweighted). With Figure 2-4 and Figure 2-5, we are able to identify the exact countries that have contributed to the increased levels of world capital controls. Examples of these middle-income group countries are Brazil, Argentina, Turkey, and Greece, all of which were prominent cases that have been the subject of much policy discussion; see IMF (2011a), for example.

Incidentally, the financial account in Canada and the United States both remain fairly open between two periods. China, one of the world's large economies, slightly moves toward a lower level of capital controls measured by the Chinn-Ito index.

2.7.2 Compare Capital Control Indices in Selected Countries

Figure 2-6 compares several publicly available capital control indices—including LMF, Chinn-Ito, Schindler, and Pasricha indices in each row of the figure in that order—for the case of Brazil and Korea from 2001 to 2015. The developments of capital flow management in both countries in the aftermath of the Global Financial Crisis have been the subject of much policy discussion; see, for example, Grabel (2018); Chamon & Garcia (2016); Fritz & Prates (2014); and IMF (2011a). The rich dynamics of the policy developments in both countries in that time period provide us with an opportunity to assess how well these capital control indices capture the policy developments. The details on the policy developments in Brazil and South Korea are discussed in Box A and Box B, while the corresponding capital control events are documented in Table 2-6 and Table 2-7, respectively. Comparing the various indices against each other and against the events of capital controls lead to some observations.

First, the evolutions of the LMF de facto financial integration index—shown in the first row of Figure 2-6—are consistent with the environment where Brazil and South Korea were situated around the Global

Financial Crisis. The discussion in Box A and Box B shows that both Brazil and South Korea saw large surges in capital inflows in the years leading up to the crisis. The surges were disrupted during the Global Financial Crisis due to the global deleverage. In the aftermath of the Global Financial Crisis, however, the inflow surges resumed. Against this backdrop, both Brazil and Korea imposed a series of inflow capital controls. The LMF index in the first row of Figure 2-1 shows that in both countries, the levels of de facto financial integration increased in the years leading up to the Global Financial Crisis, decreased in 2009, and went up again in the aftermath of the Global Financial Crisis. In the case of South Korea, the increase in levels of capital flows 2010 was noticeable. The LMF index suggests that the ratio of its external assets plus liabilities relative to South Korea's GDP went up from less than 1.2 in 2009 to more than 1.5 in 2010.

Second, a divergence between Chinn-Ito and Schindler indices exists. For example, the Chinn-Ito index suggests that South Korea's levels of capital controls declined from a value of 0.6 to a value of 0.4 from 2007 to 2012, after which the level stayed flat at 0.4. On the other hand, Schindler's index shows a steady increase in the levels of capital controls after the financial crisis from under 0.1 in 2008 to 0.16 in 2012. The divergence between Chinn-Ito and Schindler indices can be explained by how the two indices are constructed, i.e., the different parts of AREAER that the two indices are based upon (table versus text), and the methods used to convert binary values into composite indices (simple average versus the Principal Component Analysis). Because Schindler's index is a simple average on the number of asset categories that have capital controls in place, the increased levels of capital controls measured by Schindler's index suggest that South Korea extended capital controls to the asset categories that did not have capital controls in place before. On the other hand, the Chinn-Ito index extracts the first principal component that captures the most variations of the data. The decline in the levels of capital controls measured by the Chinn-Ito index suggests that other countries in the world might have raised their levels of capital controls at the same time.

Third, Pasricha's intensity index is able to capture the granularity of the developments of capital controls in Brazil and Korea. Table 2-6 and Table 2-7 document the series of capital controls that were implemented in both countries. Pasricha index—shown in the last row of Figure 2-6—captures the dynamics of the developments in the two countries fairly well. In 2009, Brazil started a series of inflow capital controls to curb capital inflows, including a 2% I.O.F tax on equity and fixed income inflows. The rate of the tax was further increased twice, first to 4 % and then to 6% in 2010. In early 2011, the scope of the tax broadened to include *other asset categories* than just fixed income flows. Starting from late 2011, Brazil began to gradually loosen the inflow controls (Chamon & Garcia, 2016). Consistent with such developments, the Pasricha index captures an increase in the intensity of capital controls from 2009 to 2011, and then a gradual decline from 2012 to 2015. For South Korea, several inflow capital controls were implemented to limit the banks' exposures to external liabilities. The Pasricha index shows an increase in

the levels of capital control intensity from 2009 to 2011. Interestingly, Schindler's index also picks up a large increase in the levels of capital controls in Brazil from 2008 to 2009, although it does not pick up the increase in the intensity of capital controls from 2009 to 2010. This suggests that capital controls that were implemented from 2009 to 2010 in Brazil were applied to asset categories that already had capital controls in place. For South Korea, the Schindler index also picks up an increase in the levels of capital control in 2010, although the jump is not as noticeable as the one suggested by the Pasricha index.

Contracting the extensiveness indices (Chinn-Ito and Schindler) with intensity indices (Pasricha) confirms the basic feature of the two types of capital control indices. By construction, the intensity indices would be more responsive to individual policy actions. The extensiveness indices, on the other hand, only pick changes when capital controls apply to new asset categories or when the changes are substantial enough that the binary values change within a given asset category.

2.8 Box A: Capital Controls in Brazil

Many emerging-market countries experienced surges in capital inflows in the aftermath of the 2007-2008 Global Financial Crisis. These countries included Brazil, Indonesia, South Korea, South Africa, Peru, Thailand, Taiwan, and Turkey (IMF, 2011a). Both push (external) and pull (internal) factors played a role. Improved fundamentals and growth prospects in these countries coupled with loose monetary policy in the advanced economies were the main reasons behind the large capital flows from advanced to the emerging-market countries. However, the surges in capital inflows carried macroeconomic challenges (e.g., loss of export competitiveness due to currency appreciation) and financial stability risks (e.g. sudden stops). In responding to the large capital inflows, many of these countries implemented inflow capital controls. Among them, Brazil provided the most cited examples due to its size among emerging markets and its active experimentation with many different forms of controls on capital inflows (Chamon & Garcia, 2016).

For Brazil, the main concern with the inflows was the appreciation of the Brazilian currency (the real), which was a result of interest rate arbitrage activities (i.e., carry trades). In the complex financial market, carry trades could take place in various ways. One way was through the futures market, of which steps are worth mentioning due to their relevance to the capital controls that were imposed by Brazil. The steps involved were as follows (Chamon & Garcia, 2016; Fritz & Prates, 2014; IMF, 2011a):

1. A non-resident investor sold a US dollar futures contract in the futures market (onshore or offshore).
2. The non-resident investor's counterpart was a resident investor (the local bank), who hedged its currency exposure by borrowing US dollars externally using its available credit lines. Because the resulting US dollar liability at maturity matched the obligation to receive US dollars on the US dollar futures contract, the bank was hedged against currency risk.
3. The local bank sold the proceeds from external borrowing into the spot market, which caused the same pressure on the exchange rate as if the non-resident investor had come directly.
4. On the fixed-income market, the local bank invested the real proceeding from selling U.S. dollars on the spot market at the domestic interest rate. The local bank was able to earn an arbitrage profit whenever the domestic interest rate was higher than the interest rate paid on its external borrowing. On the other hand, the non-resident investors profited from the appreciation of the real.

To discourage various forms of the carry trade, Brazil took a series of inflow capital controls. Table 2-6 lists the capital controls that were implemented in Brazil during the period of October 19, 2009 to June 4, 2014 (Chamon & Garcia, 2016). These measures were targeted at various types of capital flows such as fixed income, equity, depository receipts, bank external borrowing, and trade credits.

fixed income and equity flows

Brazil's capital controls had a long tradition. They dated back to 1990s when an IOF tax (i.e., a financial transaction tax) was first introduced. Since then, the IOF tax had been on-and-off and applied to fixed-income flows only due to the fact that fixed-income flows were closely related to interest rate arbitrage. Equity flows, on the other hand, had been excluded from the IOF because they typically had been perceived to be a fairly safe type of flow. However, the investors had found ways to circumvent the IOF tax by disguising fixed income flows as equity flows. For example, a financial intermediary could create a public corporation and list its shares on the Brazilian Stock Exchange (BOVESPA). The company was strictly a legal entity and had no physical activity. Because the financial intermediary held all the company's shares, it could manipulate their price by arranging the purchase and sale transactions with low liquidity. The price was completely artificial. The financial intermediary, having capital outside the country, would invest in the company as a foreign investor and declare this flow as equity flows or even direct investment. This money would be invested in short-term fixed income. Returns would go to the company and be sent abroad as profit or dividends (Carvalho & Garcia, 2008).³ On October 19, 2009, the IOF tax was brought back with a tax rate at 2 percent. This time around, the IOF tax applied to *both* fixed income flows and equity flows.

depository receipts

One way that would have allowed investors to bypass the IOF on equity flows was the conversion of Depository Receipts (DRs). DRs are securities issued by a custodian bank, which receives the underlying stock in Brazil, and issues a corresponding receipt that is traded in foreign markets (e.g. ADRs – American Depository Receipts – in the case of U.S. markets). On November 18, 2009, a 1.5 percent tax was imposed on the issuance of DRs to discourage their use as a way to buy Brazilian equities without incurring the inflow tax. When a foreign investor buys a DR, he has the right to convert that DR into the underlying stock in the Brazilian market. This provided a mechanism to enter the Brazilian financial market without incurring the 2 percent tax on capital inflows. On December 30, 2010, a tax of 2 percent was imposed on those conversions.

derivatives and bank external borrowing

The complexity and flexibility of the derivative market provided various ways for investors to bypass capital controls. Several examples are available. First, foreign investors who intended to do carry trade could buy Non-Deliverable Forward contracts of Brazilian reals in offshore markets and the local banks

³ Carvalho and Garcia (2008) also documents other ways of circumvention in Brazil.

could take an offsetting position in Brazil (discussed above). The offshore transaction would then be beyond the reach of the inflow tax. On January 6, 2011, the Brazilian central bank announced an unremunerated reserve requirement (URR) on banks' gross FX liabilities beyond 3 billion US dollars, which limited the extent to which the strategy described above could be used to bypass the controls. On March 28, 2011, Brazilian firms borrowing abroad became subject to a 6 percent tax on those flows if their maturity was less than one year (extended to two years shortly afterward).

Second, foreign investors could use derivatives to leverage their currency exposure, with the IOF tax only being applied to the money they brought to Brazil to meet their margin requirements. On July 26, 2011, a tax on the *notional amounts* of currency derivatives was announced. This tax was levied whenever a currency derivative that shorts foreign currencies is purchased, sold, or at its expiration date. Therefore, investors are exposed to the risk that the tax rate increases while they are holding the derivative.

trade credits

Investors could also disguise fixed-income capital flows as trade credits. In February and March 2012, restrictions were put in place to limit payments to exporters before the actual delivery of goods or services.

2.9 Box B: Inflow Controls in South Korea

South Korea's small open economy has historically been susceptible to volatile cross-border capital flows.

In the years leading up to the 2007-2008 Global Financial Crisis, local and foreign banks in South Korea had incurred large short-term US dollar debts due to (1) speculative demand for currency forward contracts by the corporate sector on expectations of appreciation of the Korean won, and (2) arbitraging of interest rate differentials on- and off-shore (IMF, 2011a). The demand for Korean won forward came from both domestic exporters and foreign investors. Domestic exporters (e.g., the large shipbuilding industry) faced full currency risks since most transactions in trade are contracted in terms of the U.S. dollar. Therefore, they purchased forward contracts in order to fix their cash flows in Korean won (Kim & Yang, 2010). In addition to domestic exporters, foreign investors swapped cheaply borrowed dollars for won on the expectation that the Korean won would rise. Local banks (domestic for foreign), which intermediate these contracts, were in the opposite position of selling forward contracts to buyers of forward contracts. To cover potential losses arising from forward trading, these banks borrowed dollars short-term, sold these dollars for won on the spot market, bought certificates of deposit or other domestic bonds and sold the won forward for dollars (Baba & Kokenyne, 2011). In this way, they created risk-free arbitrage profits by borrowing from abroad and trading forward contract in the domestic forward market. Under the trading rules in South Korea at that time, local banks could buy forex derivatives contracts without any limits.

In the aftermath of the global liquidity squeeze of late 2008, South Korea suffered a severe sudden stop of short-term external bank debt. Onshore banks and foreign bank branches were unable to roll over their maturing short-term external liabilities as global banks cut credit lines in order to shore up liquidity. During this episode, Korea's reserves fell by 64 billion US dollars and the stock market declined by 70 percent in only a few months (IMF, 2011a).

The situation was similar again in late 2009. To avoid the same experience, South Korea imposed a series of inflow capital controls. The policy concern was financial stability as opposed to the levels of inflows per se. Table 2-7 lists the measures from the period of 2009 to 2012.

2.10 Efficacy of Capital Controls

In Section 2.4, I have summarized the macroeconomic risks associated with large capital inflows into two broad categories: loss of export competitiveness and increased financial instability. Against these risks, the literature generally uses the following policy objectives to evaluate the efficacy of capital controls. The main policy objectives are whether capital controls are able to (1) reduce real exchange market pressures, (2) allow for a more independent monetary policy, (3) reduce the volume of capital flows, (4) alter the compositions of capital flows toward longer-maturity flows, and (5) reduce the frequency of disruptive adjustments such as currency crises and severe output loss (Magud et al., 2018). The first two policy objectives address the risks of loss of export competitiveness, while the remaining policy objectives are related to financial instability.

The strand of literature on the efficacy of capital controls can be conveniently structured into two broad groups: *case studies* and *multi-country studies*. Case studies analyze country-specific experiences and have the advantage of being flexible in creating measures of capital controls that finely reflect event-specific information. The event-specific information may otherwise be obscured at the aggregate level measured by broad indices such as the Chinn-Ito and Schindler indices. Multi-country studies usually examine whether capital controls can mitigate the build-up of macroeconomic risks that eventually lead to disruptive adjustments. To explore long-term variations in the levels of capital controls among different countries, multi-country studies—on the other hand—usually rely on using broad indices such as Chinn-Ito and Schindler that are comparable among countries over time.

Selected studies on the efficacy of capital controls are reviewed here.

2.10.1 Case Studies

Examples of case studies on the experiences of capital controls include studies on countries such as Chile, Colombia, and Brazil.

The experience of capital controls in Chile—often regarded as a poster child in the field of capital controls—has been widely studied. For example, De Gregorio, Edwards, and Valdes (2000) study the Chilean experience with the use of unremunerated reserve requirements (URR) from 1991 to 1998. They first compute the tax-equivalent of the URR as a measure of capital controls. The tax-equivalent of the URR is then used as one of the regressors for regression analysis. They find that capital controls had a persistent and significant effect on changing the composition of capital inflows toward longer maturity. However, capital controls do not affect the level of capital inflows. The impact on the real exchange rate is small and temporary.

Colombia is another country whose experience is subject to close scrutiny. For example, using datasets from the central bank of Colombia, Clements and Kamil (2009) assess the effects of capital controls imposed in Colombia in 2007 on capital flows (foreign borrowing and non-FID flows) and exchange rate dynamics. The proxy for capital controls is a dummy variable that takes a value of one in the weeks after capital controls were imposed, and zero otherwise. The result suggests that controls imposed in Colombia in 2007 were successful in reducing foreign borrowing, but had no statistically significant impact on the volume of non-FDI flows as a whole. They find no evidence that capital controls moderated the appreciation of Colombia's currency, or increased the degree of independence of monetary policy. Other studies that look into the Colombian experiences with capital controls include Ocampo and Tovar (1999) and Villar and Rincón (2000). Both studies suggest that capital controls in Colombia had little impact on containing exchange rate appreciation.

Cardoso and Goldfajn (1998) analyze the determinants of net capital flows in Brazil from 1988 to 1995. They create two indices of capital controls: one for inflow controls and the other for outflow controls. For the inflow controls index, a change in legislation that aimed to reduce (increase) capital inflows receives a value of 1 (-1). The changes in inflow capital controls in each month are added to obtain the value of the inflow control index for that particular month. Symmetrically, the outflow controls index is constructed in the same fashion. In contrast to the Colombia and Chile studies, Cardoso and Goldfajn find that both inflow and outflow capital controls affect not only the composition, but also the volume, of capital flows. But they also find that the effects of capital controls last for only about six months.

2.10.2 Multi-Country Studies

Montiel and Reinhart (1999) focus on the effects of capital controls on both the volume and the distribution of capital inflows in 9 selected countries. Based on the information gathered from various published journal articles, they constructed a non-AREAER-based de jure index for 7 years, with 0 indicating no restrictions, 1 indicating some restrictions, and 2 indicating substantial restrictions. They break down capital inflows into three categories of capital inflows: portfolio inflows, short-term inflows and FDI inflows. While they do not find any evidence that capital controls impact the volume of capital inflows, they suggest that capital controls appear to influence the composition of inflows by reducing the share of portfolio and short-term flows in total capital inflows.

Binici et al. (2010) study the experiences of capital controls in 74 countries from 1995–2005. They break the capital flows by the directions of capital flows (i.e., inflows versus outflows) and by asset types (i.e., debt flows, equity flows, and FDI flows). They use the capital control indices of Schindler (2009), which has the flexibility of pairing various inflow and outflow asset subcategories with corresponding

capital control variables. With the least square dummy variable regression (LSDV), Binici et al. find that the estimated effects of capital controls vary markedly across asset categories and the directions of capital flows. In particular, they find that both debt and equity controls can substantially reduce outflows, but seem to have little effect on capital inflows. Meanwhile, they find that capital controls seem to be able to affect both the volume and the composition of capital flows.

Forbes and Warnock (2012) analyze extreme episodes of capital flows in 52 countries from 2000 to 2009. They use various capital control indices, including the Chinn-Ito index and Schindler index. Categorizing extreme episodes of capital flows into surges, stops, flights, and retrenchment, they find that capital controls are not statistically related to any of these extreme episodes. In other words, there is no evidence in the sample that capital controls are effective in reducing the volume of capital flows. It is also worth mentioning that their study contributes to the literature by shifting the focus from using net inflows as the variable of interest to using gross inflows and gross outflows.

Ostry et al. (2012) study the relationship between capital controls and financial-stability risks from capital inflows. They investigate two sets of questions. First, to what extent are capital controls associated with financial-stability risks? Second, if capital controls help reduce the financial-stability risks, would countries with a greater level of capital controls experience smaller growth declines in the event of financial crises because of less financial fragility. The financial-stability risks they examine include (1) the structure of external liabilities, (2) the amount of foreign-currency lending, and (3) the degree of the credit boom. To measure these risks, they use as dependent variables (1) the share of portfolio debt to total external liabilities, (2) the share of domestic foreign-currency lending relative to total domestic lending, and (3) the change in private credit to GDP in a three-year period, respectively. To measure the growth declines, they use as a dependent variable the difference between the output growth rate during a crisis year and the average output growth rate five years prior to the crisis. They find that capital controls reduce financial-stability risks by lowering the proportion of portfolio debt in total external liabilities, the proportion of foreign-currency lending in total domestic bank credit, and the intensity of domestic credit booms. They also find that capital controls reduce growth declines in the aftermath of a crisis. Their main contribution to the literature is the creation of an AREAER table-based capital control indices that are specific to financial sectors, which provide more evidence on how the use of capital control indices may affect the results on the effectiveness of capital controls.

2.10.3 Possible Explanations for the Mixed Empirical Results

The above review shows that the empirical results from the existing literature on the efficacy of capital controls is inconclusive. Possible explanations for the inconclusiveness include difficulties in (1) measuring

capital controls, (2) obtaining capital flow data with high frequency, (3) standardizing the scope of capital flows, (4) addressing the selection bias problem, and (5) controlling for the circumvention of capital controls and institutional quality.

First, capital controls are complex. Constructing capital control indices that adequately capture various types of capital controls can be difficult. The mixed results may reflect the fact that capital controls have not been adequately measured.

Second, capital flows are highly volatile. When capital flow data with low frequency is used, it will be less likely to capture the effects of the capital controls when the effects are short-lived due to market circumvention.

Third, the scope of capital flows—in terms of compositions, i.e., debt flows, equity flows and FDI flows — varies across different studies. Studies with narrowly defined capital flows are more likely to find effectiveness, in particular with respect to the compositional effect of the controls (De Gregorio et al., 2000).

Fourth, capital controls are usually implemented when capital inflows or outflows surge. Such simultaneity gives rise to the selection bias problem, making measuring the effectiveness of capital controls even more challenging.

Fifth, circumvention is possible, and the mixed research results may reflect variations in each country's institutional features. Indeed, the effectiveness of capital controls depends on the design or implementation of the controls. Different countries with different administrative capacities may implement or enforce the same capital controls differently and the level of legal compliance may also vary across countries.

2.11 Concluding Remarks

In this chapter, I discuss key themes that naturally arise when one begins conducting research on capital flows and capital controls. In discussing these themes, this chapter connects to the subsequent chapters in the following ways.

First, this chapter compares different measures of capital flows along with their interpretations and limitations. While net capital flows summarize the information on a country's saving-investment behavior, gross capital flows provide information that directly pertains to international trade in financial assets and hence a country's financial stability. As I am interested in exploring the potential effects of capital controls on different countries' financial stability, the subsequent chapters will focus mostly on gross capital flows.

Second, this chapter draws the connections between measures of capital flows and measures of capital controls from the perspective of the Balance of Payments. In the following subsequent chapters, I will use various types of capital control indices, identify the capital flows that these controls intend to regulate, and explore the empirical relationships between them.

Third, this chapter compares various types of capital control indices. I show that different capital control indices could depict the levels of capital controls of the same country differently. One factor that contributes to the differences among capital control indices is the choice between granularity and comparability when converting the data input into a composite measure. Indices that cover a larger number of countries tend to focus more on the comparability at the expense of granularity. In the subsequent chapters, I will use Chinn-Ito indices and Schindler indices to conduct cross-country analyses due to their broad country coverage and the long-time period.

Fourth, this chapter identifies a number of unresolved issues concerning the assessment of capital controls that subsequent chapters will examine. Chapter 3 will revisit the efficacy of capital controls. In Chapter 2, I have shown that the speed of world financial integration has slowed down and the global levels of capital controls have increased, suggesting that more countries are engaging in tightening their financial market restrictions. Although the efficacy of capital controls has been the subject of much research, the results from the existing studies are inconclusive. One factor lies in the difficulty in addressing the selection bias issue. In Chapter 3, I will further the research on the efficacy of capital control by using a Propensity Score Matching method to specifically address the selection bias issue and examine whether countries with capital controls are less likely to experience extreme gross capital inflow movements (i.e., surges and stops). In Chapter 4, I will study surges more granularly and examine why certain episodes of surges end in financial crises.

Chapter 5 will study the spillover effect of capital controls. In Chapter 2, I have shown that most studies on the effects of capital controls focus on their domestic effects. Considering that global investors base their investment decision on relative returns, it is possible that capital controls imposed in one country could generate spillover effects on another country. So far, studies on the spillover effects of capital controls are limited. Further research that looks into not only domestic effects, but also external effects of capital controls will bring us a more complete picture of the impact of the capital controls. In Chapter 5, I will examine the effect of capital controls from a multilateral perspective.

2.12 Tables in Chapter 2

Table 2-1: A Standard Breakdown of Balance of Payments

Balance of payments	Credits	Debits	Balance
1. Current account			
Goods and services			
Primary income			
Secondary income			
2. Capital account			
3. Financial Account			
Direct investment abroad			
Direct investment in reporting economy			
Portfolio investment assets			
Portfolio investment liabilities			
Financial derivatives assets			
Financial derivatives liabilities			
Other investment assets			
Other investment liabilities			
Reserve assets			
4. Net Errors and Omissions			

Source: Host-Madsen and International Monetary Fund (2007).

Table 2-2: Balance of Payments Matching Entries

	Credit	Debit
Current Account	$EX_{i,t}$	$IM_{i,t}$
Financial Account		
Assets	$A_{i,t}^T-, A_{i,t}^F-$	$A_{i,t}^T+, A_{i,t}^F+$
Liabilities	$L_{i,t}^T+, L_{i,t}^F+$	$L_{i,t}^T-, L_{i,t}^F-$

Table 2-3: Transactions of Financial Assets and BOP Entries

	Demand	Supply	BOP Entries
Domestic Assets	non-residents buy (1)	residents sell (3)	L+
	residents buy (2)	non-residents sell (4)	L-
Foreign assets	non-residents, buy (5)	residents sell (7)	A-
	residents buy (6)	non-residents sell (8)	A+

Table 2-4: Comparison between Capital Controls Documented by AREAER and Transactions Captured by BOP:

BOP Entries Capital Controls	Foreign Assets		Domestic Assets		Classifications
	Demand		Supply		
	R, buy	NR, buy	R, sell	NR, sell	
	A+	A-	L+	L-	
(a) purchase or (foreign assets) abroad by resident	*				outflows
(b) sale or issue (domestic assets) abroad by resident			*		inflows
(c) purchase (domestic assets) locally by non-resident			*		inflows
(d) sales or issue (foreign assets) locally by non-resident	*				outflows
BOP Entries	A+	A-	L+	L-	
	NR, sell	R, sell	NR, buy	R, buy	
	Supply		Demand		
	Foreign Assets		Domestic Assets		

Table 2-5: Asset Categories in AREAER

Capital Transactions
1. On capital market securities
2. On money market instruments
3. On collective investment securities
4. Controls on derivatives and other instruments
5. Commercial credits
6. Financial credits
7. Guarantees, sureties, and financial backup facilities
8. Controls on direct investment
9. Controls on liquidation of direct investment
10. Controls on real estate transactions
11. Controls on personal capital transactions
Provisions specific to:
12. Commercial banks and other credit institutions
13. Institutional investors

Source: IMF (2016).

Table 2-6: Capital Controls in Brazil, 2009-2014

Date	Tighten/ Loosen	Measure
10/19/2009	Tighten	Tax of 2 percent on portfolio equity and fixed income inflows
11/18/2009	Tighten	Tax of 1.5% on the Issuance of DRs into local equities
10/4/2010	Tighten	Tax rate raised to 4 percent for fixed income inflows
10/18/2010	Tighten	Tax rate raised to 6 percent for fixed income inflows
12/30/2010	Tighten	Tax of 2% on the cancellation of DRs into local equities
1/6/2011	Tighten	Unremunerated reserve requirement of 60 percent on bank's gross FX positions beyond US \$3 billions
3/28/2011	Tighten	Tax of 6 percent on borrowing abroad with maturity below one year
4/6/2011	Tighten	Tax of 6 percent on borrowing abroad extended to maturities below two years
7/8/2011	Tighten	Unremunerated reserve requirement of 60 percent on bank's gross FX positions beyond US \$1 billion
7/26/2011	Tighten	Tax on notional amount of currency derivatives
9/16/2011	Tighten	Tax on notional amount of derivatives takes effect
12/1/2011	Loosen	Tax on portfolio equity inflows eliminated
2/29/2012	Tighten	Tax of 6 percent on borrowing abroad extended to maturities below three years
3/1/2012	Tighten	Restricts pre-payments to exporters to no more than one year
3/9/2012	Tighten	Tax of 6 percent on borrowing abroad extended to maturities below five years
3/15/2012	Loosen	Tax on derivatives set to zero for hedging by exporters (up to 1.2 times exports in previous year)
6/14/2012	Loosen	Tax on 6 percent on borrowing abroad restricted to maturities below two years
6/28/2012	Loosen	Pre-payments to exporters can be done by financial institutions
12/4/2012	Loosen	Pre-payments to exporters allowed for horizon above one year but below five years
12/5/2012	Loosen	Tax of 6 percent on borrowing abroad restricted to maturities below one year
12/18/2012	Loosen	Unremunerated reserve requirement on bank's gross FX position applies only after US \$3 billion
6/4/2013	Loosen	Tax on fixed income flows eliminated
6/12/2013	Loosen	Tax on notional amount of derivatives eliminated
6/25/2013	Loosen	Reserve requirements on short FX positions held by local banks eliminated
7/11/2013	Loosen	Capital requirements on foreign currency loans raised by subsidiaries abroad eliminated
12/24/2013	Loosen	Tax on Issuance of DRs eliminated
6/4/2014	Loosen	Tax on 6 percent on borrowing abroad restricted to maturities below six months

Source: Chamon and Garcia (2016).

Table 2-7: Capital Controls in South Korea, 2009-2012

Date	Measures
Nov 2009	<p>Higher foreign currency liquidity standards to reduce the maturity mismatch of banks' foreign currency assets and liabilities and to improve the quality of their liquid assets.</p> <p>A 125% cap (relative to underlying export revenues) on forward FX contracts between banks and exporters.</p> <p>A ceiling on resident banks' FX derivatives contracts of no more than 50% and for foreign bank branches of no more than 250% of their capital in the previous month.</p>
Jun 2010	<p>A limit on banks allowing them to provide only 100% of underlying transactions for forward contracts with exporters (previously 125%).</p> <p>A stipulation that resident banks' FX loans and held-to-maturity securities (equal to or more than one-year maturity) must be covered by at least 100% of FX borrowing with the maturity of more than one year.</p> <p>A limitation of foreign currency financing to overseas use only, with some exceptions for SME manufacturers.</p>
Jan 2011	<p>Reintroduction of a 14% withholding tax on non-residents' purchases of treasury and monetary stabilization bonds, bringing the tax back in line with the tax on residents' bond purchases. Foreign corporations and non-residents are subject to the withholding tax, but those based in countries that have double taxation treaties with South Korea and official investors are exempt.</p>
Jun 2011	Limits on banks' FX derivatives tightened.
Aug 2011	Levy on FX liabilities.
Nov 2012	Limits on banks' FX derivatives tightened

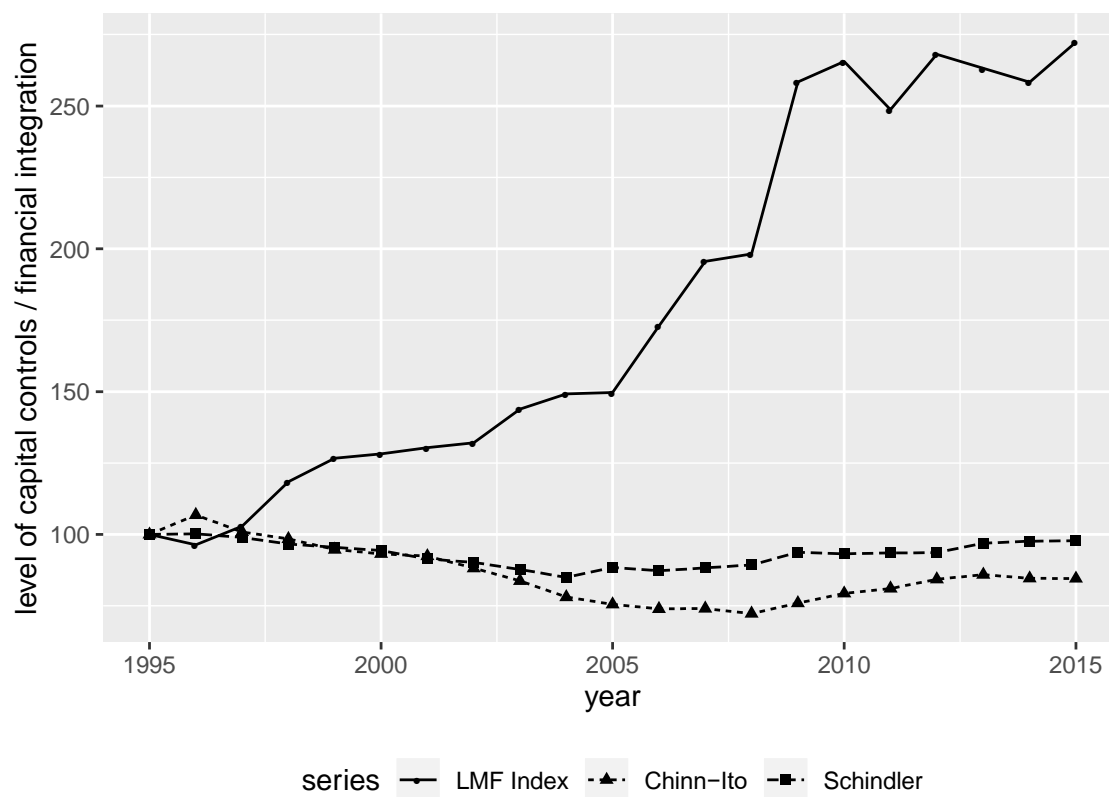
Source: Fritz and Prates Sou (2016).

Table 2-8: Capital Control Indices Reviewed

Indices	Public Availability; Time; Number of Countries
(A) Extensiveness	
<i>(A.1) De Jure</i>	
AREAER	
table	
Milesi-Ferretti and Gian Maria	N
Quinn (1997)	N
Tamirisa (1999)	N
Miniane (2004)	N
Mody and Murshid (2005)	N
Brune and Guisinger (2007)	N
Chinn and Ito (2008)	Y;1970-2017; 183
text	
Schindler (2009)	Y; 1995-2007; 99
Non-AREAER	
Kastner and Recto (2003)	N
Kaminsky and Schmukler (2007)	N
<i>(A.2) De facto</i>	
quantity-based	
Lane and Milesi-Ferretti (2007)	Y; 1970-2015; 211
price-based	
Dooley, Mathieson, and Rojas-Suarez (1997)	N
Levy Yeyati, Schmukler, and Van Horen (2009)	N
<i>(A.3) Hybrid</i>	
Edison and Warnock (2003)	N
Gygli et al. (2019) (KOF)	Y; 1970-216;183
(B) Intensiveness	
Parsricha et al. (2018)	N; 2001-2015;16

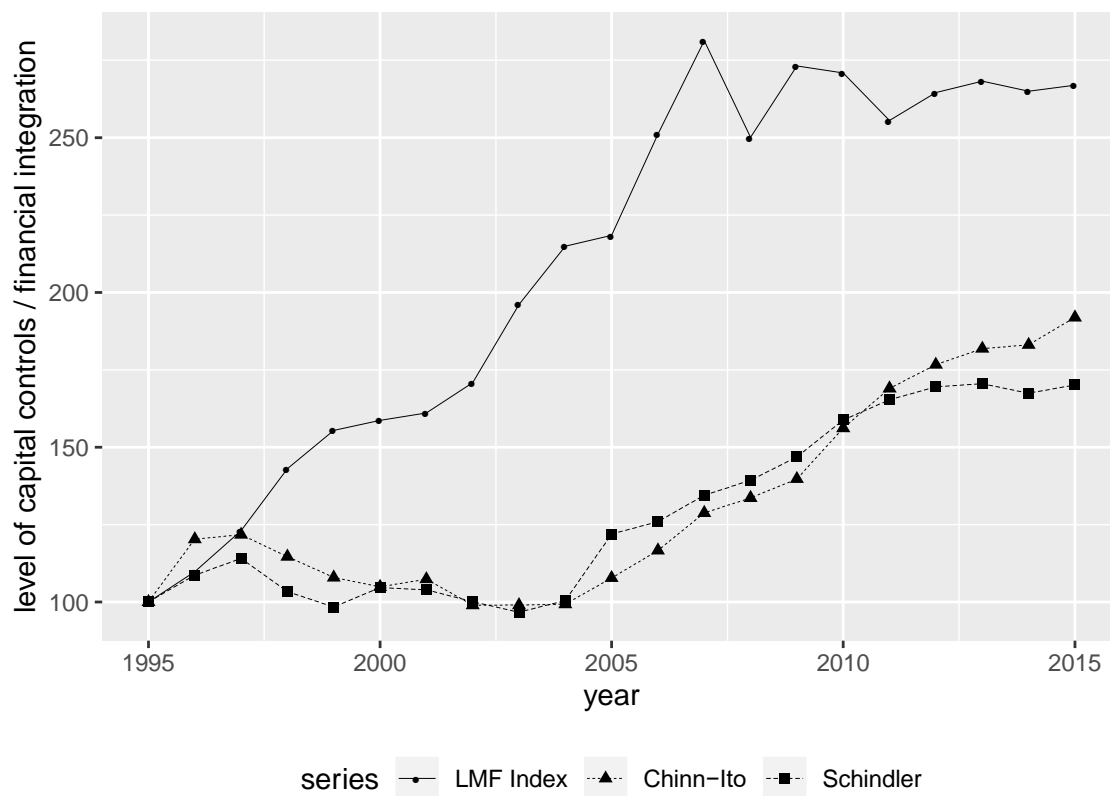
2.13 Figures in Chapter 2

Figure 2-1: The Evolution of World Capital Controls (Unweighted)



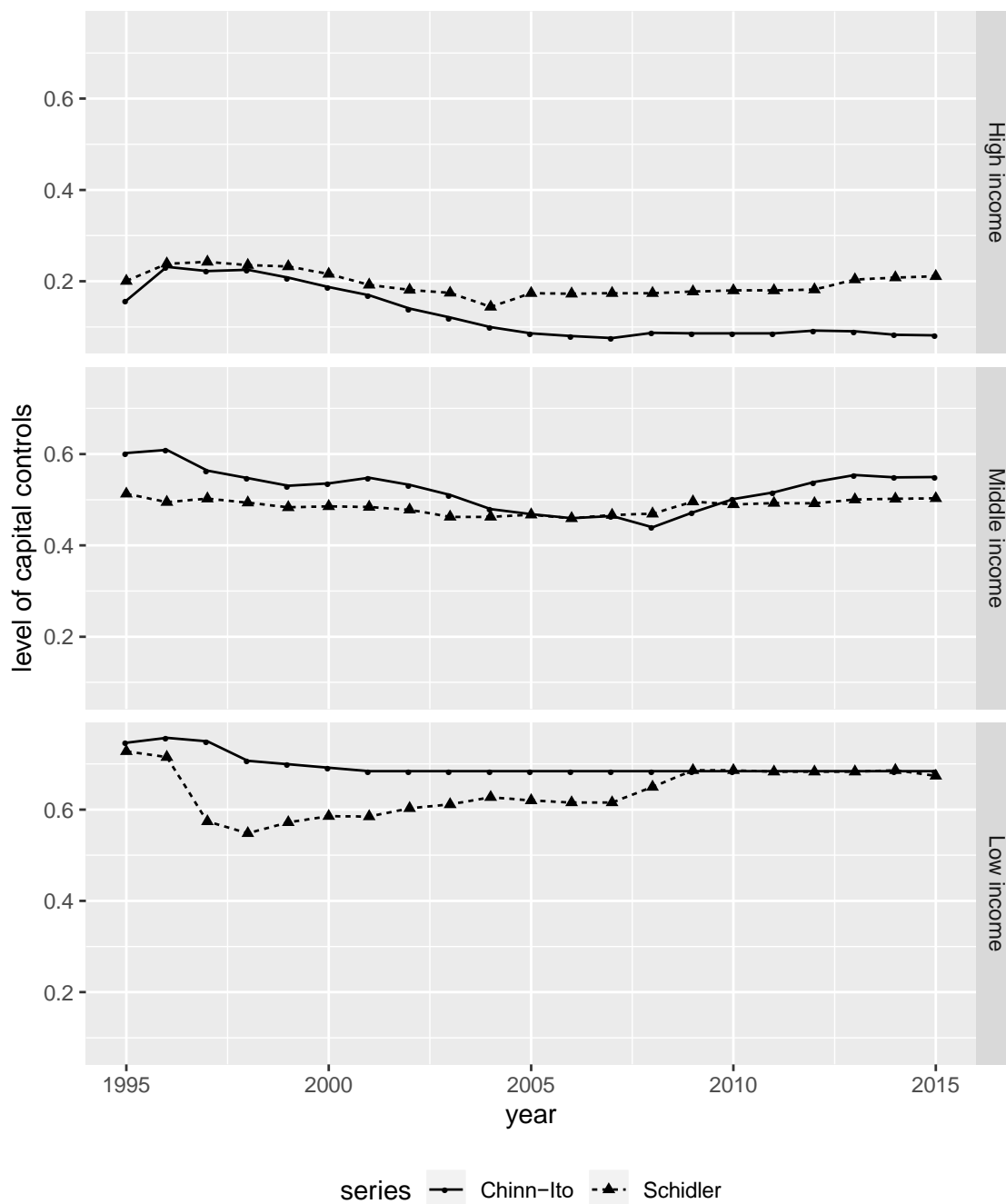
Note: (1) Source: author's calculation.

Figure 2-2: The Evolution of World Capital Controls (Weighted by Shares of World GDP)



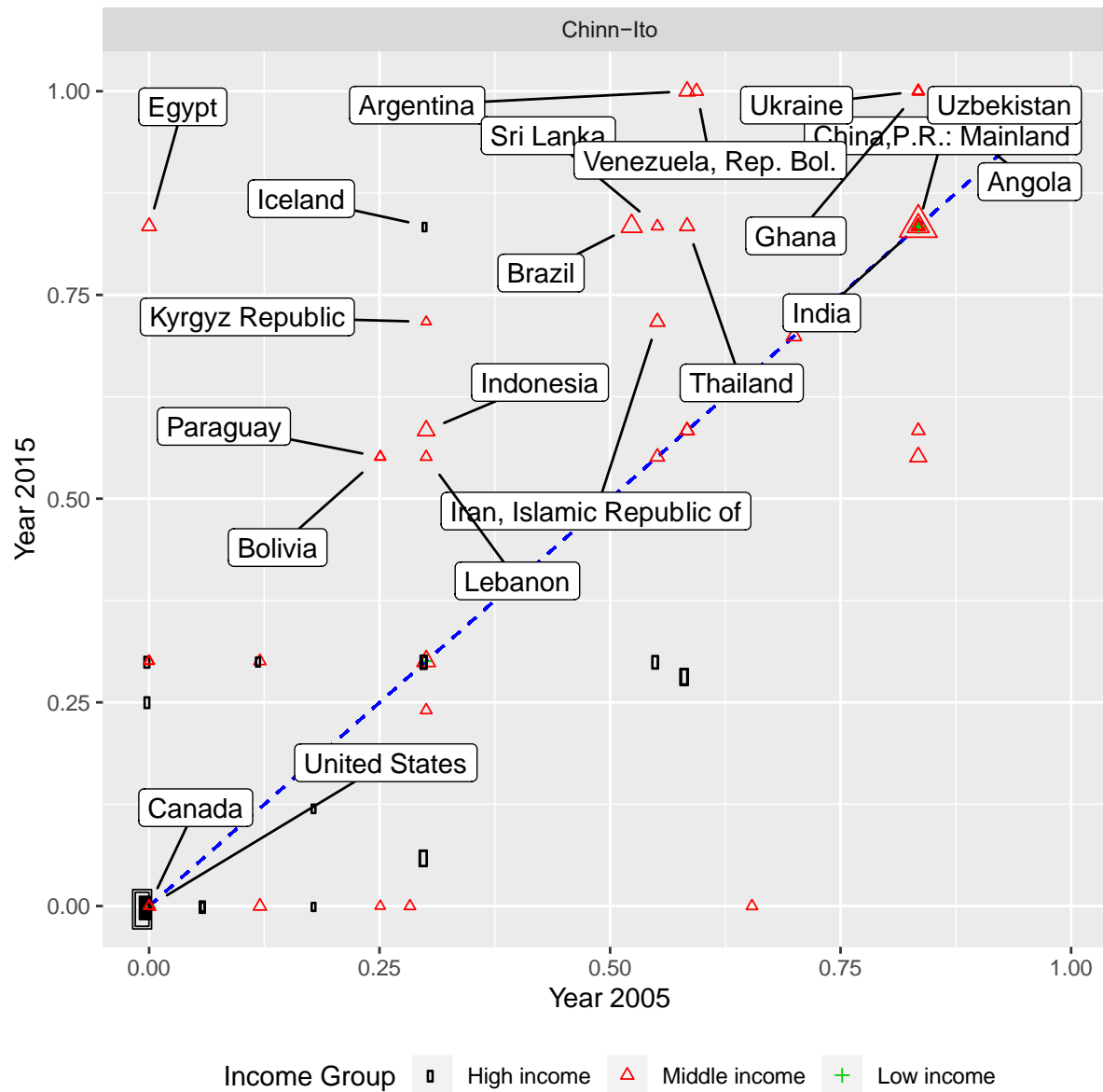
Note: (1) Source: author's calculation.

Figure 2-3: Capital Controls by Income Groups



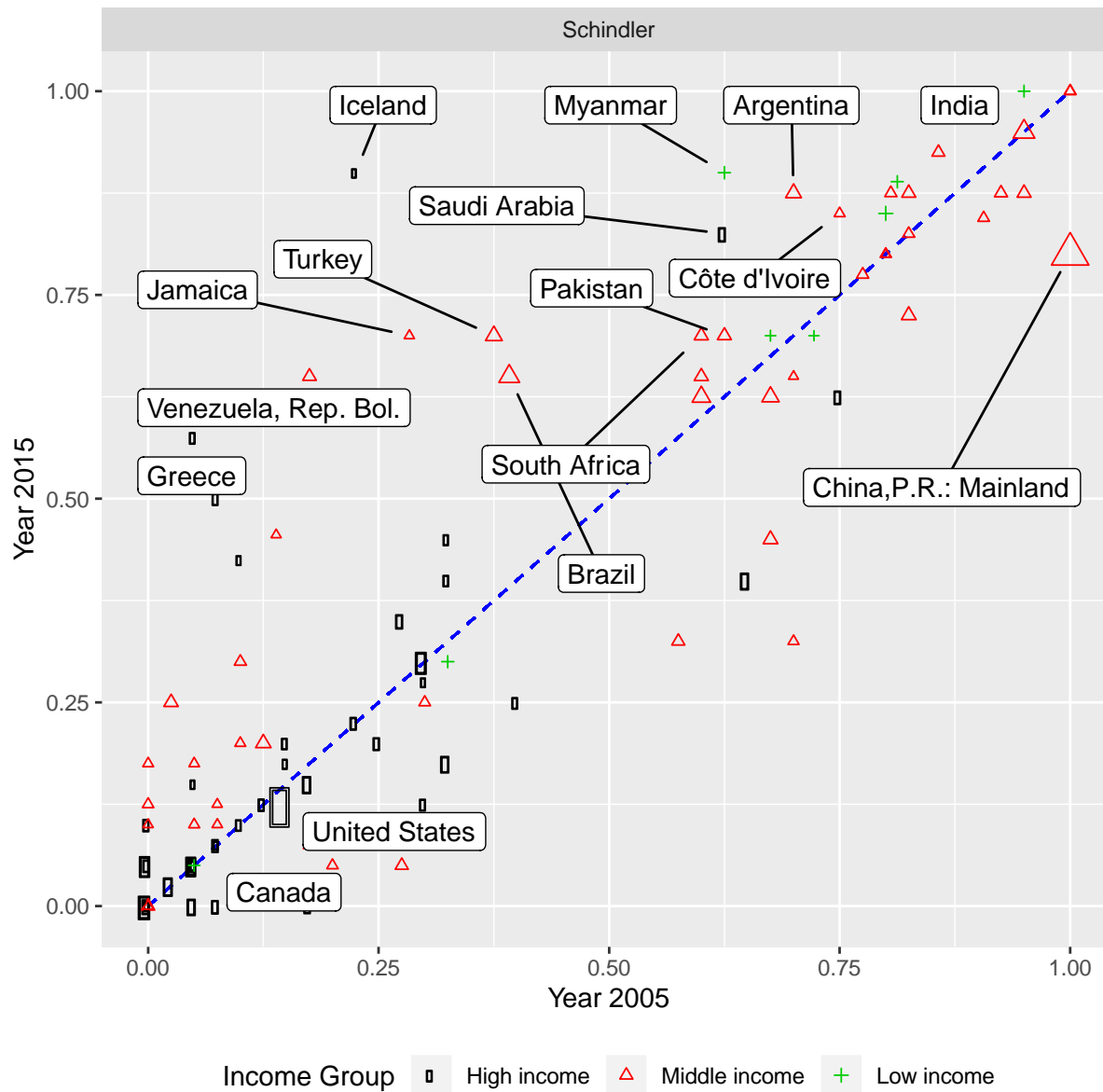
Note: (1) Source: author's calculation.

Figure 2-4: Capital Controls between 2005 and 2015 (Chinn-Ito)



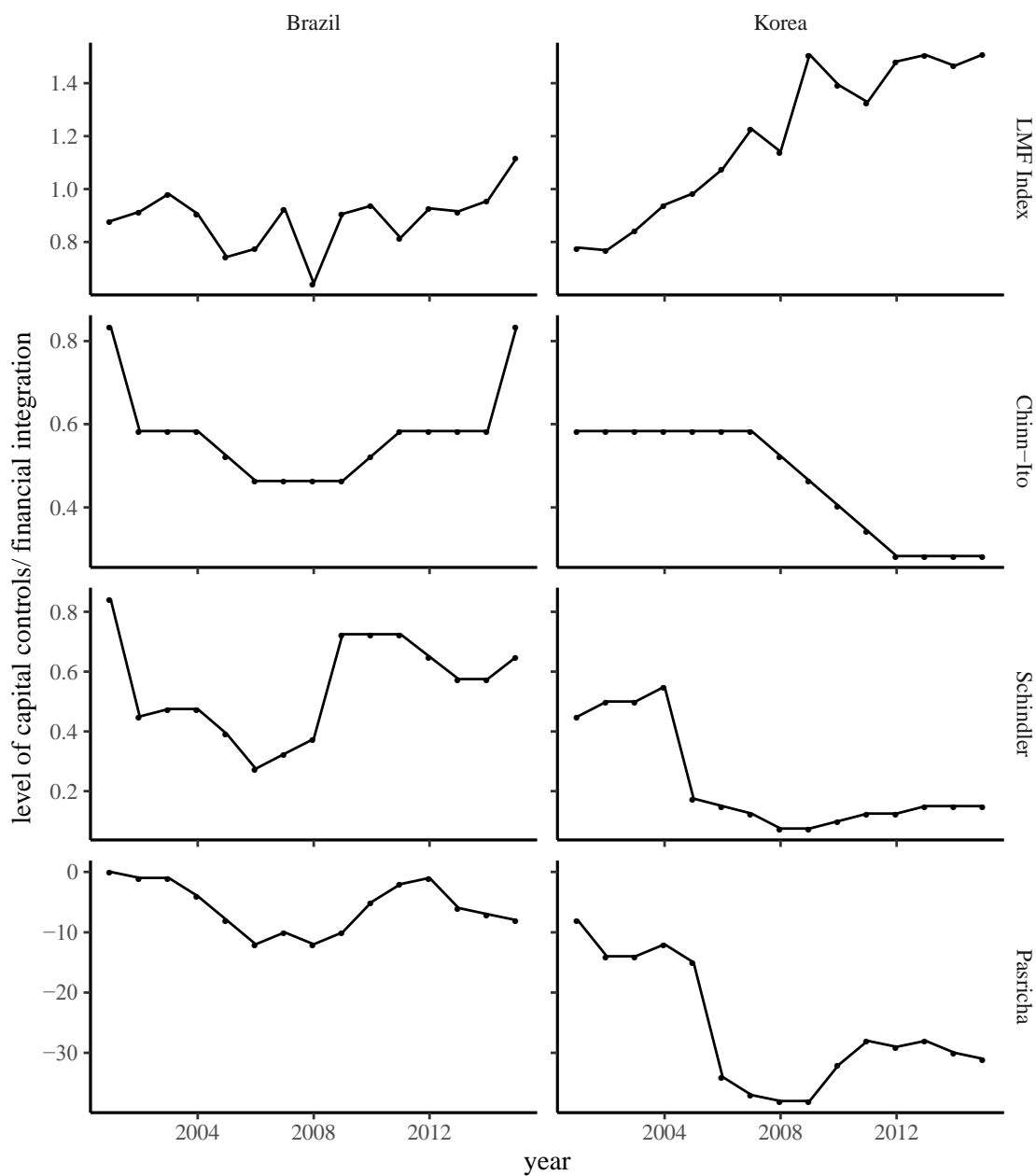
Note: (1) Source: author's calculation.

Figure 2-5: Capital Controls between 2005 and 2015 (Schindler)



Note: (1) Source: author's calculation.

Figure 2-6: Capital Controls in Brazil and South Korea



Note: (1) Source: author's calculation.

Chapter 3 Extreme Capital Flows Movements and Capital Controls

3.1 Introduction

Chapter 3 addresses the efficacy of capital controls by examining whether countries with capital controls are less likely to experience extreme capital flow movements.

The motivations of this chapter are twofold. First, capital flows are associated with macroeconomic risks such as loss of export competitiveness and increased financial instability, a theme that Chapter 2 has discussed. The macroeconomic risks associated with cross-border capital flows can manifest themselves through various macroeconomic variables. Examples include exchange rates, levels of capital flows, and compositions of the capital flows, all of which have been the focus of previous studies (Magud et al., 2018). Departing from previous studies, this chapter examines whether capital controls can be effective in managing macroeconomic risks through affecting extreme movements in capital flows, which has been studied to a much lesser extent (Forbes et al., 2015; Ostry et al., 2012).

Previous studies that look at extreme capital flow movements have focused mostly on net capital inflows. Restricting our attention solely to net flows, however, may be limited. Recent studies have demonstrated that gross capital flows have become much more volatile than net capital flows since the early 2000s, and there has been a growing recognition of the need to understand dynamics of gross rather than net flows (Bluedorn et al., 2013; Broner et al., 2013). So far, few studies have evaluated the efficacy of capital controls on financial instability from the perspective of extreme movements in gross capital flows. Because of the limited research, the question of whether capital controls can enhance a country's financial stability by reducing gross capital flow volatility is a topic yet to be further explored.

Second, studies evaluating the efficacy of capital controls face the challenge of selection bias, which may have contributed to the inconclusiveness on the effectiveness of using capital controls to manage capital flows. Selection bias arises often in observational—as opposed to randomized-controlled—studies when countries that choose to impose capital controls have distinct characteristics from those that do not choose to impose capital controls. Some of these distinct characteristics may have a direct influence on the outcome variables that capital controls target. For example, the subsequent analyses in this chapter show that countries with capital controls often have lower levels of institutional quality. Institutional quality, at the same time, is a possible factor that influences potential outcome variables of capital controls such as surges and stops. Lower levels of institutional quality contribute to a higher chance of surges and stops. So, a naïve comparison between countries with and without capital control might suggest that that country with capital controls experience a higher probability of surges and stops. Yet, one cannot ascribe such a

difference exclusively to the implementation of capital controls due to the different characteristics of the two groups.

One method to address the selection bias issue is through the propensity score matching (PSM), and another is through instrumental variable methods. As Forbes et al. (2015) discuss, the propensity score matching methodology has several advantages over instrumental variables. First, while instrumental variable estimation requires assumptions about a linear relationship between treatments, covariates, and outcomes, propensity score matching does not assume any functional forms between any of the variables and the outcomes. Not having to assume any functional forms between treatments, covariates, and outcomes is helpful when the underlying model is unclear with respect to simultaneity or endogeneity. Second, Landrum and Ayanian (2001) point out that finding an appropriate instrument that meets exclusion restrictions is challenging. Instead, the propensity matching methodology puts more emphasis on what factors determine the treatment assignment process, which by itself is of interest. In Chapter 3, the process of estimating propensity scores shed some light on the determinants of capital controls.

Third, I argue that the potential outcome framework that underlines the propensity score matching methodology provides an intuitive way to understand the causal effect of a treatment on the outcome. In this framework, the causal effect of a treatment on an observation is defined as the difference between the potential outcome when the observation receives the treatment and the potential outcome when the observation does not. Of the two potential outcomes, one is observed and the other is unobserved. The unobserved potential outcome is counterfactual and needs to be constructed.

To my knowledge, no prior studies have attempted to employ the propensity score matching methodology to assess the efficacy of capital controls in preventing countries from experiencing extreme capital flow movements. I choose propensity score matching to contribute to the literature in this regard.

The analysis of Chapter 3 shows that the unmatched sample displays considerable imbalance between the treated and the untreated group, an indication of selection bias. Although matching observations according to their propensity scores greatly improves the balance, residual imbalance remains, particularly for the samples used to estimate the average treatment effects on the treated (i.e., the ATUs). The residual imbalance may limit a more definitive conclusion on the efficacy of capital controls. Therefore, subject to some technical concerns about the quality of matching, the main results are twofold. First, I show that capital controls may be effective, but only for countries that have not imposed capital controls, perhaps due to higher institutional quality. Second, only controls that involve the use of inflow controls appear to be effective.

Chapter 3 relates methodologically to two existing studies that also employ a propensity score matching method to evaluate the effects of capital controls on the performance of macroeconomic variables. Glick and Hutchinson (2006) investigate whether capital controls can insulate countries from currency crises, while Forbes et al. (2015) examine whether capital controls are successful in affecting policy variables such as exchange rates, capital flows, interest-rate differentials, inflation, and equity indices. In specifying propensity score models, both studies estimate the conditional probability that a country would impose capital controls. This chapter relates to both studies by adopting variables that the two studies have suggested as the determinants of capital controls. The results of this chapter reinforce the roles these variables play in setting up propensity score models, which is useful for future studies that wish to use a similar propensity score matching approach to evaluate the efficacy of financial market restrictions on other macroeconomic variables. This chapter differs from both studies by examining a different variable of interest: extreme capital flow movements.

Chapter 3 pertains to the literature that explores the effects of capital controls on macroeconomic variables of interest. As Chapter 2 has discussed, one strand of this literature takes a case-study approach to examine the country-specific experience with the implementation of capital controls, while another strand of literature takes a multi-country approach to study whether a broader pattern regarding the effects of capital controls exists at the global level. Situated within the strand of multi-country studies, Chapter 3 departs from and contributes to the existing literature in several ways. First, I focus on the effects of capital control on the likelihood of countries experiencing surges and stops, an area that has been studied to a lesser extent. Second, I address the selection bias issues by using a propensity score matching methodology, a relatively new technique for program evaluation. Third, I explore the effects of capital controls measured by various capital control indices that are constructed to capture different aspects of financial market restrictions.

The rest of Chapter 3 is organized as follows. Section 3.2 previews the dataset used in this chapter. Section 3.3 constructs episodes of extreme capital flow movements. Section 3.4 introduces the propensity score matching methodology. Section 3.5 discusses the empirical results. Section 3.6 concludes.

3.2 Dataset

Table 3-1 previews the dataset with summary statistics of the variables that this study uses. The dataset covers a panel of 56 countries annually from 1995 to 2016. To enable a direct comparison, I select the same countries as those selected by Forbes and Warnock (2012). The range of the period is based on the availability of other explanatory variables used in the dataset. Note that Schindler's capital control indices

are only available from 1995 onwards. Also note that surge and stop episodes are of quarterly frequency and are converted to annual observations to match the frequency of other variables in the dataset.

Each data point in the dataset represents a country-year observation. Table 3-2 lists the countries in the dataset. The definitions and data sources of the variables are shown in Table 3-3. The main variables of interest are extreme capital flow movements that include (1) *surges* and *stops*, the *outcome* variables, and (2) status of capital controls, the *treatment status* variables. Section 3.3 discusses the empirical strategy to identify the start time and end time of surge and stop episodes. Section 3.4.1 discusses a potential outcome framework that introduces the concepts of outcome and treatment status variables. Section 3.4.2 discusses the empirical strategy to define treatment status according to various types of capital control indices, which Section 2.6 of Chapter 2 has discussed.

3.3 Measuring Surge and Stop Episodes

In this chapter, the outcome of interest is the probability of an observation experiencing episodes of surges and stops. As the first step of the analysis, I explain how I construct episodes of surges and stops.

A surge episode is defined as a period of time when gross capital inflows increase sharply. A stop episode is defined as a period of time when gross capital inflows decrease sharply. The construction of surges and stops follows the method proposed by Forbes and Warnock (2012), which is summarized here. Consider the process of constructing episodes of surges.

For a given country at period t , let ΔC_t^+ be the annual year-to-year change in the four-quarter rolling sum of quarterly gross capital inflows. That is:

$$C_t^+ = \sum_{a=0}^3 k_{t-a}^+ \quad (3.1)$$

$$\Delta C_t^+ = C_t^+ - C_{t-4}^+ \quad (3.2)$$

where k_t^+ is the quarterly gross capital inflows, C_t^+ is the four-quarter rolling sum of quarterly gross capital inflows, and ΔC_t^+ is the annual year-to-year change in C_t^+ .

Next, let $\mu_{\Delta C_t^+}$ and $\sigma_{\Delta C_t^+}$ be the rolling average and the rolling standard deviation of ΔC_t^+ over the preceding five years, respectively:

$$\mu_{\Delta C_t^+} = \frac{\sum_{a=1}^{20} \Delta C_{t-a}^+}{n} \quad (3.3)$$

$$\sigma_{\Delta C_t^+} = \sqrt{\frac{\sum_{a=1}^{20} (\Delta C_{t-a}^+ - \mu_{\Delta C_t^+})^2}{n-1}} \quad (3.4)$$

where n is the number of observations available within a five-year window.

A surge episode starts at time t when ΔC_t^+ is greater than one rolling standard deviation above the rolling mean:

$$\Delta C_t^+ > \mu_{\Delta C_t^+} + 1 * \sigma_{\Delta C_t^+} \quad (3.5)$$

A surge episode ends at time $t+a$ when ΔC_{t+a} is no longer one rolling standard deviation above rolling mean:

$$\Delta C_{t+a}^+ \leq \mu_{\Delta C_{t+a}^+} + 1 * \sigma_{\Delta C_{t+a}^+} \quad (3.6)$$

where $a > 0$.

In addition, for the entire period to qualify as a surge episode, at least one observation must be greater than two rolling standard deviations above the rolling mean:

$$\Delta C_{t+b}^+ > \mu_{\Delta C_{t+b}^+} + 2 * \sigma_{\Delta C_{t+b}^+} \quad (3.7)$$

where $b < a$.

Similarly, a stop episode starts at time t when ΔC_t^+ is less than one rolling standard deviation below the rolling mean:

$$\Delta C_t^+ < \mu_{\Delta C_t^+} - 1 * \sigma_{\Delta C_t^+} \quad (3.8)$$

A stop episode ends at time $t+a$ when ΔC_{t+a} is no longer one rolling standard deviation below rolling mean:

$$\Delta C_{t+a}^+ \geq \mu_{\Delta C_{t+a}^+} - 1 * \sigma_{\Delta C_{t+a}^+} \quad (3.9)$$

In addition, for the entire period to qualify as a surge episode, at least one observation must be less than two rolling standard deviations below the rolling mean:

$$\Delta C_{t+b}^+ < \mu_{\Delta C_{t+b}^+} - 2 * \sigma_{\Delta C_{t+b}^+} \quad (3.10)$$

where $b < a$.

Finally, a country experiences surges in a year when any quarter of that year is part of an identified surge episode for that country; a country experiences stops in a year when any quarter of that year is part of an identified stop episode for that country.

3.4 Empirical Strategies: Propensity Score Matching

As I have mentioned in the introduction of this chapter (Section 3.1), studies that employ a propensity score matching methodology to address selection bias—a common challenge in the literature on the efficacy of capital controls—are scant. In this chapter, I choose the propensity score matching to explore its possibility as well as to provide more evidence to the literature in this regard.

Austin (2011) provides an introduction to the propensity score methodology. In Section 3.4, I paraphrase Austin's discussion to explain how one can set up a propensity score matching model.

3.4.1 Potential Outcome Framework

Potential Outcomes: The key concept to the propensity score matching is the potential outcome framework. For each observation i , T_i indicates the treatment status of the observation. $T_i = 1$ indicates that the observation receives the treatment; $T_i = 0$ indicates otherwise. Y_i is the observed outcome of interest with two potential outcomes: Y_i^1 and Y_i^0 . Y_i^1 is the potential outcome when the observation receives the treatment ($T_i = 1$), and Y_i^0 is the potential outcome when the observation does not receive the treatment ($T_i = 0$). As it is not possible to simultaneously witness an observation receiving and not receiving the treatment (i.e., capital controls in the case of this study, only one of the two potential outcomes can be observed for each observation. The other potential outcome that is not observed is the *counterfactual* outcome. Equation (3.11) describes the potential outcome framework.

$$Y_i = T_i Y_i^1 + (1 - T_i) Y_i^0 \quad (3.11)$$

The causal effect of a treatment (hereafter *the treatment effect*) is defined as the difference between the two potential outcomes. That is,

$$\tau_i = Y_i^1 - Y_i^0 \quad (3.12)$$

Due to the fact that it is not possible to simultaneously observe Y_i^1 and Y_i^0 , estimating τ_i at the level of an individual observation is not possible, a challenge known as the fundamental problem of causal inference in the evaluation literature (Holland, 1986). One way to address this challenge is to estimate the treatment effect at the population level.

ATT, ATU, and ATE: Three treatment effects are usually of interest. They include the average treatment effect on the treated (ATT), the average treatment effect on the untreated (ATU), and the average treatment effect (ATE).

ATT, ATU, and ATE measure the treatment effects on different population segments. The ATT focuses on the average treatment effect on the observations that have received the treatment.

$$\text{ATT:} \quad E[Y^1 - Y^0 | T = 1] = E[Y^1 | T = 1] - E[Y^0 | T = 1] \quad (3.13)$$

where Y^1 and Y^0 are the population-level equivalents of Y_i^1 and Y_i^0 , and $E[\cdot]$ denotes the expectation operator.

In contrast, the ATU focuses on the average treatment effect on the observations that have not received the treatment.

$$\text{ATU:} \quad E[Y^1 - Y^0 | T = 0] = E[Y^1 | T = 0] - E[Y^0 | T = 0] \quad (3.14)$$

ATE is a weighted average of ATT and ATU. The ATE measures the average treatment effect on the entire population.

$$\text{ATE:} \quad E[Y^1 - Y^0] = E[Y^1] - E[Y^0] \quad (3.15)$$

The choice among the three types of treatment effects—ATT, ATU, or ATE—depends on what population segment is of interest. The ATT is more relevant when the focus lies on the subjects who have actually received the treatment. For example, if a program is specifically targeted at individuals with low family income, there is little interest in the effect of such a program for a millionaire. Therefore, the most relevant evaluation parameter is the ATT (Caliendo & Kopeinig, 2008). As another example, consider a scenario where a government has implemented a smoking cessation campaign intervention to decrease the smoking prevalence in a city. To evaluate the impact of such intervention, researchers and policymakers might be interested in explicitly evaluating the effect on individuals who have received the intervention (i.e., the ATT) but not the effect on those among whom the intervention was never intended (i.e., the ATU).

On the other hand, the ATU is more relevant when one is interested in the potential impact of an existing program on subjects who had not yet received the treatment. For instance, one might wish to project

the effect of the smoking cessation intervention in a city that did not receive the intervention in order to gauge its potential impact when such intervention is actually implemented (Wang et al., 2017).

Selection Bias: A natural candidate for estimating the treatment effects is the *naive estimator*. The naive estimator is the observed difference between the sample mean of the treated observations and the sample mean of the untreated observations. However, the naive estimator is associated with a potential selection bias, which can be seen as bellow:

$$\begin{aligned} & \underbrace{E[Y^1|T = 1] - E[Y^0|T = 0]}_{\text{observed difference}} = \\ & \underbrace{E[Y^1|T = 1] - E[Y^0|T = 1]}_{ATT} + \underbrace{E[Y^0|T = 1] - E[Y^0|T = 0]}_{\text{selection bias}} \end{aligned} \quad (3.16)$$

In evaluating the treatment effect of capital controls, the selection bias could arise when observations with and without capital controls have distinct characteristics. These distinct characteristics—known as *confounders*—will influence both the observations' probability of imposing capital controls and the observations' probability of experiencing extreme capital flow movements. With the selection bias, the expected potential outcomes will not be independent of the treatment status and the naive estimate will be biased. In equation (3.16), this means that $E[Y^0|T = 1] \neq E[Y^0|T = 0]$.

Propensity Score Matching: Rosenbaum and Rubin (1983) propose using propensity scores to control for selection bias when estimating treatment effects. The propensity score is the conditional probability of an observation receiving the treatment based on the observed baseline covariates. Rosenbaum and Rubin show that if the treatment assignment process meets (1) *unconfoundedness* and (2) *overlap*, then the propensity scores can be used to estimate the treatment effects.

The unconfoundedness assumption means that given a set of observable covariates of \mathbf{X} , which are not affected by the treatment, potential outcomes are independent of the treatment assignment.

$$\text{(Unconfoundedness)} \quad Y^0, Y^1 \perp T | \mathbf{X} \quad (3.17)$$

The overlap assumption means that each observation with the same \mathbf{X} has a positive and equal probability of receiving the treatment.

$$\text{(Overlap)} \quad 0 < P(T = 1 | \mathbf{X}) < 1 \quad (3.18)$$

Rosenbaum and Rubin (1983) show that if the treatment assignment process meets both assumptions, the treatment assignment is *strongly ignorable*, and the sample mean conditional on the observed covariates

can be used to estimate the treatment effects. The challenge of conditioning on all \mathbf{X} , however, is its high dimensionality. For instance, if \mathbf{X} contains s number of covariates, the number of possible matches will be 2^s . To address such a challenge, Rosenbaum and Rubin suggest using the *balance scores*. The balance score $b(\mathbf{X})$ is a function of observable covariates such that the conditional distribution of \mathbf{X} given the balance scores is the same for the treated group and the untreated group. Formally, the balance score $b(\mathbf{X})$ satisfies $\mathbf{X} \perp T \mid b(\mathbf{X})$. The balancing score that has the highest dimensionality is $b(\mathbf{X}) = \mathbf{X}$, and the balancing score that has the lowest dimensionality is the propensity score. Unlike $b(\mathbf{X}) = \mathbf{X}$, the propensity scores greatly reduce the number of dimensions.

Given the two assumptions and the propensity scores, the ATT and ATU can be estimated as follows:

$$(ATT) \quad E[Y^1 - Y^0 \mid T = 1] = E[Y^1 \mid T = 1, b(X)] - E[Y^0 \mid T = 1, b(X)] \quad (3.19)$$

$$(ATU) \quad E[Y^1 - Y^0 \mid T = 0] = E[Y^1 \mid T = 0, b(X)] - E[Y^0 \mid T = 0, b(X)] \quad (3.20)$$

ATE is a weighted average of ATT and ATU.

3.4.2 Estimate Propensity Scores

Probit models are often used to estimate propensity scores, which are the conditional probabilities of observations imposing capital controls. These estimated propensity probabilities from the probit models can be used as propensity scores for pairing observations in constructing counterfactual outcomes.

I use Equation (3.21) to equation (3.24) to estimate the propensity scores.

$$(Model 1) \quad \mathbf{ka}_1 = \mathbf{X}\boldsymbol{\beta}_1 + \boldsymbol{\varepsilon}_1 \quad (3.21)$$

$$(Model 2) \quad \mathbf{ka}_2 = \mathbf{X}\boldsymbol{\beta}_2 + \boldsymbol{\varepsilon}_2 \quad (3.22)$$

$$(Model 3) \quad \mathbf{ka}^+ = \mathbf{X}\boldsymbol{\beta}_3 + \boldsymbol{\varepsilon}_3 \quad (3.23)$$

$$(Model 4) \quad \mathbf{ka}^- = \mathbf{X}\boldsymbol{\beta}_4 + \boldsymbol{\varepsilon}_4 \quad (3.24)$$

The details of the models are as follows:

- An observation is a country-year observation. Thus, each country has multiple observations.
- \mathbf{ka}_1 , \mathbf{ka}_2 , \mathbf{ka}^+ , and \mathbf{ka}^- are vectors that contain binary values regarding each observation's treatment status measured by the Chinn-Ito index, the Schindler overall control index, Schindler

inflow control index, Schindler outflow control index, respectively. These various capital control indices capture different aspects of financial market restrictions and they may work to restrict capital flows in a different way. It remains to be explored what different effects these restrictions may have on capital flows. The overall controls (Chinn-Ito) broadly cover restrictions on the foreign exchange market, inflow controls, and outflow controls; the overall controls (Schindler) inflow controls and outflow controls. Inflow controls are the restrictions on the financial account that are related to incurrences of external liabilities. Outflow controls are the restrictions on the financial account that are related to acquisitions of external assets. In pure-financial transitions, occurrences of external assets are matched with acquisitions of external liabilities. Thus, both inflow controls and outflow controls—when effective—can work to reduce countries' incurrences of external liabilities (i.e., gross capital inflows).

- For each type of treatment, the observations with the corresponding capital control index above the 70th percentile of the entire sample are considered to be treated. Figure 3-1 to Figure 3-4 provide snapshots of each country's treatment status by different capital control indices in the year of 2016, the most recent year in the dataset. They serve to provide examples of the treatment status of the observations in the dataset. For example, Figure 3-1 provides each country's treatment status in 2016 according to the Chinn-Ito index. Figure 3-1 shows that Bolivia, Iceland, the Philippines, and Turkey were the countries that corresponded to the 70th percentile threshold. Their percentiles were 71.14; their values of the Chinn-Ito index were 0.55.
- \mathbf{X} is a matrix that contains the covariates of each observation. The selection of covariates is guided by previous studies on the determinants of capital controls, including Forbes et al. (2015) and Glick et al. (2006). \mathbf{X} includes current account, government spending, trade openness, commodity price, interest rate differential, private credit, stock market capitalization, and institutional quality.

3.4.3 Balance Diagnostics

An important part of the propensity score matching is to examine whether matching observations on their estimated propensity scores yields pairs with similar covariates. Various measures can be used to evaluate the similarity between the treated and the untreated group. The main measures include the standardized difference, the variance ratio and the *t*-test (Austin, 2009).

Standardized Difference: The standardized difference (also known as standardized bias) compares the means (i.e., the first moments) of variables between the treated and the untreated group. The standardized difference for a given variable is defined as:

$$d = 100 \times \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{2}}} \quad (3.25)$$

where \bar{x}_1 and \bar{x}_2 are the sample means of the treated and the untreated group, respectively; and s_1^2 and s_2^2 are the sample variances of the treated and the untreated group, respectively. The standardized difference measures the degree of balance between the two groups by the percentage of equal-weighted pooled standard deviation. A limitation in the use of standardized difference is the lack of consensus as to what value of a standardized difference denotes important residual imbalances between the treated and untreated observations in the matched sample (Austin et al., 2006). There is no universally agreed upon criterion as to what threshold of the standardized difference can be used to indicate important imbalances. (Normand et al., 2001) propose that a standardized difference that is less than 0.1 can be taken to indicate a negligible difference in the means between treatment groups.

Variance Ratio: The variance ratio compares the variances of the variables between the treated and untreated groups. The variance ratio of a given variable is defined as:

$$v = \frac{s_1^2}{s_2^2} \quad (3.26)$$

where s_1^2 and s_2^2 are the variances of the treated and untreated group, respectively. Variances are the second moments, whereas means are the first movements. Comparing the variances (and other higher-order moments) between the two groups allows one to obtain a broader characterization of the similarity between two groups (Austin, 2009; Ho et al., 2006; Imai et al., 2008). Under the null hypothesis of equal variances, the variance ratio will be close to one.

t-test: The *t*-statistic tests whether the means between the treated and untreated group are the same.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}} \quad (3.27)$$

where n_1 and n_2 are the number of observations in the treated and untreated group.

3.5 Empirical Results

3.5.1 Episodes of Extreme Capital Flows

The start dates and end dates of all episodes are available in the Online Appendix⁴. As an example to clarify how the episodes are constructed, Figure 3-5 illustrates surges and stops in Brazil from 1993Q1 to 20016Q4. Note that Figure 3-5 shows two additional years before the truncation of the dataset. For a given country at period t , let ΔC_t^+ be the annual year-to-year change in the four-quarter rolling sum of the quarterly gross capital inflows; $\mu_{\Delta C_t^+}$ is the rolling average of ΔC_t^+ over the preceding five years; $\sigma_{\Delta C_t^+}$ is the rolling standard deviation of ΔC_t^+ over the preceding five years. In Figure 3-5:

- The solid line corresponds to ΔC_t^+ .
- The 1st dotted line from the top corresponds to $\mu_{\Delta C_t^+} + 2 * \sigma_{\Delta C_t^+}$.
- The 2nd dotted line from the top corresponds to $\mu_{\Delta C_t^+} + 1 * \sigma_{\Delta C_t^+}$.
- The 3rd dotted line from the top corresponds to $\mu_{\Delta C_t^+} - 1 * \sigma_{\Delta C_t^+}$.
- The 4th dotted line from the top corresponds to $\mu_{\Delta C_t^+} - 2 * \sigma_{\Delta C_t^+}$.

The following episodes are identified for Brazil between 1990Q1 to 20016Q4.

- Surges: 1994Q1-1994Q3, 1995Q4-1996Q2, and 2006Q3-2007Q4
- Stops: 1995Q1-1995Q2, 1999Q-1999Q2, and 2008Q2-2009Q3

The identified episodes for Brazil as shown above bear close resemblance to those identified by Forbes and Warnock (2012). When compared, the episodes of stops are identical and there are only minor differences in the episode of surges. The minor differences may be because Forbes and Warnock used net errors and omissions to fill in missing data. In this Chapter, I rely solely on the Balance of Payments data provided by the International Financial Statistics (IFS) database.

Figure 3-6 graphs the identified episodes of surges and stops for each country, including our illustrating example, Brazil. Several observations can be made. First, Figure 3-6 highlights that surges may reverse themselves quickly. For example, among the three episodes of surges identified for Brazil, two of them were soon followed by episodes of stops. In Brazil, the episode of surge from 1994Q1 to 1994Q3 was followed by an episode of stop from 1995Q1 to 1995Q2; the episode of surge from 1995Q4 to 1996Q2 was

⁴ The Online Appendix of this chapter can be assessed at <https://pohsintseng.blogspot.com/>.

followed by an episode of stop from 1999Q1 to 1999Q2. The well-known case of the 1997 Asian Financial Crisis also shows up in Figure 3-6. The surge in Thailand from 1995Q2 to 1996Q1 ended with a stop episode from 1996Q3 to 1998Q2. Second, Figure 3-6 shows that the occurrences of episodes are highly correlated among countries, suggesting that the *push factors*—the global conditions that generated capital flows—have played a significant role in driving the extreme capital flow movements. For example, Figure 3-6 shows that a large number of surges and stops occurred during the Global Financial Crisis around 2008.

To understand the patterns at the global level, Figure 3-7 further summarizes the occurrences of surges and stops by years. The numbers are reported in the percentages of country-year observations that have experienced surges and stops in a year. Figure 3-7 shows that the percentage of observations experiencing surges and stops were about the same in the 1990s. About 15 percent to 20 percent of observations each year experienced surges and stops in that period. However, both surges and stops began to occur more frequently in the 2000s, especially during the period of the Global Financial Crisis. For example, the percentage of observations experiencing surges increased to about 40 percent in 2008, only to plunge to about zero percent in 2009. About 30 percent of the observations experienced stops in the early 2000s and about 60 percent of the observations experienced stops in 2009.

3.5.2 Estimating Propensity Scores

Table 3-4 reports the probit model estimates. Model (1) to Model (4) of Table 3-4 estimates equation (3.21) to equation (3.24). The estimated probabilities in each model—the propensity scores—will be used to match observations later. Table 3-4 shows that 620 observations are used for the estimations. An investigation into the dataset reveals that developing countries have limited data for interest rates used to construct the interest rate differentials. This factor contributes to most of the reduction in sample size from 1074 country-year observations. Missing values from lag operations in the first period also contribute to the reduction in sample size.

Measures of the goodness of fit—the sensitivity, the specificity, and the percent correctly predicted—all suggest that the models fit the underlying data reasonably well. Consider model (1) of Table 3-4, for example. The results show that model 1 has correctly predicted 65.66 percent of the observations with capital controls, correctly predicts 83.41 percent of the observations without capital controls, and correctly predicts 77.74 percent of the observations for their treatment status. Measures of the goodness of fit for model 2 to model 4 stay largely the same.

The results from Table 3-4 have two implications. First, they serve to provide insight into the determinants of capital controls; second, they serve to show that countries with capital controls have different characteristics than those without capital controls, an indication of selection bias. Table 3-4 shows

that the statistically significant coefficients are all with reasonable signs and consistent with priors. Both the interest rate differential and the private credit are positively related to a higher probability of receiving capital controls, while a higher level of stock market capitalization, institutional quality, and government spending are associated with a lower probability of receiving capital controls. Higher commodity prices are related to higher levels of inflow controls, suggesting that countries have a higher probability of imposing capital controls when commodity prices are high.

3.5.3 Balance Assessment

Using the estimated probabilities from the probit models, I create matched samples to estimate the average treatment effects on the treated (ATTs) and the average treatment effects on the untreated (ATUs) under various treatments, including overall controls (Chinn-Ito), overall controls (Schindler), inflow controls, and outflow controls. Table 3-5 and Table 3-6 report the balance statistics associated with these estimations.

First, consider the balance statistic for the matched and unmatched samples used to estimate the ATTs. The left side of Table 3-5 shows the balance statistics for the unmatched sample, while the right side of Table 3-5 shows the balance statistics for the matched sample. Part (A), Part (B), Part (C) and Part (D) of Table 3-5 are the balance statistics under the treatments of overall controls (Chinn-Ito), overall controls (Schindler), inflow controls, and outflow controls, respectively. The balance statistics include the mean values for the treated group, the mean values for the untreated group, the standardized differences, variable ratios and *t*-tests for the hypothesis that the mean of each variable in the treated group is equal to the mean in the untreated group. All variables previously used to estimate the propensity scores are examined. These variables include current account balances, government spending, trade openness, commodity prices, interest rate differentials, private credit, stock market capitalization, institutional quality, and inflation.

Table 3-5 shows that the total number of observations is 620, among which 198, 226, 225, and 226 observations receive overall controls (Chinn-Ito), overall controls (Schindler), inflow controls, and outflow controls, respectively. Although our choice of the threshold (70th percentile) used to determine the treatment status indicates that 30 percent of the 1072 observations (about 300 observations) receive the treatment, the limited data availability for some covariates of the observations reduces the number of the treated observations.

The left side of Table 3-5 shows that the unmatched sample exhibits a significant imbalance between the treated and the untreated observations. Countries were significantly more likely to increase their overall capital controls (Chinn-Ito) if they had higher commodity prices, larger interest rate differentials, and higher inflation. On the other hand, countries were less likely to increase their overall capital controls (Chinn-Ito)

with higher levels of current account balances, government spending, trade openness, private credit, stock market capitalization, and institutional quality. For each of the four treatment groups, the largest absolute standardized differences are 162.41 (institutional quality), 219.65 (stock market capitalization), 233.44 (stock market capitalization) and 179.92 (stock market capitalization), respectively. The variance ratios also show no evidence to support the balance between the treated and untreated groups. Table 3-5 shows that most of the variance ratios are far from unity. The variance ratio of inflation under inflow controls is as great as 10.04 before matching. The *t*-test for each covariate further reinforces the view that the unmatched sample is not well balanced. The *p*-values are all under a conventional significance level of 10 percent, suggesting that one can reject the null hypothesis that the mean value of the examined variable of the treated group and that of the untreated group is the same. These significant imbalances between the covariates of the treated and untreated group highlight the issue of selection bias. Countries that chose to impose capital controls had significantly different characteristics than countries that did not impose capital controls.

The right side of Table 3-5 reports the same balance statistics for the matched sample. The matching algorithm is the nearest neighbor 1 to 1 matching with replacement. When ties occur, weighted values are used. The caliper—a specified distance acceptable for any match—is 0.1, which ensures that no match will have a difference in the propensity scores greater or equal to 0.1 standard deviations of the estimated propensity scores. Because of the 1 to 1 matching, each observation in the treated group is matched with an observation in the untreated group with the most similar propensity score. In the order of controls (Chinn-Ito), overall controls (Schindler), inflow controls, and outflow controls, 198, 226, 225, and 226 observations from the untreated group are selected to match the observations in the treated group.

The balance statistics from the matched sample suggest that the propensity score matching has greatly improved the balance between the treated groups and the constructed untreated groups under all treatments. For all variables, the standardized differences between the treated and the untreated observations have substantially decreased. For most variables, the variance ratios have become closer to one and the *t*-tests suggest that the null hypotheses (i.e., the means between the treated and untreated group are the same) cannot be rejected for the examined variable. Take, for example, the variable of the interest rate differential under the treatment of inflow controls. After matching on the estimated propensity scores, the absolute value of the standardized difference between the treated group and untreated group reduces from 79.23 to 10.87, while the variance ratio on the same variable decreases from 3.31 to 0.43. The *p*-value of the *t*-test is 0.35, which is greater than a conventional value of 0.1.

Next, consider the balance statistic for the matched and unmatched samples used to estimate the ATUs, shown in Table 3-6 with the same layout as Table 3-5. The left side of Table 3-6 is identical to the left side of Table 3-5 because the unmatched samples are identical. The right side of Table 3-6 shows the balance

statistics after propensity score matching. The matching algorithm is the nearest neighbor 1 to 1 matching with replacement. When ties occur, weighted values are used. The caliper is set to be 0.1. The matching results show that 398, 326, 320, and 326 observations in the untreated groups are matched to observations in the treated groups with the most similar propensity scores. Notice that some matched pairs do not meet the caliper because the differences in their estimated propensity scores are greater than 0.1 standard deviations of the estimated propensity score distribution. Overall, the right side of Table 3-6 that shows that although propensity score matching has improved the balance between the treated groups and the untreated groups, there are still signs of residual imbalance. For example, the standardized differences of several variables in the matched samples are still large. The private credit under the treatment of overall controls (Schindler) has the largest standardized difference, 146.85.

To sum up, after matching there remains some signs of imbalance between the matched treated and untreated observations, particularly for the matched samples that will be used to estimate ATUs. The residual imbalance serves as an important qualification for the discussion of the treatment effect of capital controls, which I next turn to.

3.5.4 Estimating Treatment Effects

With the qualification that there remains some residual imbalance balance, Table 3-7 reports relevant statistics regarding the estimated treatment effects of capital controls—including overall controls (Chinn-Ito), overall controls (Schindler), inflow controls and outflow controls—on the probability of an observation experiencing surges and stops. For each type of capital controls, column 1 and column 2 of Table 3-7 report the estimated ATTs, while Column 3 and column 4 of the same table report the estimated ATUs. For the reported statistics in Table 3-7, potential outcomes with treatment is the ratio of observations—in the matched treated group—that experience surge or stops; potential outcomes with treatment is the ratio of observations—in the matched untreated group—that experience surge or stops; treatment effect is the difference between the two. The main focus is the treatment effect, of which the sign is expected to be *negative* if capital controls are effective in reducing the probability of observations experiencing surges or stops.

Note that Table 3-7 reports the Abadie-Imbens robust standard errors proposed by Abadie and Imbens (2016). They argue that when the propensity score is estimated before the estimation of the treatment effect, uncertainty from the estimation of the propensity score affects the standard errors of the treatment effect estimates. Ignoring this uncertainty leads to inaccurate standard errors. Abadie and Imbens show that bootstrap methods are not appropriate for matched data and that standard errors of the treatment effect

estimates need to be calculated with the Abadie-Imbens (AI) method (Garrido et al., 2014). Table 3-7 also reports *t*-statistics and *p*-value associated with the estimation of the treatment effects.

Several observations can be made about Table 3-7. First, the estimated ATTs—shown in column 1 and column 2 of Table 3-7—are mostly insignificant, suggesting that there is little evidence to support that capital controls are effective in reducing surges or stops for observations that already imposed capital controls. For surges, the signs—regardless of the types of capital controls—are all insignificantly positive. For stops, although the signs are all negative, only the estimated ATT of overall controls (Chinn-Ito) appears to be significant.

On the other hand, the estimated ATUs—shown in column 3 and column 4 of Table 3-7—are associated with more results that are statistically significant, suggesting that there is some evidence that capital controls—defined variously—can be effective in reducing surges or stops for observations that have not imposed capital controls. For example, column 3 shows that the estimated ATU of inflow controls (Schindler) is significantly negative. The potential outcome without treatment is 0.23, suggesting that 23 percent of the observations in the untreated group have experienced surges. Matching each observation in the untreated group with an observation in the treated group that has a similar propensity score, the potential outcomes with treatment—i.e., the constructed counterfactual outcomes for the untreated—show that 8 percent of these untreated observations would have experienced surges counterfactually. Taking the difference between the two potential outcomes yields a -0.15 (i.e., -15 percent) treatment effect, suggesting that for observations without inflow controls, imposing inflow controls work to lower the probability of these observations experiencing gross flow surges. Similarly, column 4 of Table 3-7 also shows negative and significant estimated ATUs on stops. The estimated ATUs of overall controls (Schindler) and inflow controls on stops are -0.12 and -0.16, respectively.

Second, outflow controls are insignificant in all cases (column 1 to column 4). This stands in contrast to the other types of capital controls, which are associated with at least one significant estimated treatment effect. Outflow controls involve restrictions on acquisitions of external assets, while the other type of capital controls that I examine (e.g., overall controls (Chinn-Ito), overall controls (Schindler), and inflow controls) all involve restrictions on incurrences of external liabilities. The insignificant estimated treatment effects of outflow controls may suggest that sharp movements in gross capital inflows are more often caused by shocks to a country's occurrences of external liabilities than shocks to a country's acquisitions of external assets. As such, there is less evidence to support the efficacy of outflow controls.

Overall, there is a divergence between the treatment effects on the treated (ATT) and the treatment effects on the untreated (ATU), suggesting that the treatment effects of capital controls are different among observations of the two groups. The heterogeneous treatment effects among observations are not unusual,

which occurs when the treatment effect depends upon some characteristics that distinguish the treated and untreated observations in the matched sample (Berk & Newton, 1985; Cattaneo, 2010; Shrier et al., 2017). For example, Cattaneo (2010) studies whether smoking during pregnancy affects birth weight and finds that the estimated ATT and ATU are different. They show that the difference is driven by the fact that in the matched sample, the treated (i.e., those who smoked) tended to be older than the untreated (i.e., those who did not smoke). As the negative effect of smoking on birth weight tends to increase as the age increases, their results find that the estimated ATT is larger than the estimated ATU. The findings of this chapter also show a divergence between the estimated ATT and ATU. One possible explanation is that the treated (i.e., those with capital controls) tends to be associated with lower institutional quality, while the untreated (i.e., those without capital controls) tends to be associated with higher institutional quality. As the enforcement of capital controls relies on the administrative capability of observations, capital controls tend to be more effective for the untreated than for the treated.

The results of this chapter pertain to the literature on the determinants of capital flows. The seminal work by Fernández-Arias (1996) introduced the distinction between push and pull factors, which have since provided a convenient framework that one can use to structure factors affecting capital flows. Push factors are the global conditions that generate capital flows. Examples of push factors include the global risk aversion, mature economy interest rates, and the output growth of mature economies. Pull factors are domestic conditions. Domestic output growth, domestic asset return indicators, and country risk indicators are examples of pull factors. The original debate was on whether push or pull factors determine capital flows. The literature has shown that both push and pull factors play roles in determining capital flows (Koepke, 2019). While push factors are outside the control of policymakers, pull factors are particularly of interest from the policy perspective because they are the factors that policy tools can affect. A key pull factor that has received much attention recently is capital controls. The results from this chapter relate to this literature by showing that capital controls can be a relevant pull factor in determining capital flows. More importantly, capital controls—as one of the relevant pull factors—can be included as part of the policy toolkit.

The results of this chapter also pertain to the literature on the efficacy of capital controls, specifically their effects on extreme capital flow movements, an area that the existing literature has studied to a lesser extent and faced the challenge of selection bias. For example, Alfaro, Kalemli-Ozcan, Volosovych (2007) study the determinants of capital flows volatility, which they measure by standard deviations of capital flows. They use the Chinn-Ito index to broadly proxy the levels of controls and find no significant effect of capital controls on capital flow volatility. Forbes and Warnock (2012) investigate possible factors that might explain extreme capital flow movements, the definitions of which are the same as this chapter. Without

explicitly controlling for selection bias, they do not establish a relationship between capital controls and extreme capital flow movements. In contrast, I use a more nuanced and disaggregated dataset on capital controls, including a broad index that covers main aspects of financial market restrictions (e.g., the Chinn-Ito index) as well as finer indices that distinguish outflow controls and inflow controls (e.g., inflow control index and outflow control index). I also address selection bias by using a propensity score matching method. With these modifications, this chapter finds some qualified evidence that capital controls reduce capital surges and stops. To the extent that the findings of this chapter are different than Alfaro et al. and Forbes and Warnock, this chapter contributes to the literature by showing that capital control indices and selection bias play roles in evaluating the efficacy of capital controls.

3.6 Concluding Remarks

In this chapter, I examine the effect of capital controls on the probability of countries experiencing surges or stops. To do so, I use a propensity score matching method on a large data set of country-time observations. The data set encompasses both developed and developing countries and covers the period 1995-2016. The propensity score matching method controls for possible selection bias—countries with particular characteristics may be more prone to both imposing capital controls and experiencing surges or sudden stops in capital flows. The propensity score matching method pairs observations with different treatment status but similar probability of receiving capital controls, yielding the estimated average treatment effects on the treated (ATTs), as well as the estimated average treatment effects on the untreated (ATUs).

A key feature of the study is its use of two different indices of capital controls, the Chinn-Ito index and Schindler's indices, and a decomposition of the latter into inflow control and outflow control indices. This latter focus is important since an obvious criticism of the aggregate controls is that they do not properly represent the true nature of controls being imposed.

The results of this chapter suggest that there is some—albeit weak—evidence to support the efficacy of capital controls on reducing surges and stops for the untreated. The estimated ATUs show that both overall controls (Schindler) and inflow controls have statistically significant estimated ATUs that range between -11 to -16 percent, which suggests that for observations without capital controls, imposing capital controls would have reduced the observations' probability of experiencing either surges or stops. Outflow controls do not appear to affect the probability of observations experiencing surges and stops. The results, however, come with qualifications. There remains some residual imbalance balance between the matched treated and untreated observations, which needs to be improved upon before one can make a more definite conclusion.

The results of this chapter have some policy implications. First, the different characteristics between the treated and untreated groups before propensity score matching confirm the selection bias issue. A naïve comparison between observations with and without capital controls in an unmatched sample would not give rise to an unbiased estimator of the efficacy of capital controls. When evaluating whether capital controls are able to achieve the policy objectives, one needs to adequately control for the selection bias issue. Second, domestic policies—such as capital controls—could be effective in enhancing a country’s financial stability by reducing the probability of their experiencing surges and stops, particularly for countries that have not yet imposed capital controls. For countries that had imposed capital controls, the effect of capital controls is less evident. A possible explanation for the divergence is the degree of law enforcement, which is usually higher for countries that have not yet imposed capital controls. This suggests that effective capital controls need to be accompanied by adequate administrative capability.

Third, capital controls that involve the use of inflow controls (e.g., overall controls (Chinn-Ito), overall controls (Schindler), and inflow controls) appear to be more effective than outflow controls. Inflow controls are restrictions on incurrences of external liabilities, whereas outflow controls are restrictions on acquisitions of external assets. The results of this chapter show that inflow controls are more effective than outflow controls in reducing surges and stops. This may suggest that sharp movements in gross capital inflows are more often caused by shocks to a country’s occurrences of external liabilities than shocks to a country’s acquisition of external assets. From the policy perspective, it would be less effective to limit surges and stops by restricting residents from purchasing foreign assets or by restricting non-residents from issuing foreign assets locally, which are the restrictions that outflow controls entail.

Future research is possible. In this chapter, I have used propensity scores to match observations with those of the opposite treatment status having similar propensity scores. Although the balance statistics suggest that the propensity score matching greatly improves the balances between the treated groups and the untreated group, the matched sample still shows signs of imbalances. Future studies may extend the analysis of this chapter by using the propensity scores without matching, such as inverse probability weighting (IPW) and regression adjustment (RA). I leave these opportunities for future research.

3.7 Tables in Chapter 3

Table 3-1: Summary Statistics

	Count	Mean	SD	Min	Max
Surge	1074	0.24	0.43	0	1
Stop	1074	0.25	0.43	0	1
Overall Controls (Chinn-Ito)	1074	0.3	0.46	0	1
Overall Controls (Schindler)	1001	0.31	0.46	0	1
Inflow Controls	1001	0.31	0.46	0	1
Outflow Controls	1001	0.31	0.46	0	1
Current Account / GDP	979	-0.04	6.23	-24.23	27.14
Government Spending / GDP	979	16.48	5.20	4.63	27.94
Trade Openness	979	79.51	62.12	15.64	442.62
Commodity Price	1074	114.96	46.25	55.09	191.69
Interest Rate Differential	808	3.59	7.45	-4.84	80.56
Private Credit /GDP	961	76.57	49.54	8.26	263.27
Stock Market Capitalization	896	47.72	76.09	0.00	822.32
Institutional Quality	969	67.16	24.16	8.14	99.76
Inflation	948	5.19	12.13	-1.74	254.95

Table 3-2: List of Countries in the Dataset

Argentina	Latvia
Australia	Lithuania
Austria	Malaysia
Bangladesh	Mexico
Bolivia	Netherlands
Brazil	New Zealand
Canada	Nicaragua
Chile	Norway
China, P.R.:	Panama
Colombia	Peru
Croatia	Philippines
Czech Republ	Poland
Denmark	Portugal
Estonia	Romania
Finland	Russian Fede
France	Singapore
Germany	Slovak Repub
Greece	Slovenia
Guatemala	South Africa
Hungary	Spain
Iceland	Sri Lanka
India	Sweden
Indonesia	Switzerland
Ireland	Thailand
Israel	Turkey
Italy	United Kingd
Japan	United State
Korea, Repub	Venezuela, R

Table 3-3: Variable Definitions and Data Sources

Variable Name	Description	Source
Surge	1 if the country-year observation falls within a surge episode; 0 otherwise. For each country, a surge episode starts when the year-to-year change in the four-quarter sum of gross capital inflows is above one rolling standard deviation from the rolling mean. The surge episode ends when that above condition no longer holds. In addition, at least one observation within the episode must be greater than two standard deviations from the rolling mean. The rolling window is a 5-year period prior to the country-year observation.	Author's calculation; International Financial Statistics database.
Stop	1 if the country-year observation falls within a stop episode; 0 otherwise. For each country, a stop episode starts when the year-to-year change in the four-quarter sum of gross capital inflows is below one rolling standard deviation from the rolling mean. The surge episode ends when that above condition no longer holds. In addition, at least one observation within the episode must be less than two standard deviations from the rolling mean. The rolling window is a 5-year period prior to the country-year observation.	Author's calculation; International Financial Statistics database.
Overall Controls (Chinn-Ito)	a binary variable that takes 1 when the Chinn-Ito capital control index exceeds the 70 th percentile of the entire sample; 0 otherwise. Chinn-Ito index measures levels of overall capital control, ranging from 0 to 1. 1 for most regulated	Author's calculation; Chinn and Ito (2008)
Overall Controls (Schindler)	a binary variable that takes 1 when the overall Schindler capital control index exceeds the 70 th percentile of the entire sample; 0 otherwise. Schindler index measures levels of overall capital control, ranging from 0 to 1. 1 for most regulated.	Author's calculation; Schindler (2009)
Inflow Controls	a binary variable that takes 1 when the inflow Schindler capital control index exceeds the 70 th percentile of the entire sample; 0 otherwise. Schindler inflow control index measures levels of inflow control, ranging from 0 to 1. 1 for most regulated.	Author's calculation; Schindler (2009)
Outflow Controls	a binary variable that takes 1 when the outflow Schindler capital control index exceeds the 70 th percentile of the entire sample; 0 otherwise. Schindler outflow control index measures levels of outflow control, ranging from 0 to 1. 1 for most regulated	Author's calculation; Schindler (2009)
Current Account	Current account balance relative to GDP.	World Development Indicator Database.
Government Spending	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees).	World Development Indicators database
Trade Openness	Sum of export and import relative to GDP.	World Development Indicators database
Commodity Price	Average of commodity price indices for fuel and nonfuel.	World Economic Outlook database
Interest Rate Differential	Difference between domestic three-month treasury rates and US three-month treasury rate.	International Financial Statistics database.
Private Credit	Private credit by deposit money banks relative to GDP.	Global Financial Development database
Stock Market Capitalization	Stock market capitalization relative to GDP.	Global Financial Development database
Institutional Quality	Average of the percentile rank of six indicators: voice and accountability, political stability, government institutional quality effectiveness, regulatory quality, rule of law, control of corruption (range: 0100, where a higher score means better institution).	Kaufmann et al. (2011)
Inflation	Consumer price index inflation.	World Development Indicators database

Table 3-4: Probit Estimations

Variables	(1)	(2)	(3)	(4)
	Model 1 Overall Controls (Chinn-Ito)	Model 2 Overall Controls (Schindler)	Model 3 Inflow Controls	Model 4 Outflow Controls
Current Account, t-1	-0.0108 (0.0132)	0.00271 (0.0141)	0.00913 (0.0145)	-0.00462 (0.0135)
Government Spending, t-1	0.0158 (0.0188)	-0.0837*** (0.0212)	-0.0477** (0.0215)	-0.0143 (0.0191)
Trade Openness, t-1	0.00115 (0.00142)	0.000727 (0.00148)	0.00166 (0.00150)	0.00194 (0.00144)
Commodity Price, t-1	0.000257 (0.00137)	0.00190 (0.00148)	0.00632*** (0.00154)	-0.000568 (0.00139)
US interest Rate Difference, t-1	0.0326** (0.0134)	0.118*** (0.0214)	0.0998*** (0.0217)	0.0521*** (0.0132)
Private Credit/GDP, t-1	0.00749*** (0.00203)	0.00986*** (0.00238)	0.00616*** (0.00237)	0.00993*** (0.00218)
Stock Market Cap., t-1	-0.00316* (0.00164)	-0.00795*** (0.00226)	0.00805*** (0.00243)	-0.00591*** (0.00204)
Institutional Quality, t	-0.0435*** (0.00502)	-0.0310*** (0.00508)	-0.0354*** (0.00534)	-0.0366*** (0.00499)
Inflation, t	-0.00911 (0.0122)	0.0150 (0.0235)	0.0220 (0.0252)	-0.00659 (0.0118)
Constant	1.424*** (0.319)	1.737*** (0.379)	1.189*** (0.376)	1.173*** (0.324)
Observations	620	620	620	620
R2 (Pseudo)	0.300	0.451	0.472	0.297
Wald Chi2 (p-value)	0	0	0	0
Percent Correctly Predicted	77.74	83.71	82.90	78.87
Sensitivity	65.66	80.97	78.22	54.24
Specificity	83.41	85.28	85.57	88.71

Note: (1) Standard errors in parentheses. (2) Results significant at 1, 5, and 10% levels are indicated by ***, **, and *. (3) In each model, the independent variable is the treatment status of an observation. (4) An observation receives a treatment when the value of the corresponding capital control index is above the 70th percentile of the entire sample. (5) Sensitivity: the percentage of observations with capital controls that are correctly identified as having capital controls. (6) Specificity: the percentage of observations without capital controls that are correctly identified as not having capital controls.

Table 3-5: Balance Assessment Before and After Matching, ATT

	Unmatched								Matched							
	Obs.	Obs.	Mean	Mean	Standardized	VR	t- test	p- value	Obs.	Obs.	Mean	Mean	Standardized	VR	t- test	p- value
	Treated	Untreated	Treated	Untreated	Difference				Treated	Untreated	Treated	Untreated	Difference			
<i>A. Overall Controls (Chinn-Ito)</i>																
Current Account	198	422	-0.51	0.61	-22.52	0.66	-2.43	0.02	198	198	-0.51	-1.09	11.53	0.91	1.24	0.22
Government Spending	198	422	13.51	16.75	-67.95	0.92	-7.79	0.00	198	198	13.51	13.02	10.42	1.07	1.09	0.27
Trade Openness	198	422	68.57	89.70	-58.44	0.19	-4.39	0.00	198	198	68.57	63.90	12.92	1.07	1.36	0.18
Commodity Price	198	422	118.93	112.65	12.92	1.07	1.52	0.13	198	198	118.93	119.39	-0.94	1.00	-0.09	0.93
Interest Rate Difference	198	422	5.62	1.76	82.97	1.01	9.65	0.00	198	198	5.62	4.67	20.48	0.81	2.04	0.04
Private Credit	198	422	63.85	92.63	-63.10	0.78	-7.02	0.00	198	198	63.85	51.80	26.42	1.11	2.80	0.01
Stock Market Cap.	198	422	26.45	68.12	-134.37	0.10	-7.82	0.00	198	198	26.45	15.59	35.03	1.51	4.13	0.00
Institutional Quality	198	422	49.89	77.70	-162.41	0.67	-17.52	0.00	198	198	49.89	47.59	13.43	0.87	2.82	0.01
Inflation	198	422	6.18	3.29	48.61	1.74	6.08	0.00	198	198	6.18	6.80	-10.29	0.63	-0.93	0.35
<i>B. Overall Controls (Schindler)</i>																
Current Account	226	394	-0.51	0.69	-25.27	0.57	-2.67	0.01	226	226	-0.51	-1.74	25.88	0.51	2.18	0.03
Government Spending	226	394	12.76	17.42	-99.69	1.05	-12.04	0.00	226	226	12.76	14.76	-42.87	1.46	-4.85	0.00
Trade Openness	226	394	67.82	91.65	-68.57	0.16	-4.85	0.00	226	226	67.82	67.01	2.34	0.43	0.21	0.84
Commodity Price	226	394	118.43	112.49	12.28	1.06	1.49	0.14	226	226	118.43	128.15	-20.07	0.97	-2.11	0.04
Interest Rate Difference	226	394	6.11	1.20	84.00	3.25	11.65	0.00	226	226	6.11	6.14	-0.51	0.97	-0.07	0.95
Private Credit	226	394	57.97	98.12	-92.76	0.75	-10.47	0.00	226	226	57.97	57.40	1.31	0.91	0.16	0.87
Stock Market Cap.	226	394	21.79	73.82	-219.65	0.05	-9.67	0.00	226	226	21.79	14.06	32.68	0.56	3.06	0.00
Institutional Quality	226	394	48.62	80.43	-187.45	0.84	-21.68	0.00	226	226	48.62	48.05	3.32	0.73	0.54	0.59
Inflation	226	394	6.82	2.71	56.21	9.64	8.22	0.00	226	226	6.82	5.96	11.73	3.50	1.72	0.09
<i>C. Inflow Controls (Schindler)</i>																
Current Account	225	395	-0.35	0.60	-19.68	0.58	-2.10	0.04	225	225	-0.43	0.35	-15.72	0.50	-1.30	0.19
Government Spending	225	395	12.79	17.39	-98.35	1.05	-11.87	0.00	225	225	13.08	13.84	-16.62	1.10	-1.89	0.06
Trade Openness	225	395	69.82	90.44	-56.49	0.18	-4.16	0.00	225	225	71.30	72.53	-3.29	0.29	-0.25	0.80
Commodity Price	225	395	123.79	109.41	29.82	1.07	3.61	0.00	225	225	123.18	118.12	10.58	0.81	1.10	0.27
Interest Rate Difference	225	395	5.96	1.30	79.23	3.11	10.94	0.00	225	225	5.26	5.70	-10.87	0.43	-0.94	0.35
Private Credit	225	395	55.46	99.47	-105.37	0.71	-11.75	0.00	225	225	57.17	50.51	15.57	1.38	2.00	0.05
Stock Market Cap.	225	395	20.33	74.53	-233.44	0.05	-10.14	0.00	225	225	21.51	14.10	31.33	0.77	3.38	0.00
Institutional Quality	225	395	47.86	80.79	-188.23	0.99	-22.49	0.00	225	225	49.62	50.71	-6.58	0.86	-1.18	0.24
Inflation	225	395	6.79	2.74	55.07	10.04	8.05	0.00	225	225	5.75	6.78	-24.41	1.01	-3.19	0.00
<i>D. Outflow Controls (Schindler)</i>																
Current Account	226	394	-0.34	0.59	-18.85	0.63	-2.05	0.04	226	226	-0.38	-0.78	8.28	0.65	0.61	0.54
Government Spending	226	394	13.22	17.15	-81.40	1.05	-9.84	0.00	226	226	13.99	13.96	0.88	1.61	0.08	0.93
Trade Openness	226	394	71.92	89.27	-46.32	0.19	-3.47	0.00	226	226	77.16	73.51	9.61	0.42	0.64	0.52
Commodity Price	226	394	121.22	110.87	21.50	1.05	2.60	0.01	226	226	123.10	122.27	1.74	1.16	0.14	0.89
Interest Rate Difference	226	394	5.65	1.46	83.84	1.36	10.57	0.00	226	226	4.93	3.15	37.83	1.64	3.86	0.00
Private Credit	226	394	62.13	95.70	-75.04	0.76	-8.52	0.00	226	226	62.89	60.61	5.26	0.95	0.46	0.64
Stock Market Cap.	226	394	24.64	72.16	-179.92	0.07	-8.71	0.00	226	226	26.66	15.99	38.90	0.80	3.51	0.00
Institutional Quality	226	394	52.19	78.35	-144.37	0.74	-16.28	0.00	226	226	55.66	54.04	9.04	0.68	1.35	0.18
Inflation	226	394	6.04	3.16	46.25	2.24	6.21	0.00	226	226	5.62	4.54	16.49	2.48	1.73	0.09

Table 3-6: Balance Assessment Before and After Matching, ATU

	Unmatched								Matched							
	Obs.	Obs.	Mean	Mean	Standardized	VR	t- test	p- value	Obs.	Obs.	Mean	Mean	Standardized	VR	t- test	p- value
	Treated	Untreated	Treated	Untreated	Difference				Treated	Untreated	Treated	Untreated	Difference			
<i>A. Overall Controls (Chinn-Ito)</i>																
Current Account	198	422	13.52	16.74	-67.38	0.93	-7.73	0.00	398	398	-0.26	0.31	-16.18	0.33	-1.62	0.11
Government Spending	198	422	67.89	89.65	-62.22	0.18	-4.59	0.00	398	398	14.72	16.62	-49.11	0.64	-6.52	0.00
Trade Openness	198	422	119.03	112.46	13.47	1.08	1.58	0.11	398	398	75.86	86.49	-41.14	0.11	-2.68	0.01
Commodity Price	198	422	5.66	1.75	84.33	1.01	9.80	0.00	398	398	81.87	113.56	-77.81	0.75	-10.92	0.00
Interest Rate Difference	198	422	63.67	92.72	-63.61	0.79	-7.09	0.00	398	398	3.07	1.73	41.15	0.73	6.13	0.00
Private Credit	198	422	26.41	67.58	-132.46	0.10	-7.77	0.00	398	398	55.81	93.93	-110.98	0.44	-12.41	0.00
Stock Market Cap.	198	422	49.83	77.76	-162.88	0.67	-17.60	0.00	398	398	29.49	59.23	-70.98	0.32	-6.87	0.00
Institutional Quality	198	422	6.20	3.28	48.95	1.76	6.12	0.00	398	398	71.82	76.85	-29.14	0.69	-10.09	0.00
Inflation	198	422	-0.57	0.67	-26.67	0.54	-2.79	0.01	398	398	5.33	3.34	62.60	0.48	7.16	0.00
<i>B. Overall Controls (Schindler)</i>																
Current Account	226	394	12.77	17.40	-98.97	1.06	-11.98	0.00	326	326	-0.64	0.08	-17.14	0.41	-1.60	0.11
Government Spending	226	394	67.23	91.58	-72.37	0.16	-5.02	0.00	326	326	16.29	16.81	-14.23	0.80	-1.92	0.06
Trade Openness	226	394	118.51	112.29	12.83	1.07	1.56	0.12	326	326	86.61	85.17	5.74	0.11	0.33	0.74
Commodity Price	226	394	6.14	1.19	84.85	3.25	11.76	0.00	326	326	98.38	114.42	-32.67	1.10	-4.97	0.00
Interest Rate Difference	226	394	57.79	98.16	-93.24	0.75	-10.55	0.00	326	326	2.19	1.53	26.12	0.56	3.65	0.00
Private Credit	226	394	21.74	73.19	-216.88	0.05	-9.63	0.00	326	326	49.99	98.08	-146.85	0.42	-14.64	0.00
Stock Market Cap.	226	394	48.56	80.48	-187.83	0.84	-21.75	0.00	326	326	22.31	54.30	-101.24	0.33	-9.19	0.00
Institutional Quality	226	394	6.84	2.71	56.41	9.71	8.24	0.00	326	326	72.32	77.62	-34.74	0.64	-8.32	0.00
Inflation	226	394	-0.41	0.58	-20.96	0.56	-2.21	0.03	326	326	4.42	2.86	46.16	1.86	7.23	0.00
<i>C. Inflow Controls (Schindler)</i>																
Current Account	225	395	12.79	17.37	-97.64	1.06	-11.81	0.00	320	320	-0.42	0.11	-12.86	0.40	-1.23	0.22
Government Spending	225	395	69.23	90.37	-59.59	0.17	-4.32	0.00	320	320	15.78	16.98	-37.37	0.57	-4.64	0.00
Trade Openness	225	395	123.89	109.24	30.33	1.08	3.68	0.00	320	320	85.17	85.18	-0.05	0.13	0.00	1.00
Commodity Price	225	395	5.99	1.29	80.06	3.11	11.04	0.00	320	320	79.40	113.36	-81.96	0.79	-10.99	0.00
Interest Rate Difference	225	395	55.26	99.50	-105.91	0.71	-11.83	0.00	320	320	2.66	1.69	37.20	0.55	4.77	0.00
Private Credit	225	395	20.27	73.89	-230.64	0.05	-10.10	0.00	320	320	51.74	98.23	-131.50	0.51	-13.03	0.00
Stock Market Cap.	225	395	47.81	80.83	-188.61	0.99	-22.54	0.00	320	320	22.48	51.79	-97.45	0.35	-8.60	0.00
Institutional Quality	225	395	6.81	2.73	55.26	10.11	8.07	0.00	320	320	73.46	77.86	-30.42	0.63	-7.33	0.00
Inflation	225	395	-0.40	0.57	-20.06	0.60	-2.16	0.03	320	320	5.62	2.93	108.41	1.02	13.11	0.00
<i>D. Outflow Controls (Schindler)</i>																
Current Account	226	394	13.23	17.13	-80.77	1.06	-9.78	0.00	326	326	-0.71	0.00	-16.18	0.47	-1.64	0.10
Government Spending	226	394	71.34	89.22	-48.96	0.18	-3.62	0.00	326	326	16.43	16.77	-6.92	1.27	-1.16	0.25
Trade Openness	226	394	121.31	110.69	22.03	1.06	2.67	0.01	326	326	97.96	81.98	45.55	0.23	3.52	0.00
Commodity Price	226	394	5.68	1.45	84.90	1.36	10.71	0.00	326	326	110.96	113.56	-6.42	0.74	-0.83	0.41
Interest Rate Difference	226	394	61.97	95.76	-75.49	0.77	-8.59	0.00	326	326	1.48	1.67	-4.91	1.33	-0.86	0.39
Private Credit	226	394	24.60	71.55	-177.42	0.07	-8.66	0.00	326	326	59.63	93.92	-81.53	0.68	-9.90	0.00
Stock Market Cap.	226	394	52.15	78.42	-144.69	0.75	-16.35	0.00	326	326	35.88	48.86	-33.56	0.60	-3.99	0.00
Institutional Quality	226	394	6.05	3.16	46.52	2.27	6.25	0.00	326	326	71.08	75.47	-26.89	0.57	-5.97	0.00
Inflation	226	394	0.00	0.00	0.00	0.00	0.00	0.00	326	326	3.18	3.38	-6.24	0.51	-0.74	0.46

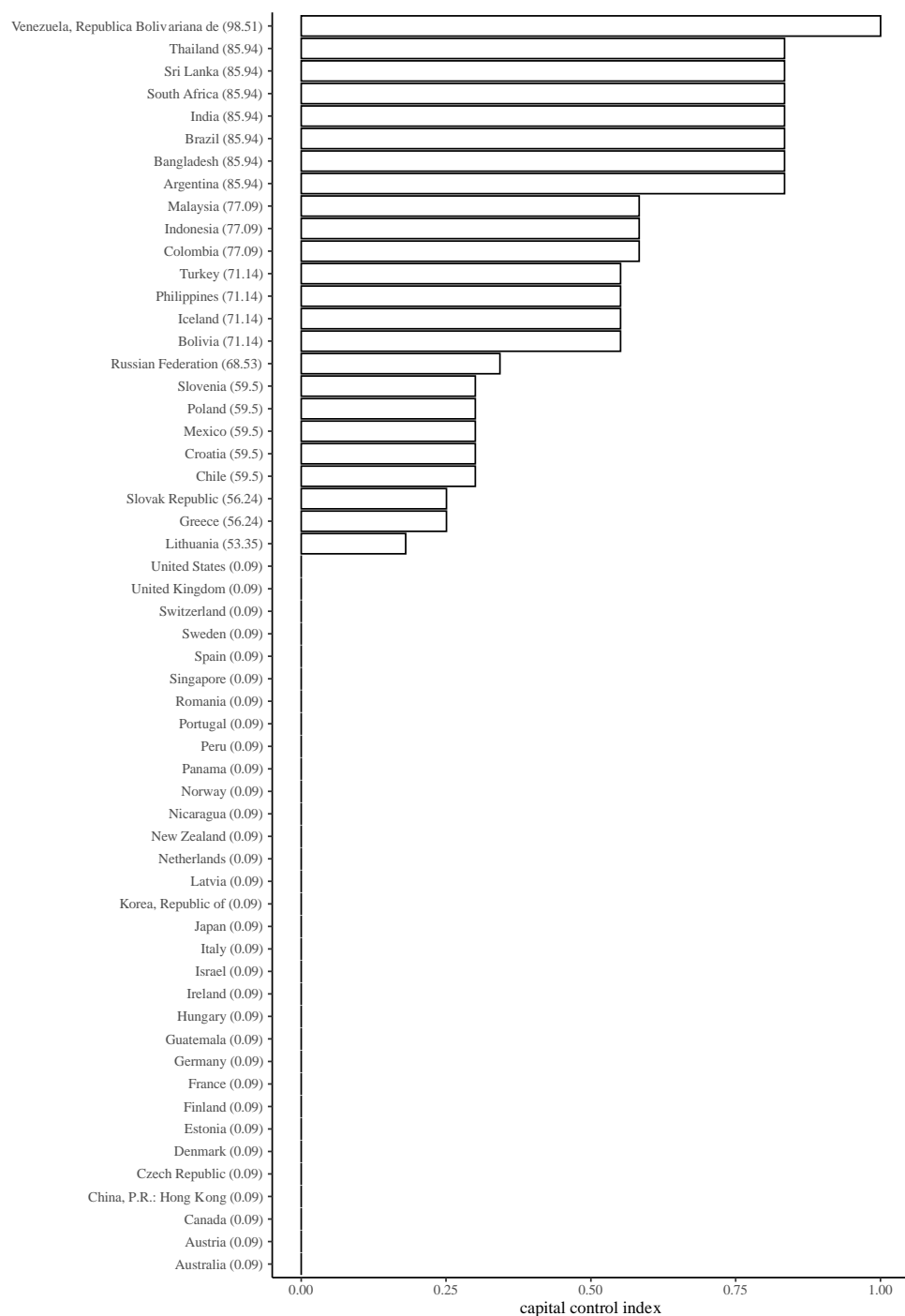
Table 3-7: Treatment Effects of Capital Controls

	ATT		ATU	
	Surge	Stop	Surge	Stop
<i>Overall Controls (Chinn-Ito)</i>				
potential outcomes with treatment	0.23	0.25	0.14	0.20
potential outcomes without treatment	0.18	0.40	0.23	0.26
treatment effect	0.05	-0.15**	-0.09	-0.06
AI SE	0.05	0.08	0.09	0.10
<i>t</i> -statistics	0.88	-2.03	-1.01	-0.63
<i>p</i> -value	0.38	0.04	0.31	0.53
<i>Overall Controls (Schindler)</i>				
potential outcomes with treatment	0.22	0.28	0.11	0.12
potential outcomes without treatment	0.13	0.40	0.22	0.24
treatment effect	0.08	-0.11	-0.11	-0.12***
AI SE	0.06	0.10	0.08	0.04
<i>t</i> -statistics	1.45	-1.10	-1.35	-3.08
<i>p</i> -value	0.15	0.27	0.18	0.00
<i>Inflow Controls (Schindler)</i>				
potential outcomes with treatment	0.19	0.27	0.08	0.09
potential outcomes without treatment	0.19	0.34	0.23	0.25
treatment effect	0.01	-0.07	-0.15**	-0.16***
AI SE	0.13	0.07	0.07	0.03
<i>t</i> statistics	0.07	-1.08	-2.16	-5.93
<i>p</i> -value	0.94	0.28	0.03	0.00
<i>Outflow Controls (Schindler)</i>				
potential outcomes with treatment	0.23	0.29	0.14	0.32
potential outcomes without treatment	0.21	0.30	0.23	0.24
treatment effect	0.02	-0.01	-0.09	0.08
Abadie-Imbens Standar Error	0.06	0.07	0.11	0.12
<i>t</i> -statistics	0.16	-0.17	-1.32	3.03
<i>p</i> -value	0.71	0.86	0.42	0.48

Note: (1) Results significant at 1,5, and 10% levels are indicated by ***, **, and * respectively.

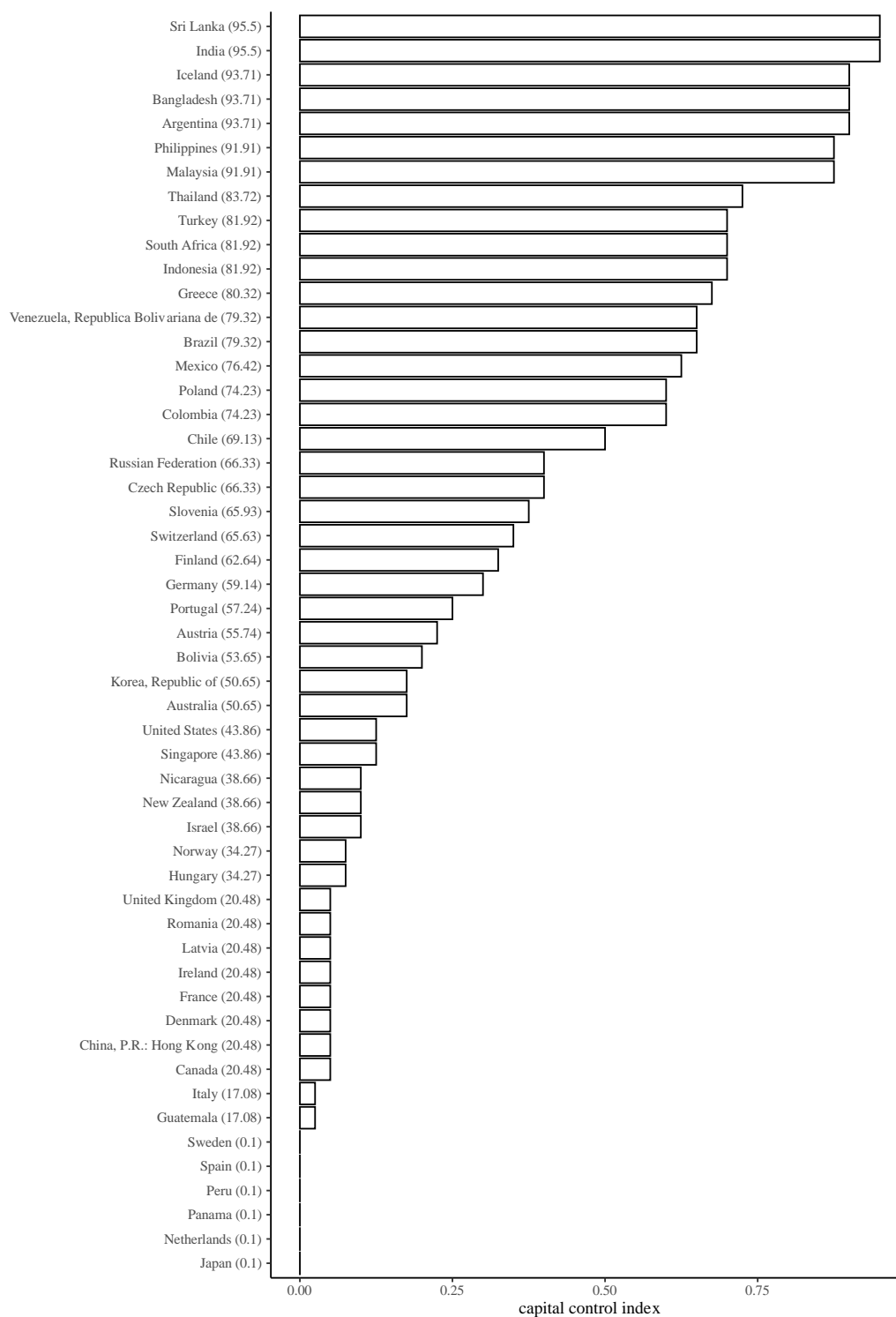
3.8 Figures in Chapter 3

Figure 3-1: Levels of Capital Controls (Overall Controls, Chinn-Ito), 2016



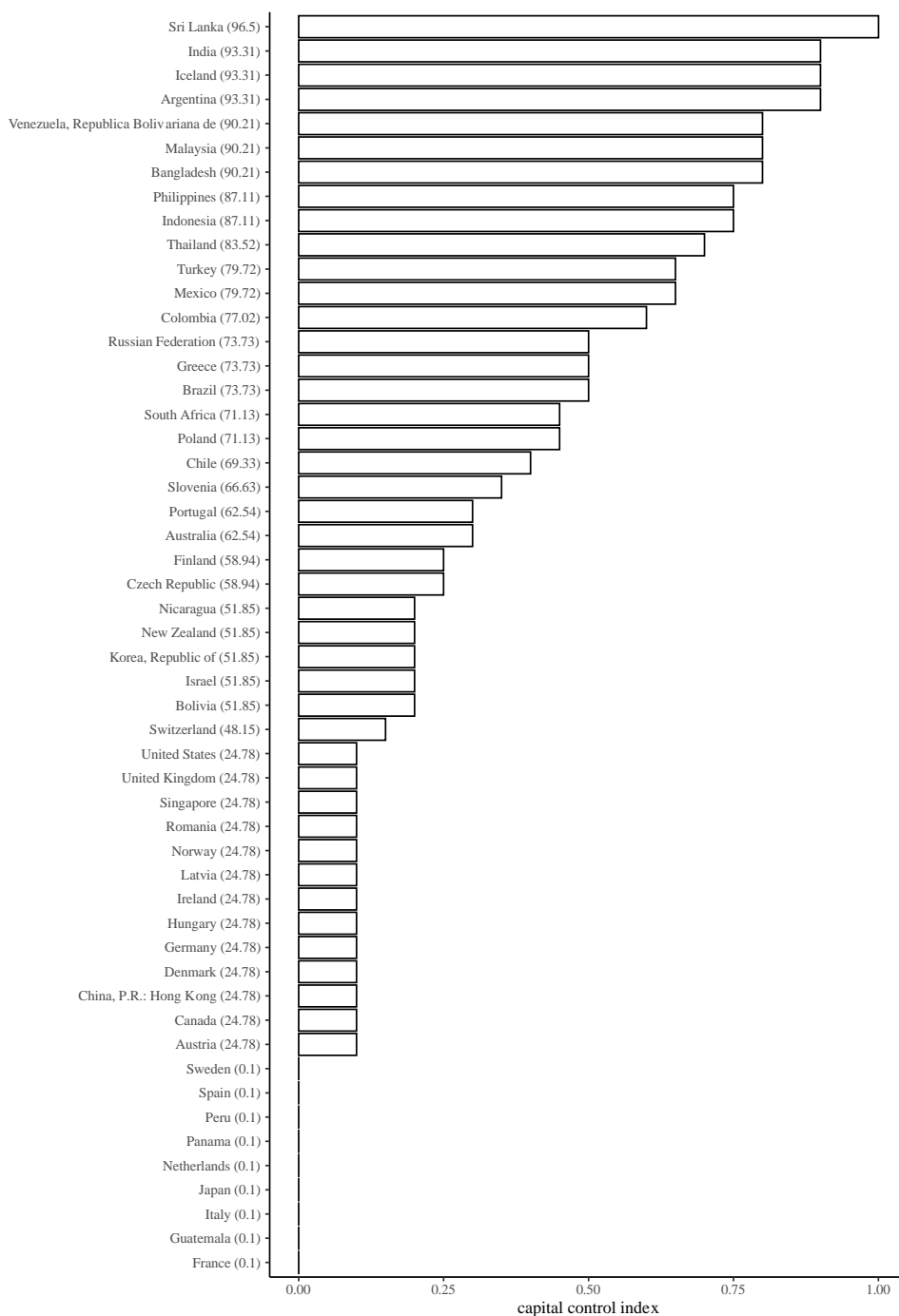
Notes: (1) Percentile in parentheses.

Figure 3-2: Levels of Capital Controls (Overall Controls, Schindler), 2016



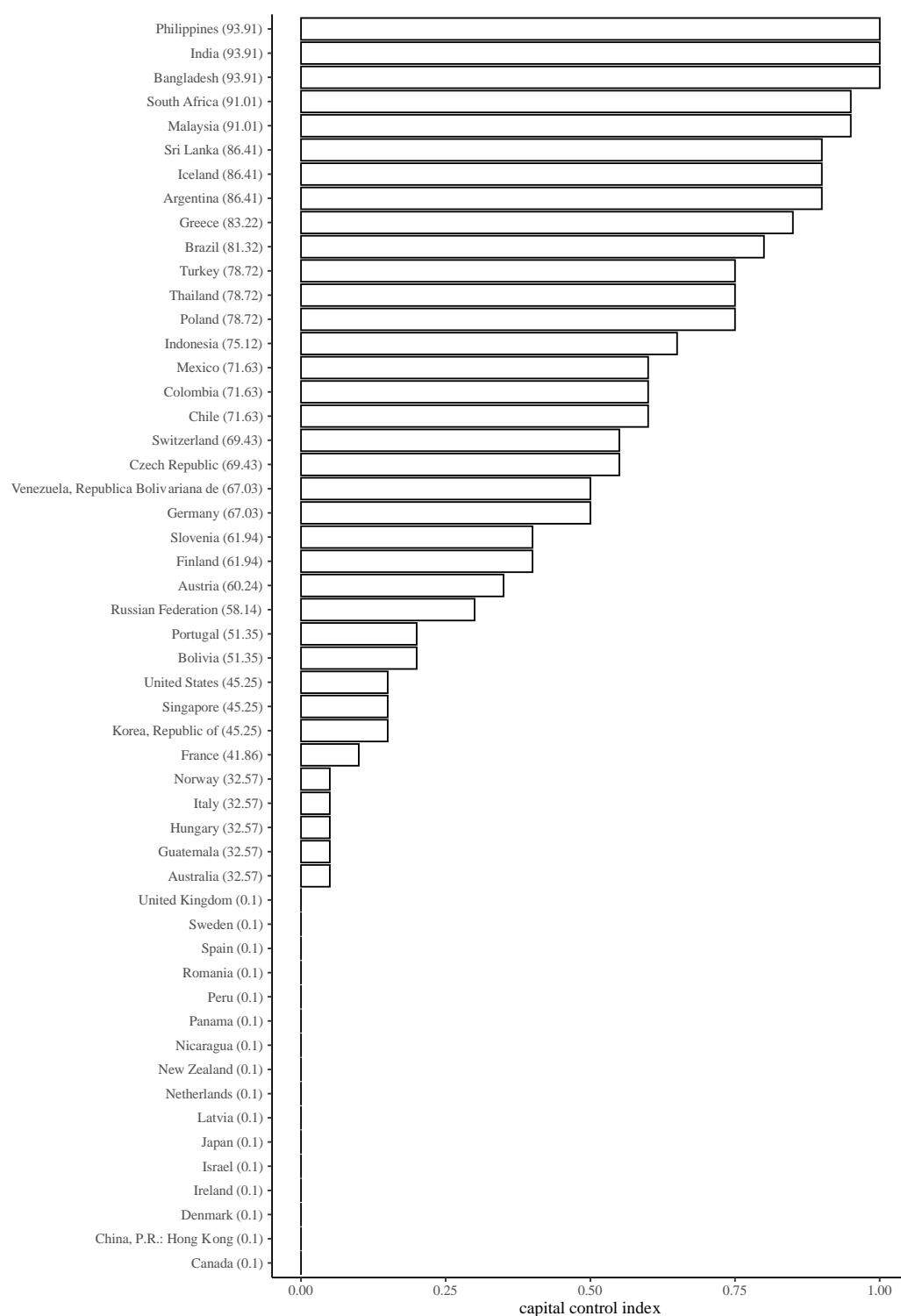
Notes: (1) Percentile in parentheses.

Figure 3-3: Levels of Capital Controls (Inflow Controls), 2016



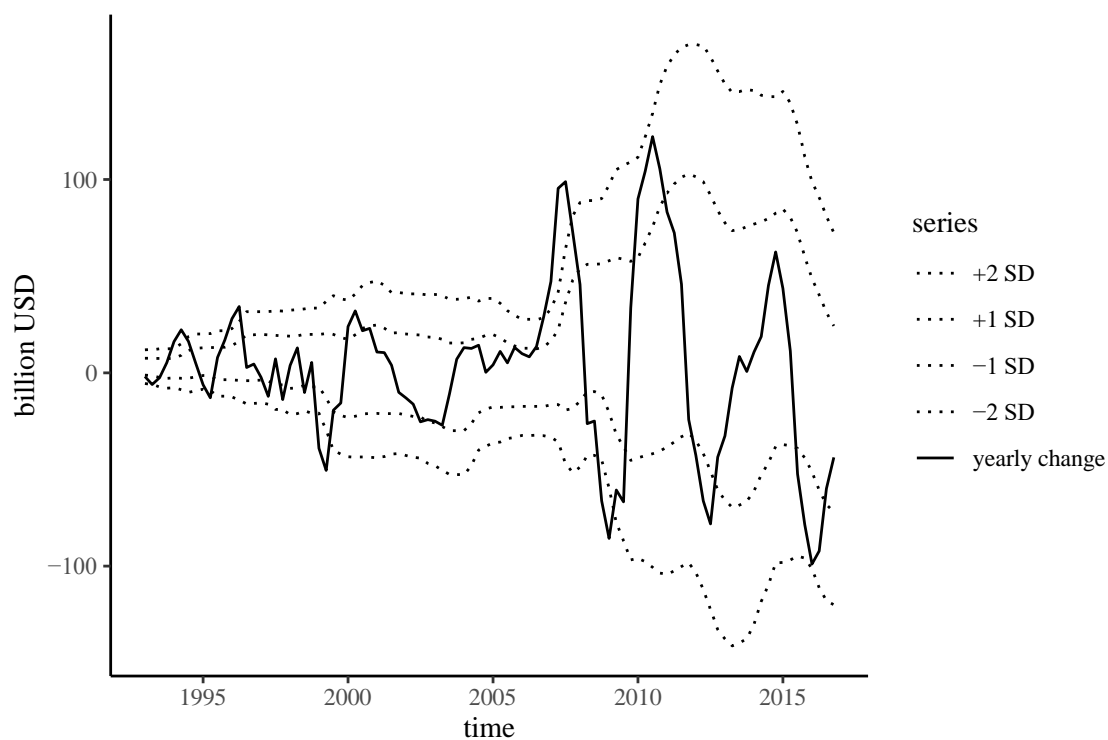
Notes: (1) Percentile in parentheses.

Figure 3-4: Levels of Capital Controls (Outflow Controls), 2016

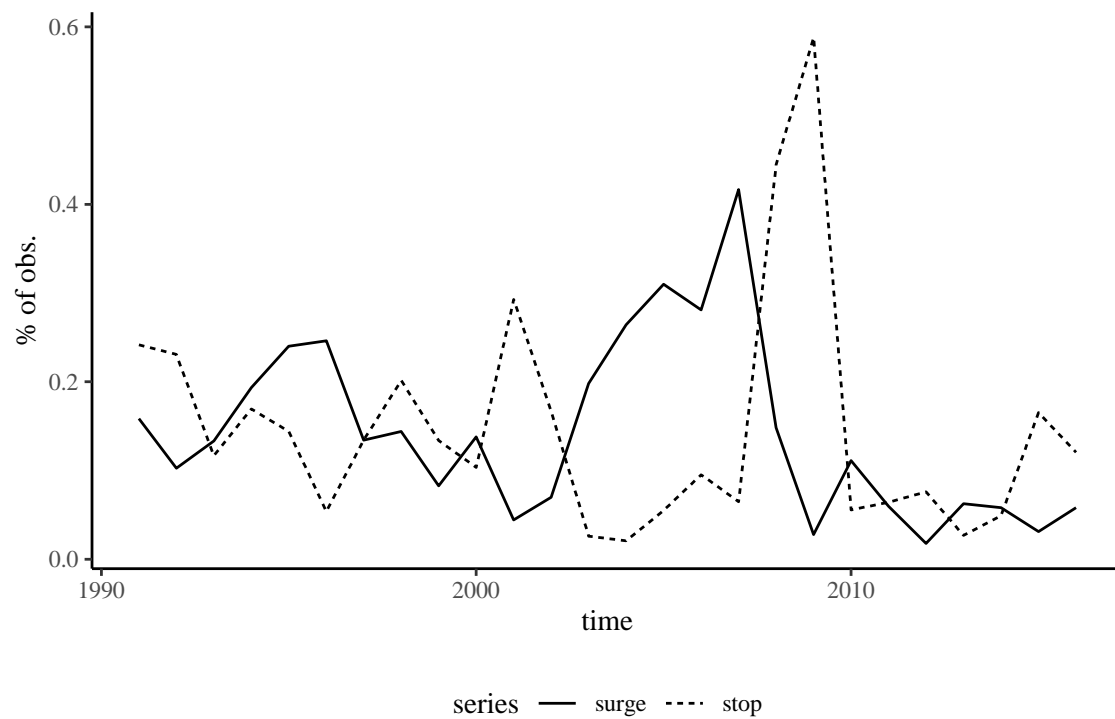


Notes: (1) Percentile in parentheses.

Figure 3-5: Episodes of Grow Inflow Surges and Stops in Brazil



Notes: (1) The solid line is ΔC_t^+ . (2) The 1st dotted line from the top represents $\mu_{\Delta C_t^+} + 2 * \sigma_{\Delta C_t^+}$. (3) The 2nd dotted line from the top represents $\mu_{\Delta C_t^+} + 1 * \sigma_{\Delta C_t^+}$. (4) The 3rd dotted line from the top represents $\mu_{\Delta C_t^+} - 1 * \sigma_{\Delta C_t^+}$. (5) The 4th dotted line from the top represents $\mu_{\Delta C_t^+} - 2 * \sigma_{\Delta C_t^+}$. (6) For a given country at period t , let ΔC_t^+ be the annual year-to-year change in the four-quarter rolling sum of the quarterly gross capital inflows; $\mu_{\Delta C_t^+}$ is the rolling average of ΔC_t^+ over the preceding five years; $\sigma_{\Delta C_t^+}$ is the rolling standard deviation of ΔC_t^+ over the preceding five years.

Figure 3-7: Occurrences of Grow Inflow Surges and Stops Over Time at the Global Level

Note: (1) Source: author's calculation.

Chapter 4 Gross Capital Flow Surges and Financial Crises

4.1 Introduction

Chapter 4 addresses why some episodes of gross inflow surges ended in financial crises (hereafter hard landings), while other episodes of gross inflow surges ended with normal times (hereafter soft landings).

The motivations of this chapter are threefold. First, the literature has employed a variety of methods to identify surge episodes. Constructing surge episodes involves two main considerations. The first consideration pertains to whether net or gross capital inflows are used as the underlying data. The second consideration pertains to how thresholds are set to separate surge periods from non-surge periods. Surges—by definition—are periods when capital flows increase significantly compared to the norm. While none of these methods appear to be unreasonable, no single approach seems to dominate the others (Crystallin et al., 2015). It is unclear to what extent surge episodes, identified by these various methods, are different. In setting up the analyses, this chapter compares the main surge identification strategies.

Second, the literature has shown that surges may lead to subsequent reversals of foreign capital as global and domestic factors deteriorate. For example, studies from Reinhart and Reinhart (2008), Sula (2010) Benigno et al. (2015) and Kim et al. (2017) all show that large reversals of capital inflows are mostly preceded by large surges in capital flows. The reversals of capital flows can be accompanied by severe macroeconomic adjustments, a phenomenon that the literature has described as sudden stops. Not all surges, however, lead to subsequent reversals of capital inflows accompanied by severe macroeconomic adjustments. As this chapter will show, some episodes of surges did—as the literature has shown—end up with drastic macroeconomic adjustments such as financial crises; other episodes, however, ended with normal times. It is possible that countries are able to absorb capital flows without a build-up of financial instability. In this chapter, I examine the factors that are relevant in explaining the differences, which assist in the effective management of capital flows.

Third, there has been a growing interest in understanding whether the effect of financial account restrictiveness—with capital controls on the one end of the spectrum and financial liberalization on the other end—depends upon some country-specific characteristics (Kose et al., 2009; Mishkin, 2007). Among them, institutional quality is a factor that has begun to receive attention. For example, Okada (2013) examines how the effect of financial openness on capital inflows depends upon the institutional quality of individual countries. Okada finds that lowering financial restrictiveness in countries with higher institutional quality increase capital inflows. However, the same policy action—when implemented in

countries with lower institutional quality—decreases capital inflows. Okada argues that better institutional quality—measured by law and order as well as bureaucratic quality—creates a conducive macroeconomic environment that supports the success of financial liberalization, thereby promoting cross-border capital flows as the financial markets become more financially open. On the other hand, when the rule of law is not established and the institutional quality is low, foreign investors may risk expropriation from the government and disadvantageous changes of rules after investment. Therefore, foreign investors are unlikely to invest in countries with inadequate institutional quality even if these countries become more financially open. Continuing such a direction of the literature, I examine the interaction effect between capital controls and institutional quality on the probability of capital surges ending in financial crises.

With the above motivations, Chapter 4 contributes to the literature in the following ways. First, I compare four different methods that are commonly used to construct surge episodes. I use a common set of 53 countries that include both advanced and emerging countries. The four different methods differ by two considerations: whether net or gross flows are used, as well as how thresholds are set (a rolling approach versus a percentile approach). Net flows capture trade-related transactions, while gross flows capture pure-financial transactions; the rolling approach uses a country-specific threshold, while the percentile approach uses a sample-specific threshold. I show that the relationships—measured by correlation coefficients—among these methods range from 0.15 to 0.43, suggesting that episodes captured by these identification strategies differ considerably. The choice of methods would depend on what one intends to capture.

Second, I examine the factors that affect the endings of surge episodes. I show that both global factors (such as investors' risk aversion) and domestic factors (such as domestic credit growth, foreign exchange reserves, institutional quality, and capital controls) play roles in explaining the endings of surge episodes. Among the global factors that I will examine, the one that matters the most is the global risk aversion measured by the S&P 500 return volatility. Episodes of surges are more likely to end in financial crises (defined by Laeven and Valencie, 2013) when global investors become more risk-averse. Because the sentiment of global investors is outside the control of policymakers, such a finding that hard landings are associated with global risk aversion is consistent with a key feature of sudden stops: capital flows could reverse themselves abruptly as capricious foreign lenders suddenly become unwilling to provide that finance, a theme that I have already discussed in Section 2.3.3 of Chapter 2. Turning to the domestic factors, increases in domestic credit contribute to higher probabilities of hard landings, while higher levels of official reserves create buffers during capital reversals and hence reduce the likelihood of hard landings.

Third, I show that the effect of capital controls depends on a country's level of institutional quality. For countries with lower institutional quality, imposing capital controls does not decrease the probability of hard landing, possibly due to lack of enforcement. Capital controls only start to contribute to a lower

probability of hard landings when a proxy for the institutional quality of a country exceeds a threshold of 80, measured by the index of Kaufmann and Kraay (2011).

The rest of this chapter is organized as follows. Section 4.2 preview the dataset used in this chapter. Section 4.3 compares methods that are commonly used to construct episodes of surges. Section 4.4 discusses the model specifications. Section 4.5 discusses the empirical results. Section 4.6 concludes.

4.2 Dataset

Table 4-1 previews the dataset with summary statistics of the variables that this study uses for the regression analysis. Table 4-2 provides the definitions of the variables and their data sources. The dataset contains 168 complete gross inflow surge episodes for the same 56 countries used in Chapter 2 from 1981 to 2015. Table 4-3 provides a full list of the 168 gross inflow surge episodes. The 56 countries are consistent with those selected by Forbes and Warnock (2012), which my main surge identification strategy builds upon. In addition, I select a period that is consistent with Ghosh et al. (2016), to which my benchmark models reference. Note that Ghosh et al. use Chinn-Ito index as their capital control variable. Chinn-Ito index coverages years from 1970 onwards, making including observations before 1995 possible.

4.3 Surge Episodes

4.3.1 Comparing Surge Episodes under Different Identification Strategies

Constructing surge episodes involves two main considerations. The first consideration pertains to whether net or gross capital inflows should be used when one considers surge episodes. Early studies tend to focus on surges in net capital flows; see, for example, Cuddington (1986), Dooley (1988), Calvo and Reinhart (1999), and Bernanke (2005). Recent studies, however, have started to pay more attention to gross flows; see, for example, Forbes and Warnock (2012), Blanchard & Milesi-Ferretti (2012), Borio & Disyatat (2015) and Obstfeld (2012a, 2012b). As Section 2.3 in Chapter 2 has discussed, net capital flows measure intertemporal trade while gross capital flows are more related to pure financial transactions.

The second consideration pertains to how a threshold should be set to separate surge periods from non-surge periods. Surges—by definition—are periods when capital flows increase significantly compared to the norm. While variations exist, the two main approaches are the percentile approach and the rolling approach. The rolling approach defines surges as periods when capital inflows increase more than some deviation from the norm. For example, Forbes and Warnock (2012) define surges as periods when the increase in gross capital inflows is more than one rolling standard deviation from the rolling mean. Other

studies that adopt this rolling approach include Balakrishnan et al. (2013), Caballero (2016) and Sula (2010). The percentile approach, on the other hand, defines surge episodes according to a specified percentile of the sample. The percentile approach has been used by Benigno et al. (2015) Ghosh et al. (2016) and Reinhart and Reinhart (2008). One drawback of the percentile approach is that the threshold is sensitive to the underlying sample. The percentile of a selected sample of countries may not necessarily be the same as another selected sample of countries, which poses a challenge for the reproducibility of the study and generalization of the results.

With the two main considerations, I use a common set of 53 countries from 1980 to 2015 to construct surge episodes in the following four ways:

- Surge 1: surges in net flows by the rolling approach
- Surge 2: surges in gross inflows by the rolling approach
- Surge 3: surges in net flows by the percentile approach
- Surge 4: surges in gross inflows by the percentile approach

Net flows and gross inflows follow the standard definitions.⁵ The rolling approach defines surges in the same way as Chapter 3.⁶ The percentile approach follows Ghosh et al. (2016), who define surges as periods when a capital flow observation exceeds the 70th percentile of both the country's and the full sample's distribution of capital flows, expressed in percent of GDP.

Table 4-4 compares the four main methods. For a country-year observation, each method gives rise to a binary value that takes a value of 1 if the country-year observation falls within a surge episode according to that method; 0 otherwise. The comparisons are expressed in the Pearson correlation coefficients among the country-year observations among the four methods. For example, Table 4-4 shows that Surge 1 (net flows by the rolling approach) and Surge 2 (gross inflows by the rolling approach) are the most correlated with the correlation coefficient of 0.43, while Surge 2 (gross inflows by the rolling approach) and Surge 3 (net flows by the percentile approach) are the least correlated with the correlation coefficient of 0.15.

⁵ Net flows are the balances of countries' financial account; gross flows are the changes in countries' external liabilities.

⁶ For clarity, the definition is reproduced here: for a given country at period t , let ΔC_t^+ be the annual year-to-year change in the four-quarter rolling sum of the quarterly gross capital inflows; $\mu_{\Delta C_t^+}$ is the rolling average of ΔC_t^+ over the preceding five years; $\sigma_{\Delta C_t^+}$ is the rolling standard deviation of ΔC_t^+ over the preceding five years. A surge episode starts at time t when $\Delta C_t^+ \geq \mu_{\Delta C_t^+} + 1 * \sigma_{\Delta C_t^+}$. The surge episode ends when the condition no longer holds. In addition, for the entire period to be qualified as a surge episode, at least one observation must be greater than two rolling standard deviations above the rolling mean:

Overall, the correlation coefficients among these methods suggest that episodes captured by these methods are not that comparable.

4.3.2 Surges in Gross Episodes by the Rolling Approach

The choice of methods would depend upon the purpose of the study, one of the themes that Chapter 2 has discussed. For the following reasons, I focus on surges in gross inflows by the rolling approach for the subsequent analyses. First, the literature has started to recognize the role that gross flows play in identifying surge episodes. Crystallin et al. (2015) argue that the concept of net flow reversals may be inconsistent with the theoretical definition of sudden stops. They argue that the initial discussions of sudden stops focused on countries suddenly losing their access to international financial markets. As such, the sudden stop concept should refer to the behavior of foreigners in providing foreign liquidity to the country's economy—as is the case when gross flows are used, and should not include the behavior of domestic investors as is the case when net flows are used. Similarly, Borio and Disyatat (2015) argue that sudden stops arise when foreign lenders cease lending because they perceive risks that domestic borrowers may become unable to meet their debt obligations. Aside from market perceptions, they argue that there is no reason why current account deficits *in and of themselves* imply such greater exposure. A sudden stop crisis ends not because the current account deficits are reduced, but when the funding gap is eliminated through either new financing or debt restructuring. Blanchard and Milesi-Ferretti (2012) make a similar point, suggesting that gross capital flows—not just net capital flows—should be included as part of the indicators for global financial stability surveillance. When it comes to sudden stops, net flows will no longer be relevant when the external assets and liabilities are held by different sectors, or when the external assets and liabilities have different liquidity characteristics. For example, a country's public sector may hold external debts while the private sector holds external assets. In this case, it is unlikely that the rolling over of external debts can be offset by the private sectors selling external assets.

The second choice that concerns the measures of surge episodes relates to how a deviation from a normal period is defined. Compared to the percentile approach, the rolling approach identifies surge episodes in a way that is not sensitive to the underlying sample. This is particularly helpful when one wishes to ensure that the constructed surge episodes are comparable to those identified by previous studies that also use the same rolling approach with a different set of countries.

Grouping consecutive country-year observations, this approach yields 168 completed surge episodes in our panel of 53 countries over 1981 to 2015. Table 4-3 has reported the 168 episodes of surges with their start dates and end dates along with their magnitude of reversal expressed in percent of GDP.

Figure 4-1 graphs the 168 surge episodes by the years when the episodes ended. For each year, the transparent bar represents the total number of surges that ended in that year. Within each transparent bar, the squared dot represents the number of surges that ended in financial crises (i.e., the hard landings) within two years after the end of surge episodes.⁷ Figure 4-1 shows that episodes of surges have highly synchronized endings and highly synchronized crashes—clustered around the East Asian financial crisis (1997) and the global financial crisis (2007–2008).

Figure 4-2 further shows the distributions of the magnitude of gross capital inflow reversals by the years when the episodes ended. Each boxplot presents the 25th percentile, the median, and the 75th percentile of the sample. Figure 4-2 shows considerable variations in the magnitude of the gross flow reversals.

Finally, Table 4-5 shows how surge and non-surge episodes surges relate to occurrences of financial crises. The 168 completed surge episodes correspond to 344 country-year observations and account for 25 episodes of financial crises, which implies that the probability of experiencing financial crises conditional on surge episodes is $25/344=7.2$ percent. In contrast, the 220 non-surge episodes correspond to 1,035 country-year observations and account for 47 episodes of financial crises, which implies that the probability of experiencing financial crises conditional on non-surge episodes is $47/1035=4.5$ percent =4.5 percent. The higher probability of hard landings when surges end relative to normal times is consistent with the findings of Reinhart and Reinhart (2008), who also find that surges in capital inflows are associated with a higher likelihood of economic crises. On the other hand, 143 episodes of surges end in normal times, which highlight the fact that not all surges lead to financial crises and provide variations that one can explore to examine the factors that contribute to the different endings of surge episodes.

4.4 Empirical Strategies

To examine the factors that may affect the endings of surge episodes, I use probit models to estimate the probability of gross flow surges ending in financial crises. To establish a reference point to the existing literature, the specifications that I use follow closely those of Ghosh et al. (2016), who address surges in net flows that end in financial crises among emerging countries. I extend their specifications by replacing surges in net capital flows with surges in gross capital inflows and by incorporating into the models institutional quality and its interaction with capital controls as explanatory variables.

The models that I will estimate take the following general form:

⁷ See Section 4.3 for the definition of the financial crises.

$$Prob(I_{i,t} = 1) = \mathbf{x1}'_t\boldsymbol{\beta}_1 + \mathbf{x2}'_{i,t}\boldsymbol{\beta}_2 + \varepsilon_{i,t} \quad (4.1)$$

The details are as follows.

- $I_{i,t}$ is a binary indicator that takes a value of 1 if a financial crisis occurs within two years after a surge episode ends; 0 otherwise. Occurrences of financial crises are taken from Laeven and Valencie (2013) who define financial crises as when countries see the following two conditions: (1) significant losses and (2) significant policy interventions. The significant losses are measured by a share of nonperforming loans above 20 percent of total loans, bank closures of above 20 percent of banking system assets, and fiscal restructuring costs of the banking sector above 5 percent of GDP. The significant policy interventions are measured by deposit freezes and bank holidays, bank nationalizations, bank guarantees, liquidity support, bank reconstruction, and asset purchases.
- $\mathbf{x1}'_t$ contains global factors. To measure changes in global conditions, I include changes in the US interest rates, commodity prices, and global risk aversion, all of which are relevant global factors that the literature has identified in driving capital flows (Koepke, 2019). Here, the changes are defined as the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. Since a hard landing is defined as the situation when a financial crisis occurs within two years of the end of the surge, I measure changes in global conditions as the average in the two post-episode years relative to the average over the episode.
- $\mathbf{x2}'_t$ contains domestic factors. I include domestic credit, official reserves, real GDP per capita, institutional quality, capital controls, and the interaction of institutional quality and capital controls. Both the variable of the domestic credit and the capital controls are potentially subject to the endogeneity problem. Specifically, domestic variables such as credit growth and capital controls often move in response to a crisis, leading to a potential reverse-causality challenge. To mitigate such a problem, for these two variables, I use the differences between the average over the surge episode and the year before the surge started. I also include the institutional quality and the stock of official reserves. They may affect the investor's sentiment in level terms. For these two variables, I use the value of the last year of the surge episode. I include the interaction term between institutional quality and capital controls. Finally, I also include pre-episode real GDP per capita as a control variable. It is defined as the level in the year before the episode starts.

The model specifications that I use are similar to and different from those of Ghosh et al. (2016) in the following ways. In terms of similarities, I include the same global factors (i.e., US interest rates, commodity prices, and global risk aversion), which are standard explanatory variables to be included in the literature. For the domestic factors, three of them—domestic credit, official reserves, and real GDP per capita—are adapted from the specifications of Ghosh et al.. The data for these variables is publicly available and including these three same variables allows one to establish a reference point to the existing literature and enables direct comparisons of the results. Ghosh et al. also examine additional domestic variables such as output gap, overvaluation, FDI surge, and other investment liability surge. The methods of constructing these domestic variables, however, are not readily available. As Ghosh et al. consider each of these additional domestic variables in separate regression models, not including these additional domestic variables will not affect the results of the regression models that I will use.

In terms of differences, I modify and extend the analyses of Ghosh et al. (2016) in the following four aspects. First, Ghosh et al. do not explore the possibility that the effect of capital controls may depend upon country-specific characteristics. In contrast, I include institutional quality and its interaction term with capital controls to examine whether the effect of capital controls would vary according to different levels of institutional quality. Second, Ghosh et al. use net capital flows and a percentile approach to identify surge episodes. Instead, I use gross flows and a rolling approach as the surge identification strategy. As discussed, gross flows are more conceptually consistent with the concept of capital reversals and their associated risks, while the rolling approach has the advantage of identifying surge episodes in a way that is not sensitive to different samples of countries. Third, Ghosh et al. focus their analyses on emerging countries, while I extend the analyses to include both emerging and advanced countries. Including both emerging and advanced countries in the analyses enhances the generalizability of results. Fourth, I recode the financial openness variable to levels of capital controls, a practice consistent with the other chapters of this dissertation.

4.5 Empirical Results

I first establish benchmark results by re-estimating the specifications used by Ghosh et al. (2016), who address surges in *net* flows that end in financial crises among emerging countries. Recall from the previous discussion in Section 4.3.1 of this chapter, Ghosh et al. define surges as periods when a capital flow observation exceeds the 70th percentile of both the country's and the full sample's distribution of capital flows, expressed in percent of GDP (i.e. Surge 3). Table 4-6 shows the results. Model 1 includes a set of global factors common to all models while control for countries' initial real GDP per capita. These global factors are changes in the US real interest rate, commodity prices, and S&P 500 return volatility. Model 1 shows that relative to the average values during the surge episodes, post-surge increases in the US real

interest rate, decreases in commodity prices, and increases in global risk aversion—measured by S&P 500 volatility return—are all associated with crises occurring within 2 years after the end of the surge episodes. Model 2 to Model 4 each adds a domestic factor to the specifications. Higher domestic growth, less-restricted financial account, and lower stock of official reserves during the surge episode all raise the probability of hard landings. Overall, although not identical, the results of Table 4-6—as a reference point to the literature—are broadly similar to those of Ghosh et al. with reasonable signs, which lends credibility to the underlying dataset of this chapter. The minor differences might be driven by data revisions.

I now start modifying and extending the analyses of Ghosh et al. (2016) by changing the dependent variable from surges in *net* flows to surges in *gross* flows, adding to the independent variables institutional quality and its interaction term with capital controls, including both emerging and advanced countries in the sample, and recoding financial openness into levels of capital controls. Table 4-7 shows that the estimated coefficients of the modified and extended specification, while Table 4-8 reports the marginal effects of the dependent variable at the means of all variables.

I first consider the impact of changes in global conditions—controlling for real GDP per capita—on the likelihood of hard landings. The estimated coefficients of the first four variables in Table 4-7 and Table 4-8 show the results. Table 4-7 shows that S&P 500 return volatility is significantly positive across all models. S&P 500 return volatility is a proxy for changes in the degree of global risk aversion. Higher values of S&P 500 return volatility are associated with higher degrees of risk aversion. The positive estimated coefficients of the S&P 500 return volatility in all models indicate that surge episodes are more likely to end in financial crises when global investors become more risk-averse, which is consistent with the benchmark results in Table 4-6. Turning to the marginal effects—the magnitude of one unit change on the probability of surges ending in financial crises all else equal, Table 4-8 suggests that when post-episode S&P 500 return volatility increases by one unit relative to its value during the surge episode, the probability of hard landings increases by 1.68 to 2.53 percent. Meanwhile, the US real interest rate and commodity prices are both insignificant.

Turning to domestic factors, Model 2 in Table 4-7 looks at the effect of domestic credit expansion. Model 2 indicates that the probability of hard landings is significantly higher for surge episodes that experience greater credit expansion. Such a finding is consistent with the literature. For example, Mercado (2018) argues that as domestic bank lending increases, the likelihood of crises rises as lower borrowing costs exacerbate the moral hazard problem, risky investment, and currency matches. There is also considerable evidence that links credit booms to a heightened probability of future financial crises. A sample of recent empirical studies includes Borio and Lowe (2002), Hernández and Landerretche (2002), Hume and Sentance (2009), Schularick and Taylor (2012), and Gourinchas and Obstfeld (2012). The

positive association between domestic credit growth and the surge episodes that end in financial crises provides support on implementing more proactive policies in dealing with domestic credit expansion.

Model 3 in Table 4-7 turns to the effect of reserve accumulation. Model 3 shows that a higher stock of foreign reserves reduces the probability of hard landings. Indeed, many countries—emerging countries in particular—have accumulated sizeable international reserves as a self-insurance strategy to avoid the liquidation of long-term projects during sudden stops (Aizenman & Lee, 2007). The marginal effects in Table 4-8 suggest that a one-percent increase in domestic credit relative to GDP leads to a 0.8 percent increase in the probability of hard landings and a one percent increase in official reserves relative to GDP leads to a 0.4 percent decrease in the probability of hard landings

So far, the results of Table 4-7 and Table 4-8—the extended models—are all consistent with those of Table 4-6—the benchmark model that follows Ghosh et al. (2016). While I have shifted the focus from surges in net flows to surges in gross flows and extended the analyses to both advanced and emerging countries, the same base results have not changed. That is, surges can either end gracefully or in some form of crisis. While global factors determine how surges end, domestic policy responses also matter. For global factors, both this chapter and Ghosh et al. find that surges are more likely to end with financial crises when global investors become more risk-averse. For domestic factors, both this chapter and Ghosh et al. show that excessive credit growth and maintaining foreign exchange lowers the likelihood that the surge will end in a crisis. To the extent that the base results of both studies are broadly similar, the regression results of this chapter so far enhance the generalizability of the Ghosh et al.

I next examine the roles of institutional quality—an additional variable available to Ghosh et al.—and its interaction term with capital controls. Model 4 in Table 4-7 shows the results. Two observations can be made. First, the estimated coefficient of institutional quality is significantly negative, which suggests that countries with better institutional quality have a better ability to absorb foreign capital flows. As such, large capital inflows have a less destabilizing impact on their economies and do not increase the probability of surges ending in financial crises. The finding is similar to other studies that examine the effects of institutional quality on macroeconomic stability. For example, both Caballero and Krishnamurthy (2001) and Aghion and Banerjee (2005) suggest that sudden changes in the direction of capital flows tend to induce or exacerbate boom-bust cycles in countries that lack deep and well-functioning financial sectors (Kose et al., 2009). Second, the estimated coefficient of capital controls is significantly positive, while the estimated coefficients of the interaction term between capital controls and institutional quality are significantly negative. Taken together, the results show that the effect of tightening capital controls during surge episodes depends upon the levels of a country's institutional quality. Figure 4-3 illustrates such a relationship with the marginal effect of tightening capital controls at different levels of institutional quality. Figure 4-3 shows

that for countries with lower institutional quality, tightening capital controls increases the probability of hard landings. Capital controls only start to contribute to a lower probability of hard landing when institutional quality is above a threshold of 80. Using the data from 2015 as examples, the level of institutional quality for France is at the threshold of 80, while the level of institutional quality for Bangladesh, Indonesia, and Malaysia are below the threshold at 20, 40, and 60, respectively.

The varying effect of capital controls contingent on the level of institutional quality warrants further discussion. A possible explanation is that the effect of capital controls contains two opposite effects: a stabilizing effect and a signaling effect. The stabilizing effect limits excessive external borrowings and thereby enhances systematic financial stability. The signaling effect, on the other hand, causes the investors to reassess the soundness of the underlying macroeconomic fundamentals and thereby catalyzes economic adjustments such as financial crises. Although the model specifications that I use are unable to separate one effect from the other, we could see that the stabilizing effect appears to be stronger in countries with higher institutional quality and weaker in countries with lower institutional quality. This may explain why the effects of capital controls vary among countries with different institutional quality. Also, note that the marginal effect of capital controls is not statistically significant above the threshold but is statistically significant at the lower end of the institutional quality spectrum. This may suggest that there is stronger evidence for the signaling effect than for the stabilizing effect.

4.6 Concluding Remarks

In Chapter 4, I compare surge episodes that are constructed in four different ways: net flows with the rolling approach (Surge 1), gross flows with the rolling approach (Surge 2), net flows with the percentile approach (Surge 3), and gross flows with the percentile approach (Surge 4). The correlation coefficients among the constructed episodes range from 0.15 to 0.43, suggesting the surge episodes captured by different identification strategies vary considerably. I focus on using gross flows with the rolling approach (i.e., Surge 2) to examine why surge episodes may end with financial crises, because the concept of gross flow reversals is more consistent with the theoretical definition of sudden stops, and because the rolling approach has the advantage of constructing surge episodes in a way that is comparable to previous studies that also use the same rolling approach with a different set of countries.

Grouping consecutive country-year observations, this approach yields 168 completed surge episodes and 220 non-surge episodes in a panel of 53 countries over 1995 to 2017. The 168 completed surge episodes—clustering around the East Asian financial crisis (1997) and the global financial crisis (2007–2008)—correspond to 344 country-year observations and account for 25 episodes of financial crises, which implies that the probability of experiencing financial crises conditional on surge episodes is $25/344=7.2$

percent. In contrast, the 220 non-surge episodes correspond to 1,035 country-year observations and account for 47 episodes of financial crises, implying that the probability of experiencing financial crises conditional on non-surge episodes is $47/1035=4.5$ percent and that the probability of experiencing financial crises is higher during gross capital flow surges relative to normal times.

Nonetheless, not all surges lead to financial crises. I build upon the specifications of Ghosh et al. (2016) and examine the factors that contribute to the different endings of surge episodes. The regression results show that both global and domestic factors are relevant in explaining the endings of surge episodes. Surge episodes are more likely to end with financial crises when the global investors become more risk-averse, when the stacks of official reserves are low, when domestic credit expands, and when the countries have low institutional quality. Capital controls are also relevant. The effect of capital controls, however, depends upon institutional quality. Capital controls only start to contribute to a lower probability of a hard landing when the institutional quality is above a threshold of 80. It is possible that is that the effect of capital controls contains two opposite effects: a stabilizing effect and a signaling effect. The stabilizing effect limits excessive external borrowings and thereby enhances systematic financial stability. The signaling effect, on the other hand, causes the investors to reassess the soundness of the underlying macroeconomic fundamentals and thereby catalyzes economic adjustments such as financial crises. The stabilizing effect appears to be stronger in countries with higher institutional quality and weaker in countries with lower institutional quality.

The results from this chapter have some policy implications in terms of implementing capital controls. First, surge episodes alone are not sufficient conditions to call for policy actions. When the contributing factors of hard landings are not present, it is likely that surge episodes may end with normal times. Countries with high institutional quality, high official reserves, and no excessive credit expansions are thus less in need of imposing capital controls to avoid hard landings. This also implies that countries—to avoid hard landings—could improve these aspects of their economies without implementing capital controls. Second, as the efficacy of capital controls depends upon the institutional quality, policymakers may wish to examine if their institutional quality is at the level where capital controls would work to lower the likelihood of hard landings. Otherwise, they may consider improving other domestic contributing factors such as excessive credit growth or insufficient foreign exchange reserves.

The results from this chapter complement those from previous studies. Crystallin et al. (2015) compare seven different measures of surge episodes. Their comparisons involve the same two considerations that this chapter addresses (i.e., whether net or gross flows are used, and how the thresholds are set), as well as other considerations such as whether the GDP or the populations should be used to normalize the capital flows. Their findings show that surge episodes identified by the seven methods vary greatly, which

underscores the importance of analyzing the methods used to capture surges. They suggest it may be worth considering using a composite measure to identify surge episodes.

Future research is possible. In this chapter, I have dichotomized the endings of surge episodes into financial crises and normal times. It is possible, however, that countries channel the capital inflows to productive uses with better economic outcomes. In fact, a large strand of literature focuses on the relationship between capital flows and the potential economic benefit such as faster economic growth. Instead of a binary result, future results may model the endings of surge episodes with multiple outcomes.

4.7 Tables in Chapter 4

Table 4-1: Summary Statistics

	Count	Mean	SD	Max	Min
Financial Crisis	168	0.15	0.36	1	0
Interest Rate Differential	168	-0.49	1.76	2.96	-3.94
Commodity Price	168	5.52	24.08	58.8	-64.07
S&P 500 Index	168	1.07	5.63	13.02	-13.12
GDP per capita	168	9.01	1.38	11.29	5.71
Private Credit	165	3.25	9.08	79.12	-33.55
Chinn-Ito Index	168	0.08	0.36	2.28	-1.07
Reserve/GDP	168	8.72	12.16	83.19	0.15

Table 4-2: Variables Definitions and Data Sources

Variables	Descriptions	Sources
Surges	1 if the country-year observation falls within a surge episode; 0 otherwise. For each country, a surge episode starts when the year-to-year change in the four-quarter sum of gross capital inflows is above one rolling standard deviation from the rolling mean. The surge episode ends when that above condition no longer holds. In addition, at least one observation within the episode must be greater than two standard deviations from the rolling mean. The rolling window is a 5-year period prior to the country-year observation.	Author's calculation; International Financial Statistics database.
Financial Crises	Binary variable equal to 1 for banking or currency crisis, 0 otherwise	Laeven and Valencia (2013)
U.S. Interest Rate	3-month Treasury Bill rate; in percent.	International Financial Statistics database.
Commodity Prices	Average of commodity price indices for fuel and nonfuel.	World Economic Outlook Database
S&P 500 index return Volatility	Annual average of twelve-month rolling standard deviation of S&P 500 index annual returns	Authors' calculations; Yahoo Finance.
Real GDP per Capita	Gross domestic product divided by the population; in USD.	World Economic Outlook Database
Domestic Credits	Private credit by deposit money banks relative to GDP.	Global Financial Development Database
Official Reserves	Stock (in billions of USD)	International Financial Statistics database.
Institutional Quality	Average of the percentile rank of six Indicators: voice and accountability, political stability, government institutional quality effectiveness, regulatory quality, rule of law, control of corruption (range: 0100, where a higher score means better institution).	Kaufmann et al. (2011)
Capital Controls	Index of capital control, ranging from 0 to 1. 1 for most regulated.	Chinn and Ito (2008)

Table 4-3: All Episodes of Surges in Gross Inflows

Country	Begin	End	Crisis	Magnitude of Reversal	Country	Begin	End	Crisis	Magnitude of Reversal	Country	Begin	End	Crisis	Magnitude of Reversal
Argentina	1990	1992	0	-3.13	Guatemala	1987	1988	0	2.84	Poland	2007	2008	0	6.70
Argentina	2015	2015	0	-0.65	Guatemala	1991	1991	0	-0.39	Portugal	1988	1990	0	0.01
Australia	1999	1999	0	-0.26	Guatemala	2003	2004	0	0.32	Portugal	1993	1995	0	2.48
Australia	2002	2004	0	4.79	Hungary	2003	2003	0	-4.14	Portugal	2000	2000	0	-0.52
Australia	2006	2007	0	4.46	Hungary	2005	2008	1	64.42	Portugal	2003	2004	0	5.29
Bangladesh	1989	1989	0	0.27	Iceland	1987	1987	1	1.24	Portugal	2010	2010	0	32.99
Bangladesh	1998	1998	0	0.46	Iceland	1995	1996	0	-3.24	Romania	2000	2001	0	1.08
Bangladesh	2003	2004	0	-0.28	Iceland	1999	1999	0	3.01	Romania	2004	2007	0	9.42
Bangladesh	2006	2008	0	0.59	Iceland	2003	2006	1	35.38	Russian Federation	2003	2004	0	-3.60
Bangladesh	2010	2010	0	1.58	India	1984	1985	0	-0.21	Russian Federation	2007	2008	1	8.93
Bolivia	1996	1998	0	4.49	India	1987	1987	0	-0.29	Singapore	2007	2008	0	114.17
Bolivia	2002	2002	0	4.83	India	1993	1994	0	0.82	Slovak Republic	2004	2005	0	11.23
Bolivia	2007	2008	0	0.41	India	1996	1997	0	0.99	Slovak Republic	2013	2014	0	10.27
Bolivia	2013	2013	0	8.95	India	2003	2008	0	3.91	Slovenia	2002	2003	0	-0.04
Brazil	1990	1992	1	0.34	Indonesia	1990	1991	0	0.58	Slovenia	2007	2007	1	26.28
Brazil	1994	1996	0	0.62	Indonesia	1995	1996	1	8.74	South Africa	1985	1985	0	2.99
Brazil	2006	2007	0	4.50	Indonesia	2005	2006	0	-0.68	South Africa	1987	1987	0	-0.09
Canada	1994	1994	0	2.29	Indonesia	2010	2010	0	-0.33	South Africa	1994	1995	0	-0.60
Canada	1996	1997	0	4.59	Ireland	2014	2015	0	22.82	South Africa	1997	1998	0	4.51
Canada	2000	2001	0	4.46	Israel	1989	1990	0	-2.31	South Africa	2003	2006	0	3.35
Canada	2006	2007	0	2.64	Israel	1995	1996	0	-0.68	Spain	1987	1988	0	-0.34
Chile	2005	2008	0	5.60	Israel	1999	2000	0	9.57	Spain	1990	1991	0	-0.19
China, P.R.: Hong Kong	2007	2008	0	79.44	Israel	2006	2006	0	2.63	Spain	1993	1993	0	9.30
Colombia	2005	2006	0	-1.05	Israel	2013	2013	0	2.33	Spain	2000	2001	0	5.61
Colombia	2010	2011	0	0.44	Italy	1990	1991	0	4.06	Spain	2014	2015	0	3.50
Colombia	2013	2014	0	3.10	Italy	1996	1997	0	-1.06	Sri Lanka	1989	1990	0	0.11
Croatia	2002	2004	0	3.42	Italy	2003	2003	0	2.67	Sri Lanka	2011	2012	0	-1.38
Croatia	2006	2007	0	2.88	Italy	2005	2006	1	9.18	Sweden	1985	1987	0	-1.44
Croatia	2013	2014	0	11.76	Italy	2011	2011	0	7.24	Sweden	1989	1990	1	13.05
Czech Republic	2002	2005	0	3.72	Japan	2010	2011	0	0.19	Sweden	1998	1998	0	-7.93
Denmark	1985	1987	0	1.23	Korea, Republic of	1988	1989	0	-2.40	Sweden	2004	2007	1	16.43
Denmark	1991	1991	0	5.96	Korea, Republic of	1994	1995	1	-0.48	Sweden	2013	2014	0	12.91
Denmark	1995	1996	0	-3.67	Korea, Republic of	2006	2007	0	7.39	Switzerland	2005	2007	1	67.83
Denmark	2005	2005	0	3.22	Korea, Republic of	2009	2010	0	2.35	Thailand	1987	1990	0	-0.86
Estonia	2003	2007	0	35.43	Latvia	2003	2007	1	44.54	Thailand	1995	1996	1	21.54
Finland	1984	1985	0	5.42	Lithuania	2003	2008	0	17.79	Thailand	2004	2006	0	5.87
Finland	1987	1987	0	-1.34	Malaysia	2007	2010	0	-0.96	Thailand	2009	2010	0	2.96
Finland	1990	1990	1	7.96	Mexico	1989	1991	0	0.44	Turkey	1992	1993	0	3.61
Finland	1998	1999	0	-2.20	Mexico	2005	2005	0	0.26	Turkey	2000	2000	1	7.77
Finland	2004	2004	0	2.37	Mexico	2007	2008	0	2.18	United Kingdom	1985	1987	0	1.03
Finland	2008	2008	0	7.48	Netherlands	1985	1987	0	-1.42	United Kingdom	1992	1993	0	7.88
Finland	2011	2011	0	58.48	Netherlands	1989	1989	0	6.40	United Kingdom	2000	2000	0	29.19
France	1986	1987	0	-0.42	Netherlands	1992	1992	0	2.86	United Kingdom	2007	2007	1	93.30
France	1989	1989	0	2.33	Netherlands	1997	1998	0	-1.97	United States	1982	1982	0	1.00
France	1997	1999	0	0.45	Netherlands	2004	2007	1	103.95	United States	1986	1987	1	0.08
France	2001	2001	0	8.98	Nicaragua	2005	2006	0	19.76	United States	1993	1994	0	-0.90
France	2005	2006	1	7.55	Nicaragua	2008	2009	0	2.43	United States	1997	1997	0	1.48
Germany	1986	1986	0	2.64	Norway	1982	1982	0	1.85	United States	1999	2000	0	2.19
Germany	1989	1990	0	-0.71	Norway	1984	1985	0	-3.36	United States	2004	2004	0	-0.08
Germany	1992	1993	0	3.62	Norway	1994	1997	0	-0.60	United States	2006	2007	1	16.18
Germany	2000	2000	0	13.88	Norway	2000	2003	0	-3.66	Venezuela	2005	2005	0	3.49
Germany	2005	2005	0	-0.10	Norway	2005	2007	0	36.58	Venezuela	2007	2008	1	0.51
Germany	2007	2008	1	20.54	Norway	2010	2011	0	5.52					
Greece	1989	1991	0	1.71	Peru	1994	1995	0	-0.02					
Greece	1995	2000	0	3.83	Peru	2006	2008	0	6.57					
Greece	2002	2003	0	-2.97	Philippines	1994	1994	0	-0.53					
Greece	2005	2005	0	2.74	Philippines	1996	1997	1	11.21					
Greece	2007	2007	1	-3.86	Philippines	2007	2007	0	7.85					

Notes:

1. Magnitude of reversals is expressed in percentages of countries' GDP. It is measured by the difference between the maximum of gross capital flows during the surge episode and the minimum of the gross capital inflows within the two years after the episode ends. 2. Occurrences of financial crises are taken from Laeven and Valencie (2013) who define financial crises as when countries see the following two conditions: (1) significant losses and (2) significant policy interventions. The significant losses are measured by a share of nonperforming loans above 20 percent of total loans, bank closures of above 20 percent of banking system assets, and fiscal restructuring costs of the banking sector above 5 percent of GDP. The significant policy interventions are measured by deposit freezes and bank holidays, bank nationalizations, bank guarantees, liquidity support, bank reconstruction, and asset purchases.

Table 4-4: Correlations Among Different Surge Identification Strategies

	Rolling		Percentile	
	Surge 1	Surge 2	Surge 3	Surge 4
	Gross Inflows	Net Flows	Gross Inflows	Net Flows
Rolling				
Surge 1: Gross Inflows	1.00	--	--	--
Surge 2: Net Flows	0.43	1.00	--	--
Percentile				
Surge 3: Gross Inflows	0.25	0.15	1.00	--
Surge 4: Net Flows	0.16	0.23	0.30	1.00

Notes: (1) The numbers are expressed in the Pearson correlation coefficients among country-year observations under different methods. (2) Net flows are the balances of countries' financial accounts; gross flows are the changes in countries' external liabilities. (3) The percentile approach defines surges as periods when a capital flow observation exceeds the 70th percentile of both the country's and the full sample's distribution of capital flows, expressed in percent of GDP. (4) The rolling approach defines surges in the same way as Chapter 3. For clarity, the definition is reproduced here: for a given country at period t , let ΔC_t^+ be the annual year-to-year change in the four-quarter rolling sum of the quarterly gross capital inflows; $\mu_{\Delta C_t^+}$ is the rolling average of ΔC_t^+ over the preceding five years; $\sigma_{\Delta C_t^+}$ is the rolling standard deviation of ΔC_t^+ over the preceding five years. A surge episode starts at time t when $\Delta C_t^+ \geq \mu_{\Delta C_t^+} + 1 * \sigma_{\Delta C_t^+}$. The surge episode ends when the condition no longer holds. In addition, for the entire period to be qualified as a surge episode, at least one observation must be greater than two rolling standard deviations above the rolling mean.

Table 4-5: Relationships between Gross Inflow Surge Episodes and Occurrences of Financial Crises

	No. of Episodes	No. Occurrences of Financial Crises	No. of Obs.	Prob. Of Financial Crises
Surge Episodes	168	25	344	7.27%
Non-Surge Episodes	220	47	1,035	4.54%

Table 4-6: Probit Regression of Surges in *Net Flows*, Ghosh et al (2016)

	(1)	(2)	(3)	(4)
US real Interest Rate	0.149 (0.097)	0.127 (0.098)	0.126 (0.101)	0.170* (0.098)
Commodity Prices	- 0.015*** (0.005)	-0.017*** (0.005)	-0.013** (0.006)	-0.014*** (0.005)
S&P 500 Return Volatility	0.061** (0.029)	0.042 (0.030)	0.059* (0.031)	0.084*** (0.032)
Real GDP per Capita	0.004 (0.158)	-0.064 (0.168)	0.062 (0.193)	0.321* (0.184)
Domestic Credit/GDP		0.048*** (0.015)		
Financial Openness			0.366* (0.218)	
FX reserves/ GDP				-0.060*** (0.022)
Constant	-1.111 (1.338)	-0.660 (1.414)	-1.702 (1.628)	-3.250** (1.454)
Observations	141	140	133	141
Countries	48	48	47	48
R2 (Pseudo)	0.0702	0.104	0.0887	0.132
Percent correctly predicted	82.27	83.57	84.96	80.85
Sensitivity	0	8	4.762	0
Specificity	100	100	100	98.28

Notes: (1) Standard errors in parentheses. (2) Results significant at 1, 5, and 10% levels are indicated by ***, **, and *. (3) Dependent variables are binary indicators that take a value of 1 if a financial crisis occurred within two years of a *net* surge episode end; 0 otherwise. (4) Increases in the US interest rate, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (5) Increases in commodity prices, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (6) Increases in the S&P 500 return volatility, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (7) Levels of the GDP per capita, measured by the value of the year before the surge episode started. (8) Increases in domestic credit relative to GDP, measured by differences between the average over the surge episode and the year before the surge started. (9) Levels of official reserves, measured by the values in the last year of the surge episodes. (10) Increases in the levels of capital controls, measured by differences between the average over the surge episode and the year before the surge started. (11) Levels of institutional quality, measured by the values in the last year of the surge episodes

Table 4-7: Probit Regression of Surges in *Gross Flows*

	(1)	(2)	(3)	(4)
US real Interest Rate	0.018 (0.082)	0.049 (0.091)	-0.020 (0.074)	0.390 (0.309)
Commodity Prices	0.003 (0.005)	-0.003 (0.005)	0.005 (0.006)	0.009 (0.011)
S&P 500 return volatility	0.085*** (0.030)	0.079** (0.033)	0.094*** (0.031)	0.234*** (0.083)
Real GDP per Capital	0.163 (0.105)	0.172 (0.110)	0.195 (0.119)	0.456* (0.249)
Domestic Credit/GDP		0.042** (0.021)		
FX reserves/ GDP			-0.023** (0.010)	
Capital Controls				25.117** (12.383)
Institutional Quality				-0.028** (0.012)
Capital Controls*Institutional Quality				-0.327* (0.174)
Constant	- 2.950*** (1.037)	- 3.096*** (1.153)	- 3.177*** (1.176)	-5.192*** (1.994)
Observations	168	165	168	114
Countries	53	53	53	52
R2 (Pseudo)	0.124	0.177	0.148	0.340
Percent correctly predicted	85.12	86.06	85.12	90.35
Sensitivity	0	12	4	52.63
Specificity	100	99.29	99.30	97.89

Notes: (1) Standard errors in parentheses. (2) Results significant at 1, 5, and 10% levels are indicated by ***, **, and *. (3) Dependent variables are binary indicators that take a value of 1 if a financial crisis occurred within two years of a *gross* surge episode end; 0 otherwise. (4) Increases in the US interest rate, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (5) Increases in commodity prices, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (6) Increases in the S&P 500 return volatility, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (7) Levels of the GDP per capita, measured by the value of the year before the surge episode started. (8) Increases in domestic credit relative to GDP, measured by differences between the average over the surge episode and the year before the surge started. (9) Levels of official reserves, measured by the values in the last year of the surge episodes. (10) Increases in the levels of capital controls, measured by differences between the average over the surge episode and the year before the surge started. (11) Levels of institutional quality, measured by the values in the last year of the surge episodes.

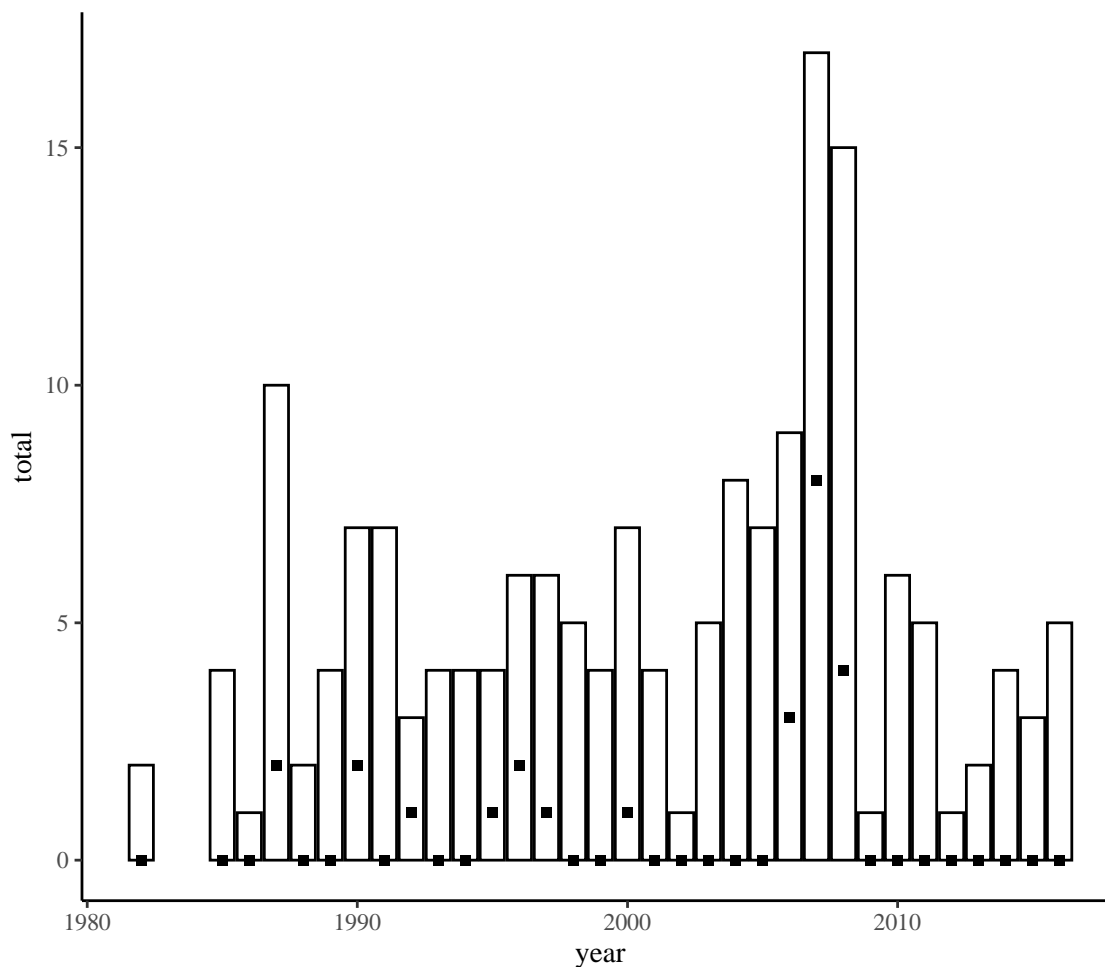
Table 4-8: Marginal Effects on the Likelihood of Surge Episodes Leading to Financial Crises

	(1)	(2)	(3)	(4)
US real Interest Rate	0.357 (0.22)	0.947 (0.57)	-0.368 (-0.26)	4.234 (1.43)
Commodity Prices	0.0680 (0.63)	-0.0612 (-0.60)	0.0887 (0.79)	0.0941 (0.79)
S&P 500 return's volatility	1.684*** (3.23)	1.525*** (2.97)	1.772*** (3.60)	2.539*** (2.78)
Real GDP per Capital	3.232 (1.63)	3.302* (1.67)	3.684* (1.76)	4.959* (1.88)
Domestic Credit/GDP		0.800** (2.25)		
FX reserves/ GDP			-0.439** (-2.26)	
Capital Controls				28.25 (1.24)
Institutional Quality				-0.267* (-1.95)
N. Obs.	168	165	168	114

Notes: (1) Standard errors in parentheses. (2) Results significant at 1, 5, and 10% levels are indicated by ***, **, and *. (3) Dependent variables are binary indicators that take a value of 1 if a financial crisis occurred within two years of a *gross* surge episode end; 0 otherwise. (4) Increases in the US interest rate, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (5) Increases in commodity prices, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (6) Increases in the S&P 500 return volatility, measured by the differences between the two-year average *after* the end of the surge episode and the average over the surge episode. (7) Levels of the GDP per capita, measured by the value of the year before the surge episode started. (8) Increases in domestic credit relative to GDP, measured by differences between the average over the surge episode and the year before the surge started. (9) Levels of official reserves, measured by the values in the last year of the surge episodes. (10) Increases in the levels of capital controls, measured by differences between the average over the surge episode and the year before the surge started. (11) Levels of institutional quality, measured by the values in the last year of the surge episodes.

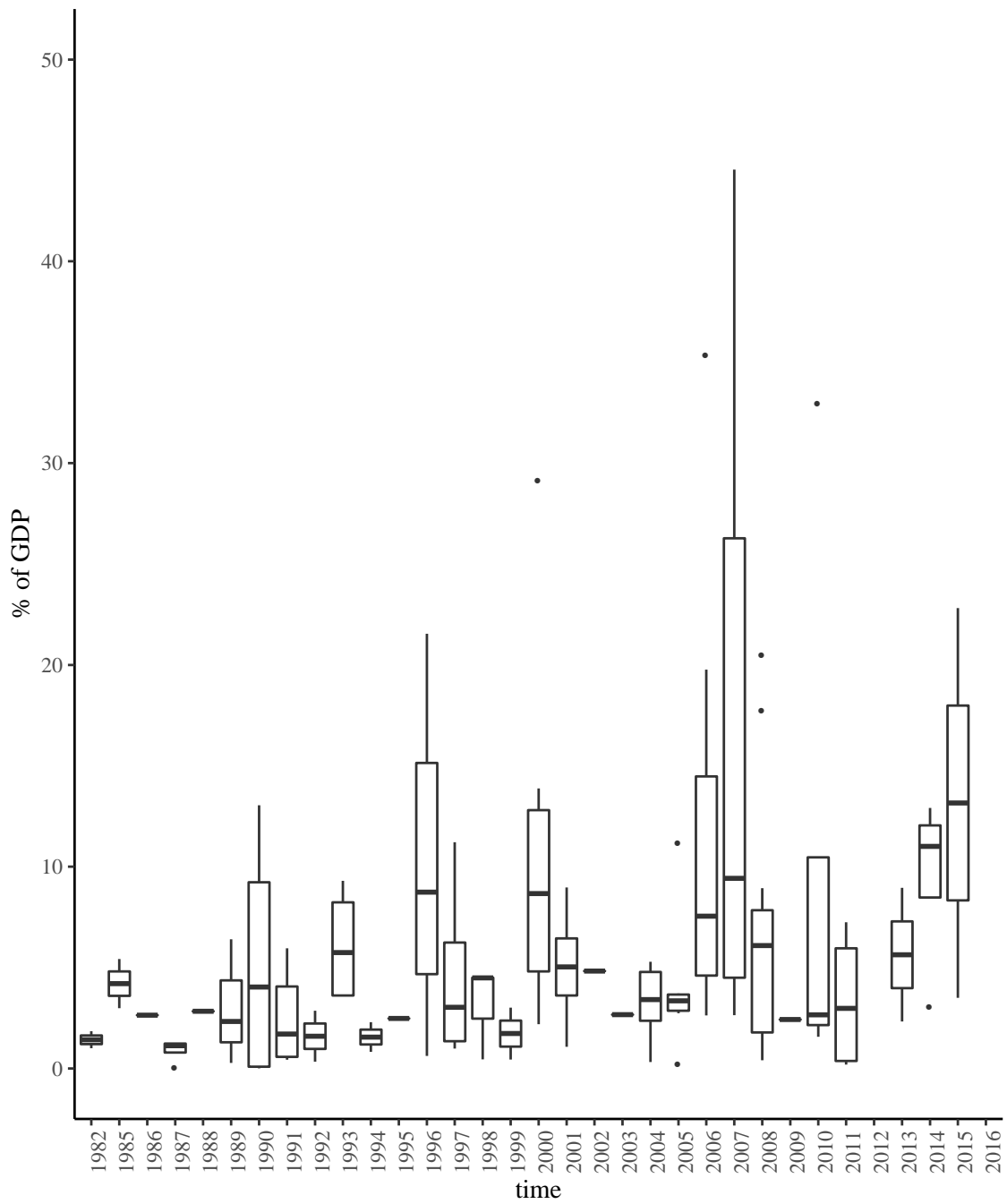
4.8 Figures in Chapter 4

Figure 4-1: Number of Grow Inflow Surges Episodes that Ended in Financial Crises



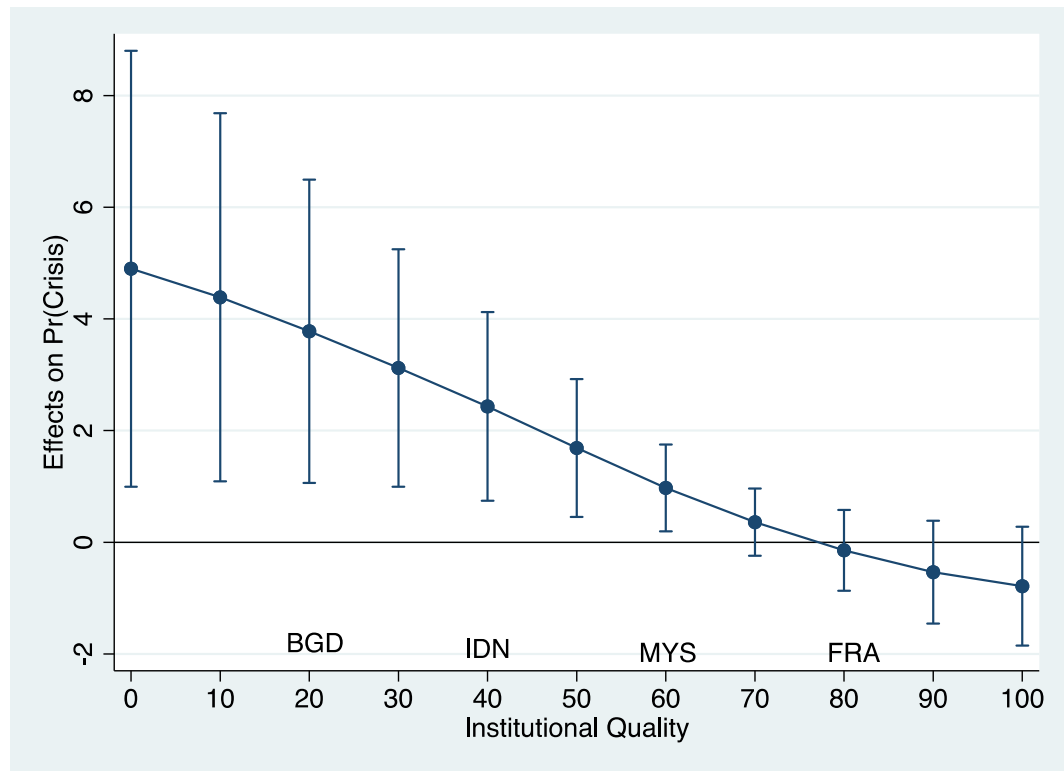
Notes: (1) The transparent bars represent the total number of surge episodes that ended in that year; the solid square dots represent the number of surge episodes that ended in crises. (2) The total number of episodes: 168. (3) The number of episodes ending with financial crises: 25. (4) Source: author's calculation.

Figure 4-2: Magnitude of Grow Inflow Surge Reversals



Note: (1) Each boxplot presents the 25th percentile, the median, and the 75th percentile of the distribution. (2) Source: author's calculation.

Figure 4-3: Marginal Effect of Capital Controls



Notes: (1) BGD=Bangladesh; IND=Indonesia; MYS=Malaysia; FRA=France. (2) The marginal effects are computed at the means of each variable. (3) Source: author's calculation.

Chapter 5 The Spillover Effects of Capital Controls

5.1 Introduction

Chapter 5 evaluates the spillover effects of foreign-implemented capital controls. From a domestic country's perspective, I propose three hypotheses. First, foreign-implemented inflow controls may reduce domestic outflows going into these foreign countries, due to the bilateral linkages between these foreign countries and the domestic country (hereafter, the domestic-outflow-reduction hypothesis, or Hypothesis 1). Second, foreign-implemented outflow controls may reduce the domestic inflows from these foreign countries, again due to the bilateral linkages between these foreign countries and the domestic country (hereafter, the domestic-inflow-reduction hypothesis, or Hypothesis 2). Third, foreign-implemented inflow controls may deflect capital flows—originally going to these foreign countries—to the domestic country (hereafter, the deflection hypothesis, or Hypothesis 3). I refer to the first two hypotheses as the *direct* effect and the third hypothesis as the *indirect* effect of the spillover effects of foreign-implemented capital controls.

Capital flows can be a two-edged sword, bringing potential positive as well as negative impacts on economies. To manage capital flows, capital controls have been used as part of the macroeconomic policy toolkit. Previous studies have mostly focused on evaluating the effectiveness of domestic capital controls on domestic flows, the *domestic* effects of domestically-implemented capital controls. Little attention, however, is paid to the possibility that domestic capital flows can also be affected by capital controls implemented in other countries: the potential *spillover effects* of foreign-implemented capital controls.

The spillover effects of foreign-implemented capital controls can be direct as well as indirect. The direct spillover effects stem directly from the bilateral linkages among countries. In an open economy, both internal and external factors affect domestic capital flows—a framework known as the push and pull framework. The literature has offered strong evidence to support several external factors as relevant push factors, such as global risk aversion, growth of mature economies, and interest rates of mature economies (Koepke, 2019). Aside from these external factors that have been examined by previous studies, another possible external factor yet to be explored is foreign-implemented capital controls. Possible mechanisms for the direct spillover effects to occur are two. First, from the perspective of the domestic country, when foreign-implemented inflow controls work to reduce capital inflows going to these foreign countries, domestic outflows should decrease accordingly. Second, when foreign-implemented outflow controls work to reduce capital outflows coming from these foreign countries, domestic inflows should decrease accordingly. If the direct spillover effects exist, it means that capital controls implemented in foreign

countries serve as a relevant external factor that policymakers may need to respond to. It also means that it is possible to regulate capital flows at both ends—either at the receiving country or at source countries.

The indirect spillover effects stem from the concern that capital controls can be used as a *beggar-thy-neighbor* policy. This comes from the assumption that foreign-implemented capital controls can possibly deflect capital flows into the domestic country that shares similar characteristics with these foreign countries, complicating the management of capital inflows for the domestic country. Moreover, if the implication of capital controls is indeed a beggar-thy-neighbor policy, a risk of a *ratchet effect* is possible, whereby countries respond to foreign-implemented capital controls by imposing progressively higher barriers to the movement of capital flows. The ratchet effect may lead to a global shrinkage of capital flows.

So far, the existing literature has offered scant studies on this issue, both theoretically and empirically. Korineck (2012) provides a theoretical analysis of the rationales and the multilateral implications of imposing capital controls. Forbes et al. (2016), Lambert et al. (2011), and IMF (2011b) take an event-study approach and analyze the potential spillover effects of the Brazilian tax on financial operations (hereafter the IOF tax) implemented around 2009 on portfolio capital inflows.⁸ Both Forbes et al. (2016) and IMF (2011b) find that the Brazilian IOF tax has led to increases in capital inflows to some countries, but decreases in inflows to others. On the other hand, Lambert et al. (2011) only find that the Brazilian IOF tax has a positive association with capital inflows into the neighboring countries.

The existing literature on the spillover effects of capital controls, however, is still insufficient in the following aspects. First, the previous studies all rely on fund-flow data (e.g. mutual-fund flows and pension-fund flows), which only constitutes a subset of global capital flows. Evidence from capital flow data aggregated at a country level is still missing. Policymakers usually base decisions on information at a country level and would benefit from more evidence in this regard.

Second, previous studies are all individual case studies that focus on the Brazilian experience in imposing the IOF tax. In practice, capital controls take various forms and have been instituted in other countries in addition to Brazil. Hence, a more general pattern of the spillover effects from a broader perspective may exist, which calls for a cross-country analysis that exploits variations among countries.

Third, an important question regarding the transmission mechanism of the spillover effects has also been largely overlooked. One can think of a number of linkages through which the impacts of foreign-implemented capital controls might be transmitted across countries. Possible linkages include trade linkages, financial linkages, and geographic linkages. Investigating which channels the spillover effects might take

⁸ See Box A in Chapter 2 for a case study on the implementation of Brazilian tax from 2009 to 2014.

place would help countries understand which foreign countries' capital controls the domestic country's capital flows may be sensitive to.

Fourth, while capital controls can take many forms (inflow controls versus outflow controls; debts, equity, versus foreign direct investment, FDI), previous studies have mostly focused on the case of the Brazilian IOF tax on portfolio bond inflows. However, different types of foreign-implemented capital controls may impact domestic capital flows differently. As previously stated, foreign-implemented inflow controls may reduce the capital inflows going into these foreign countries, while foreign-implemented outflow controls may reduce the domestic capital inflows received from these foreign countries. In addition, foreign-implemented inflow controls may deflect capital inflows that are originally going into these foreign countries. Hence, it stands to reason that inflow controls and outflow controls may have different implications. Exploring the potential differences among different types of controls will provide a more thorough understanding of the spillover effects of capital controls.

The results of this chapter show evidence in support of both the domestic and spillover effects of capital controls. In terms of the domestic effects, I show that domestic inflow capital controls reduce domestic inflows, while domestic outflow controls reduce domestic outflows. In terms of the spillover effects, the findings of this chapter support the existence of spillover effects. For the three hypotheses, I find that a tightening of foreign-implemented inflow controls—measured by increases in trade-weighted and geographic-proximity-weighted inflow control indices of other countries in the rest of the world—reduces domestic outflows, while tightening foreign-implemented outflow controls—measured by increases in trade-weighted and geographic-proximity-weighted outflow control indices of other countries in the rest of the world—reduces domestic inflows. Such results suggest that the effects of capital controls can propagate across countries through reductions in bilateral capital flows via trade- or geographic-linkages. In this case, the evidence for trade-linkages is stronger than that for geographic-linkages. In addition to the direct effects through bilateral reductions in capital flows, tightening foreign-implemented inflow controls—measured by finance-weighted capital control indices of other countries—indirectly divert capital inflows away from the domestic country. The result suggests that foreign-implemented capital controls have signaling effects on domestic capital flows via common lenders. When one country implements inflow capital controls, the policy actions prompt the common lenders to perceive that other countries with similar borrowing patterns become less supportive of foreign investment, making the investment less attractive. As such, foreign investors retreat their investment, leading to reductions in domestic inflows.

Chapter 5 contributes to the literature in the following ways. First, I offer evidence from capital flows data aggregated at a country level. Second, I provide a cross-country analysis that offers evidence to support

the existence and the directions of various spillover effects at a much larger scale. Third, I consider different ways in which countries are connected (including trade linkages, geographic linkages, and financial linkages) and model the spillover effects via these linkages accordingly. Fourth, I separate capital controls into inflow and outflow controls over asset types (i.e. debt, equity, and FDI), disentangling the spillover effects of potentially different directions.

The rest of Chapter 5 is organized as follows. Section 5.2 reviews relevant studies. Section 5.3 proposes three hypotheses of the potential spillover effects of capital controls. Section 5.4 explains the empirical methodology. Section 5.5 presents descriptive statistics. Section 6 discusses the results. Section 5.7 concludes.

5.2 Relevant Studies

Previous work on the potential spillover effects of capital controls includes Forbes et al. (2016), Lambert et al. (2011), and IMF (2011b), all of which use fund-flow data collected by Emerging Portfolio Fund Research (EPFR).

Forbes et al. (2016) address how the Brazilian IOF tax on bond inflows from 2006 to 2011 affects global funds' portfolio weights on different countries. They examine two main issues: (1) the impact of the Brazilian IOF tax on Brazilian capital inflows, and (2) the externalities (i.e., the spillover effects) on other countries. Their findings support both the effectiveness of capital controls on affecting domestic inflows and the existence of spillover effects. Their findings are twofold. First, capital controls affect investors through a direct effect as well as a signaling effect. The direct effect refers to higher transaction costs directly created by capital controls; the signaling effect refers to the fact that the government becomes less supportive of foreign investors. They find that an increase in the IOF tax on Brazilian *bond* inflows not only decreases foreign investor's portfolio weights on Brazilian *bonds* (i.e., the direct effect), but the same IOF tax on bond inflows also reduces foreign investor's portfolio weights on Brazilian *equity* flows (i.e., the signaling effect). Turning to the spillover effects, they find that the IOF tax on Brazilian bond inflows causes foreign investors to significantly reduce their portfolio weights on countries that are perceived to have a higher likelihood of implementing similar capital controls. At the same time, the same IOF tax causes foreign investors to increase their portfolio weights on countries that are either in the same region or are deemed as a good substitute for Brazil.⁹

⁹ In a survey conducted by the authors, many investors express that they view their allocations to Brazil as a way of benefiting from the strong growth in China. In this context, good substitutes for Brazil are then countries that are believed to be closely linked to the growth in China.

Closely related to Forbes et al (2016) is Lambert et al. (2011), who study the same two questions: (1) whether the Brazilian IOF tax on bond inflows are effective in reducing Brazilian inflows, and (2) whether the IOF tax has impacts on other countries. Lambert et al use a different dependent variable. Instead of portfolio weights as used by Forbes et al., Lambert et al. use capital inflows as shares of GDP. Compared to Forbes et al., their results bear some similarities and differences. Similar to Forbes et al. (2016), who find that the IOF tax on bond inflows reduces global investors' portfolio weights on Brazilian bonds, Lambert et al. also find that the IOF tax on bond inflows reduces Brazilian bond inflows. In contrast to Forbes et al. (2016), who find that the IOF tax on bond inflows reduces foreign investors' weights on both Brazilian bonds and Brazilian equities, Lambert et al. find that the IOF tax on bond inflows *increases* equity inflows into Brazil. As opposed to creating a signaling effect as Forbes et al. (2016) suggest, the findings of Lambert et al. propose that capital controls can be effective in altering the composition of inflows. Interestingly, the contrast also shows that the spillover effect is also relevant to flows of different asset types within the same country (that is, the spillover effects might take within a country). Finally, their findings reveal that following an increase in the IOF tax on bonds in Brazil, neighbouring countries experience significant surges in their own bond inflows and, to a lesser extent, in their own equity inflows.

IMF (2011b) addresses the spillover effects of capital controls on neighbouring countries. Unlike Forbes et al. (2016) and Lambert et al. (2011), who both look at the domestic as well as the external effects of the Brazilian IOF tax, the IMF only looks at the potential spillover effects. The IMF conducts two sets of regression analyses. The first set of regression analyses concerns the potential spillover effects of capital controls on equity returns in the neighboring countries, considering separate episodes of capital controls instituted in Brazil, Columbia, Korea, and Thailand at various points in time. The results show that episodes of capital controls increase equity returns in some neighboring countries, but decrease equity returns in others. The second set of regression analyses switches the variable of interest to equity fund net inflows and focuses only on the case of Brazil. The results also show that capital controls in Brazil increase equity fund inflows in some neighbouring countries and decrease in others.

Chapter 5 also relates to the broader literature on financial contagion, in which researchers investigate how macroeconomic shocks in one country propagate across different countries. Topics in this literature are many, including how changes in interest rate policies in a major economy may affect other countries, how currency crises may spread, and so on. For example, Di Giovanni and Shambaugh (2008) explore the connection between interest rates in major industrial countries and annual real output growth in other countries. The results show that high foreign interest rates have a contractionary effect on annual real GDP growth in the domestic economy. Consistent with what the theory of trilemma predicts, the results also show that such a contractionary effect is only centered on countries with fixed exchange rates. Glick and Rose (1999) investigate why currency crises tend to be regional and affect countries in geographic

proximity. They show that currency crises affect clusters of countries tied together by international trade. Forbes (2012) provide an extensive survey in the academic literature on defining, measuring, and identifying financial contagion and the various channels through which it can occur.

Despite the variations, the studies under the literature on financial contagion all share a common estimation framework. With the left-hand side the variable of interest (e.g. occurrences of domestic currency crises), the right-hand-side variables can be grouped into two sets of explanatory variables: internal variables and external variables. Internal variables are country-specific variables (e.g. domestic current account deficits) and external variables are external shocks (e.g. occurrences of currency crises in other countries, or change in US interest rates). Particularly relevant to this present study is how external shocks enter the model specifications, especially when the sources of contagion are multiple, and a weighting scheme based on some relationships between pairs of countries is needed. For example, Eichengreen and Rose (1999) test for contagion in foreign exchange markets using a framework that distinguishes two channels of international transmission of currency crises. The first channel are the trade linkages. Eichengreen and Rose hypothesize that crises spread from one country to other countries with which it trades. The second channel is macroeconomic similarities, and the hypothesis is that currency crises spread to other countries where macroeconomic policies and conditions are broadly similar. The trade-linkage weighting scheme is intended to quantify—using trade data—the intensity of bilateral trade between countries. On the other hand, the macroeconomic-similarity weighting scheme intends to capture macroeconomic similarities using differences in major macroeconomic variables. Two countries are viewed as being similar if they display similar macroeconomic conditions. For example, country A would be viewed as being similar to country B if they have similar rates of growth of domestic credit. Using data for 20 industrial countries spanning more than three decades, they find strong evidence in favor of the existence of contagious currency crises. Both the trade-weighted contagion proxy and the macro-weighted proxy are statistically significant in explaining the likelihood of the occurrence of domestic currency crises.

Van Rijckeghem and Weder (2001) also address the issue of currency crisis contagion. They contribute to this strand of literature by the novel use of financial linkages. The financial linkages measure the similarity between the two countries in terms of their borrowing patterns. The hypothesis is that currency crises may spread through a common lender effect. For example, suppose that country A and country B share a common lender country C. Suppose further that a currency crisis occurs in country A. Country C's exposure to country A thus implies substantial losses, and hence the need for country C to restore capital-asset ratios, meet margin calls, and adjust risk exposures. As such, these adjustments in country A—known as the *common lender effect*—generate spillover effects on country B. Van Rijckeghem and Weder use data from the Bank for International Settlements' (BIS) consolidated banking statistics to construct the financial

linkages. They show that the financial linkages—as opposed to the trade linkages and country characteristics—can help explain the currency crisis contagion.

5.3 Hypotheses on the Spillover Effects

From a domestic country's perspective, I propose that capital controls implemented in foreign countries can affect domestic capital flows as follows:

- **The domestic-outflow-reduction hypothesis, or Hypothesis 1:** *Inflow controls* implemented in foreign countries may reduce domestic outflows going into these foreign countries. This is because the capital inflows going into these foreign countries as a whole correspond to the same amount of capital outflows coming from the domestic country. When foreign-implemented inflow controls work to reduce their capital inflows, the domestic capital outflows would decrease accordingly. As such, inflow capital controls reduce domestic inflows through these *bilateral* linkages. Similar to the literature on financial contagion, possible bilateral linkages between pairs of countries include trade linkages and geographic linkages.
- **The domestic-inflow-reduction hypothesis, or Hypothesis 2:** *Outflow controls* implemented in foreign countries may reduce domestic inflow coming from these foreign countries. This is because the capital outflows coming from these foreign countries as a whole correspond to the same amount of capital inflows going into the domestic country. When foreign-implemented outflow controls work to reduce their capital outflows, the domestic capital inflows would decrease accordingly. As such, outflow capital controls reduce domestic inflows through these *bilateral* linkages, and possible linkages include trade linkages and geographic linkages.
- **The deflection hypothesis, or Hypothesis 3:** *Inflow controls* implemented in foreign countries—in addition to Hypothesis 1—may divert capital inflows going into these foreign countries to the domestic country. There are two possible effects. The first effect is a diverting-in argument. It is possible that capital inflows are driven by motives for seeking higher investment returns. The foreign-implemented inflow controls make the domestic investment environment relatively more attractive. As a result, inflow controls implemented in these foreign countries *increase* domestic inflows. The second effect is a diverting-away argument. In this case, the foreign-implemented inflow controls cause investors to reassess the global investment environment. Similar to the *wake-up call argument* in the currency crisis literature, the reassessment prompts concern among

investors that countries with similar characteristics may follow suit (Corsetti et al., 1999). As a result, foreign-implemented inflow controls decrease domestic inflows. Put differently, if capital flows going into these foreign countries and capital flows going to the domestic countries are substitutes, then tightening foreign-implemented inflow controls would *increase* domestic inflows. On the other hand, if capital flows going into these foreign countries and capital flows going to the domestic countries are complements, then tightening foreign-implemented inflow controls would *increase* domestic inflows.

5.4 Empirical Strategies

In assessing the efficacy of capital controls on policy outcomes, one of the key challenges is to control for selection bias. Not only do countries with capital controls have distinct characteristics that by themselves affect the outcome variables, but also the implementation of capital controls often responds to the evolution of the outcome variables. For example, capital controls are often implemented when the levels of capital inflows are high. In Chapter 3, I address selection bias using a propensity score matching method, which focuses on estimating the effects on capital flows of capital controls but not of other explanatory variables. In this chapter, as my focus is to address the spillover effects of foreign-implemented capital controls (modeled as one of the explanatory variables), an instrumental variable estimation would be a more suitable method. In addition, to establish a reference point to the existing literature, the specifications that I use in this chapter follow closely those of Binici et al. (2010), who address the effects of domestically-implemented capital controls on domestic capital flows. I extend their specifications by incorporating spillover variables into the models.

5.4.1 Model Specifications

The basis for estimation is the following set of regression models:

$$\text{Model 1} \quad k_{i,t}^{(+)} = \alpha_0^1 + \alpha_1^1 I_{i,t}^{(+)} + \mathbf{x}_{i,t} \gamma^1 + \varepsilon_{i,t}^1 \quad (5.1)$$

$$\text{Model 2} \quad k_{i,t}^{(-)} = \alpha_0^2 + \alpha_1^2 I_{i,t}^{(-)} + \mathbf{x}_{i,t} \gamma^2 + \varepsilon_{i,t}^2 \quad (5.2)$$

$$\text{Model 3} \quad k_{i,t}^{(-)} = \alpha_0^3 + \alpha_1^3 I_{i,t}^{(-)} + \alpha_2^3 S_{i,t}^+ + \mathbf{x}_{i,t} \gamma^3 + \varepsilon_{i,t}^3 \quad (5.3)$$

$$\text{Model 4} \quad k_{i,t}^{(+)} = \alpha_0^4 + \alpha_1^4 I_{i,t}^{(+)} + \alpha_2^4 S_{i,t}^- + \mathbf{x}_{i,t} \gamma^4 + \varepsilon_{i,t}^4 \quad (5.4)$$

$$\text{Model 5} \quad k_{i,t}^{(+)} = \alpha_0^5 + \alpha_1^5 I_{i,t}^{(+)} + \alpha_2^5 S_{i,t}^+ + \mathbf{x}_{i,t} \gamma^5 + \varepsilon_{i,t}^5 \quad (5.5)$$

The notations for the models, for a domestic country i and during period t , are as follows:

- $k_{i,t}^{(+)}$: log capital inflows as a share of GDP.
- $k_{i,t}^{(-)}$: log capital outflows as a share of GDP.
- $I_{i,t}^{(+)}$: inflow capital control index.
- $I_{i,t}^{(-)}$: outflow capital control index.
- $S_{i,t}^{(+)}$: weighted average of inflow control indices in foreign countries.
- $S_{i,t}^{(-)}$: weighted average of outflow controls indices in foreign countries.
- $\mathbf{x}_{i,t}$: a set of explanatory variables.

Model 1 and Model 2 are benchmark models and do not include the spillover effect variables. They serve as a reference point to the existing literature, particularly the models estimated by Binici et al. (2010), which examines the effects of various types of financial market restrictions on the associated capital flows. Contrasting with Binici et al., however, I make the following improvements. First, for most of their analysis, Binici et al. aggregate equity and FDI flows. They argue that the distinction between the two types of flows depends on arbitrary definitions that may vary from country to country. In contrast, I take a more general approach and disaggregate equity and FDI flows throughout the study. Second, Binici et al. use capital flows per capita as the dependent variable, and log of GDP per capita as one of the control variables. Log of GDP per capita, however, exhibits substantial trends over time for most countries. To mitigate a potential non-stationarity problem, I use capital flows as a share of GDP as the dependent variable and exclude the variable of GDP per capita from the independent variables.¹⁰ Third, the possibility that capital control variables are endogenous is ignored by Binici et al. Endogeneity, however, is a legitimate concern. For example, policymakers who face large inflows may respond with inflow restrictions. Failing to account for endogeneity will lead to inconsistent estimators of the effects of capital controls. The benchmark models in this study contrast the estimation results with and without instrumental variables.

Proceeding further, Model 3, Model 4, and Model 5 include the spillover effect variables to examine Hypothesis 1, Hypothesis 2, and Hypothesis 3, respectively. For clarity, they are summarized below.

¹⁰ The model specifications used in this study is equivalent to Binici et al.'s (2010) models with the log of GDP moved to the left-hand side.

- The domestic-outflow-reduction hypothesis (i.e., Hypothesis 1): An increase in foreign countries' inflow controls, a rise in $S_{i,t}^{(+)}$, reduces the domestic country i 's outflows. In this case, $\alpha_2^3 < 0$ in Model 3.
- The domestic-inflow-reduction hypothesis (i.e., Hypothesis 2): An increase in foreign countries' outflow controls, a rise in $S_{i,t}^{(-)}$, reduces country i 's inflows. In this case, $\alpha_2^4 < 0$ in Model 4.
- The deflection hypothesis (i.e., Hypothesis 3): An increase in foreign countries' inflow restrictions, a rise in $S_{i,t}^{(+)}$ affects country i 's inflows. The direction of the impact, however, is uncertain. If the diverting-in argument holds, $\alpha_2^5 > 0$ in Model 5; if the diverting-away argument holds, $\alpha_2^5 < 0$ in Model 5.

5.4.2 Dependent Variables

Following Binici et al. (2010), capital inflows, for each asset class (i.e., debt, equity, and FDI), are defined as

$$K_{i,t}^{(+)} = \max(\Delta L_{i,t}, 0) - \min(\Delta A_{i,t}, 0) \quad (5.6)$$

The notations are as follows. For a country i during period t , $K_{i,t}^{(+)}$ is capital inflow so that $K_{i,t}^{(+)} / Y_{i,t} \equiv k_{i,t}^{(+)}$ in equation (5.1), where $Y_{i,t}$ is GDP. $\Delta L_{i,t}$ is the change in external liabilities, and $\Delta A_{i,t}$ is the change in external assets. When non-residents purchase domestic assets in country i , this is an increase in external liabilities, $\Delta L_{i,t} > 0$, and contributes to capital inflows. At the same time, when residents in country i sell foreign assets, $\Delta A_{i,t} < 0$, which also contributes to capital inflow. The max and min function serve to screen out other transactions that affect these assets and liabilities but do not represent capital inflows. For example, if foreign investors sell country i assets to country i residents, then $\Delta L_{i,t} < 0$ and this is a capital outflow. Similarly, if country i residents purchase foreign assets so that $\Delta A_{i,t} > 0$, then this is also a capital outflow.

In the first instance, we might expect inflow capital controls to be concerned with $\Delta L_{i,t}$. For example, a country might be concerned with large volumes of overseas investment, e.g. “hot money”, taking advantage of and contributing to excess valuations in domestic asset markets. As such, the country might impose capital controls that limit this type of investment with the expectation that $\Delta L_{i,t}$ will decrease (all else equal). It is also possible that the capital controls may be designed to limit returning capital that is associated with $\Delta A_{i,t} < 0$. This would be the case if there were limits imposed on foreign exchange purchases for investment in domestic assets, which would affect domestic residents attempting to repatriate investment back into the country. Measuring capital inflows as we do here and as others have done (Binici

et al., 2010; Broner et al., 2013; Saborowski et al., 2014) thus has the advantage of capturing all of the possible effects of capital inflow restrictions.

The same logic applies to capital outflows, which are constructed from the asset and liability data in a similar way:

$$K_{i,t}^{(-)} = \max(\Delta A_{i,t}, 0) - \min(\Delta L_{i,t}, 0) \quad (5.7)$$

where $K_{i,t}^{(-)}/Y_{i,t} \equiv k_{i,t}^{(-)}$ is the capital inflow in equation (5.2).

5.4.3 Capital Control Indices

I use Schindler (2009) indices to measure levels of capital controls across countries. Recall from Chapter 2 that Schindler indices are AREAER-based indices and have the advantage of distinguishing between directions of capital flows (inflows versus outflows) and asset types (equities, bonds, and FIDs). Schindler (2009) indices are constructed by first coding binary values for the restrictiveness of controls at the level of a basic category. These binary values are then aggregated to obtain inflow or outflow indices of an asset type. For example, equity inflow transactions can arise from two types of transactions: residents selling or issuing domestic equity assets abroad, and non-residents buying domestic equity assets locally. Each of these transactions is coded as 1 if restrictions exist and 0 otherwise. Thus, an aggregate equity inflow control index would be the average of the binary variables and could thus take on 3 different values: 0, 0.5, or 1.

5.4.4 Instrumental Variables

To mitigate the endogeneity problem, I use a two-stage least squares (2SLS) estimator. The endogeneity issue arises from the fact that policymakers who face large inflows may respond with inflow restrictions. In other words, inflows are a function of restrictions, but inflow controls are potentially also a function of inflows. The problem may also occur with capital outflows and outflow controls. That is,

$$I_{it}^{(+)} = a_0 + a_1 k_{it}^{(+)} + \mathbf{x}_{i,t} a_2 + \mathbf{z}_{it} a_3 + \varepsilon_{it}^6 \quad (5.8)$$

$$I_{it}^{(-)} = b_0 + \alpha_1 k_{it}^{(-)} + \mathbf{x}_{i,t} b_2 + \mathbf{z}_{it} b_3 + \varepsilon_{it}^7 \quad (5.9)$$

Estimating equation (5.1) to equation (5.5) using ordinary least squares (OLS) estimators without taking into consideration equation (5.8) and equation (5.9) will lead to inconsistent estimators. To address this endogeneity concern, the potential endogenous variable, $I_{i,t}^{(+)}$, will have to be instrumented by some

valid exogenous variables, $\mathbf{z}_{i,t}$, that can explain $I_{i,t}^{(+)}$ but are not correlated with the error terms in equation (5.1) to equation (5.5). Similarly, the potential endogenous variable, $I_{i,t}^{(-)}$, needs to be instrumented by some exogenous variables, $\mathbf{z}_{i,t}$, that can explain $I_{i,t}^{(-)}$ but are not correlated with the error terms in equation (5.1) to equation (5.5).

In determining the instruments, I relied on several observations that can be made from examining the data. First, there appeared to be a trend, on average, in the global developments of capital controls. Figure 5-3 shows that countries appeared to have experienced financial account liberalization in the late 1990s and early 2000s, but then have started tightening capital controls in around 2007. Second, the trend was more noticeable in countries of which the levels of capital controls were initially high. With these observations, a possible set of instruments is as follows:

$$I_{i,t}^{(+)} = a_0 + a_1 k_{i,t}^{(+)} + a_2 I_{i,0}^{+} * t + a_3 I_{i,0}^{+} * t^2 + \varepsilon_{i,t}^8 \quad (5.10)$$

$$I_{i,t}^{(-)} = b_0 + b_1 k_{i,t}^{(-)} + b_2 I_{i,0}^{-} * t + b_3 I_{i,0}^{-} * t^2 + \varepsilon_{i,t}^9 \quad (5.11)$$

where $t = 1995, 1996, \dots$

Both $I_{i,0}^{+} * t$ and $I_{i,0}^{-} * t$ can be thought of as a force that drives the evolution of capital account restrictions over time (either financial liberalization or capital controls). This force, however, is contingent on each country's initial level of financial account restrictions. For countries that initially have fairly open capital markets, the force is small. On the other hand, countries that initially have fairly restricted capital markets, the force is large. In addition, the trends are not linear, which are captured in the quadratic term of $I_{i,0}^{+} * t^2$ and $I_{i,0}^{-} * t^2$.

5.4.5 Spillover Effect Variables

Spillover effect variables are constructed to capture the mechanism through which the impacts of foreign-implemented capital controls may affect domestic capital inflows or outflows. As a domestic country connects facing multiple foreign countries in the rest of the world, the sources of spillovers that originate from these countries are multiple. Moreover, not every country in the rest of the world is of equal economic importance to the domestic country. As such, a weighted average of some sort should be used.

Recall from Section 2.2 in Chapter 2 that cross-border capital flows involve both trade-related transactions (i.e., exports and imports of goods and services) as well as pure-financial transactions (i.e., purchases and sales of external financial assets). Therefore, trade volumes (trade linkages), geographic proximity (geographic linkages), and patterns of external borrowing (financial linkages)—for their

relevance to the creation of capital flows—all serve as natural candidates that one can use to model spillover effects, which are linkages that I use in this chapter. These linkages have been employed by the literature on financial contagion; see, for example, Glick and Rose (1999) and Van Rijckeghem and Weder (2001).

In addition, direct spillover effects (i.e., the domestic-outflow-reduction hypothesis, or Hypothesis 1, and the domestic-inflow-reduction hypothesis, or Hypothesis 2) explore the effects of capital controls on bilateral flows. So, trade linkages—which capture bilateral trade volumes between pairs of countries—and geographic linkages—which capture geographic proximity between pairs of countries—would appear to be more relevant in measuring such bilateral relationships. On the other hand, an indirect spillover effect (i.e., the deflection hypothesis, or Hypothesis 3) concerns the possible substitutability among countries. So, geographic linkages—which also capture the possible substitutability among countries that fall into the same geographic region—and financial linkages—which capture the possible substitutability from a common lender’s perspective—would appear to be more relevant for that purpose.

Note that other ways of measuring relevance between pairs of countries are available. For example, Eichengreen and Rose (1999) use weights that the International Monetary Fund (IMF) has computed in the course of constructing its real multilateral effective exchange rate. They also use macroeconomic similarities as their weighting scheme. To make the subsequent analyses manageable, in this chapter I focus on the linkages that are easy to implement, including trade linkages, geographic linkages, and financial linkages.

Trade Linkages

Trade linkages measure the importance of a foreign country j to the domestic country i in terms of volumes of bilateral trade. For the domestic country i during the period t , the trade linkages with a country j are constructed in the following way:

$$w_{i,j,t}^T = \frac{x_{i,j,t} + m_{i,j,t}}{x_{i,t} + m_{i,t}} \quad (5.12)$$

where $x_{i,t}$ is the total export, $m_{i,t}$ is the total import, $m_{i,j,t}$ is the import from a foreign country j , and $x_{i,j,t}$ is the export to country j and $m_{i,j,t}$ is the trade weight between the domestic country i and a foreign country j . The spillover effect variables via trade linkages are trade-weighted averages of capital control indices in the rest of the world.

Geographic Linkages

Geographic linkages measure the geographic proximity between a foreign country j and a domestic country i . Spillover effect variables via geographic linkages are constructed as weighted averages of the capital control indices of all the other countries in the same region. For example, spillover effects via geographic linkages for Brazil in a given year are the average of capital control indices of all other countries in the region of Latin America in that given year. Specifically,

$$w_{i,j,t}^G = \frac{1}{n} \quad (5.13)$$

where n is the number of countries in the same region classified by the World Development Indicators (WDI) database.

Financial Linkages

Financial linkages are constructed to capture the degree of similarity between a foreign country j and the domestic country i in terms of borrowing from a common lender country k . Following Van Rijckeghem and Weder (2001) and Hernandez and Valdes (2001), financial linkages are constructed in the following way:

$$w_{i,j,t}^F = \sum_k \left(\frac{b_{i,k,t} + b_{j,k,t}}{b_{j,t} + b_{i,t}} \left(1 - \frac{|b_{j,k,t} - b_{i,k,t}|}{b_{j,k,t} + b_{i,k,t}} \right) \right) \quad (5.14)$$

where $b_{i,k,t}$ is the stock of external liabilities that the domestic country i borrows from a common lender country k , and $b_{i,t}$ is the total stock of external liabilities in the domestic country i . Similarly, $b_{j,k,t}$ is the stock of external liabilities that foreign country j borrows from common lender country k , and $b_{j,t}$ is the total stock of external liabilities in a foreign country j . The first component of the equation $\left(\frac{b_{i,k,t} + b_{j,k,t}}{b_{j,t} + b_{i,t}} \right)$ measures the overall importance of the common lender country k for the domestic country i and a foreign country j , whereas the second component $\left(1 - \frac{|b_{j,k,t} - b_{i,k,t}|}{b_{j,k,t} + b_{i,k,t}} \right)$ measures the extent to which the country i and a foreign country j compete for borrowing from the common lender country k .

The domestic-outflow-reduction hypothesis (i.e., Hypothesis 1) and the domestic-inflow-reduction hypothesis (i.e., Hypothesis 2) involve weighting the economic importance of a foreign country j to the domestic country i according to the bilateral relationships between the two, which means that trade linkages or geographic linkages would make more sense. On the other hand, Hypothesis 3 involves measuring the degree of substitutability between pairs of countries from a third country's perspective. This means that geographic linkages and financial linkages would be more appropriate. As such, in constructing the

spillover effect variables, I use trade linkages and geographic linkages to test the domestic-outflow-reduction hypothesis (i.e., Hypothesis 1) and the domestic-inflow-reduction hypothesis (i.e., Hypothesis 2), and geographic linkages and financial linkages for the deflection hypothesis (i.e. Hypothesis 3).

5.4.6 Other Explanatory Variables

Other explanatory variables include (1) institutional quality, (2) trade openness, (3) domestic financial development, and (4) natural resources. The choice of control variables used in this paper is guided by Binici et al. (2010), who survey and include most control variables that are typically found to be a significant determinant of aggregate capital flows in the literature.

The first variable is a measure of institutional quality. Countries with better institutions provide better protection of property rights, less corruption, more political stability and rule of law, and lower default risk. Hence, higher institutional quality should better attract capital inflows and discourage capital outflows. The second is a measure of trade openness. International trade in goods and services involves financial transactions. Higher levels of trade openness are thus expected to be associated with higher levels of capital flows. The third variable is a proxy for domestic financial development, measured by private credit and stock market capitalization in shares of GDP. Empirical evidence, such as Lane and Milesi-Ferretti (2003), suggests that financial sector development in domestic countries facilitates international capital flows because deeper domestic financial markets and a more sophisticated financial infrastructure offer a broader array of instruments through which capital can be allocated. As a result, financial development needs to be controlled for. The fourth control variable is a measure of a country's endowment of natural resources, measured by the sum of the ratio of fuel, ores, and metal exports to total exports. Capital flows, especially FDI and equity inflows, are likely to be partly driven by foreign investors' desire to exploit basic natural resources as inputs in the international production chain (Faria & Mauro, 2009). Hence, I also include natural resources as one of the control variables.

5.5 Data and Descriptive Statistics

Table 5-1 shows the summary statistics of the list of variables used in this study, which covers 74 countries from 1995-2011. To enable a direct comparison, I select the same 74 countries as those selected by Binici et al. (2010), of which the methodology I closely follow. The range of the time is based on the availability of other explanatory variables in the dataset.

Table 5-7 provides the corresponding variable definitions and data sources. Figure 5-1 to Figure 5-4 provide visual presentations regarding important variables (i.e., flows, capital controls indices, and spillovers) used in this study.

Figure 5-1 first plots capital inflows and capital outflows of different asset types (i.e., debt, equity, and FDI) by income groups (i.e., high, middle, and low income). Two observations can be made. First, when compared horizontally, the bar charts show that debt flows stand out as the main component of capital flows in high-income countries, while FDI is the main component of capital flows in middle-income countries. Debt flows in higher-income countries are about 2 percent of the GDP, while both equity flows and FDI are less than 1 percent of the GDP. On the other hand, for middle-income countries, FDI flows are slightly higher than debt or equity flows. For low-income countries, capital flows are equally low across all asset types. Second, when compared vertically, Figure 5-1 shows that on average, higher-income countries experience a higher ratio of capital inflows and capital outflows. This pattern is particularly noticeable in debt flows, which are nearly 2 percent of GDP for high-income countries but are only about 0.5 percent of GDP for both middle and low-income countries. High-income countries also experience higher levels of equity flows (about 1 percent) than middle and low-income countries (about 0.5 percent). The levels of FDI flows are almost equal in middle-income countries and in high-income countries. This may reflect the fact that FDI flows are the main component of capital flows in middle-income countries. Figure 5-2 adds a time dimension to Figure 5-1, presenting the evolution of capital flows over time. Immediately noticeable is that capital inflows and outflows almost overlap each other. This pattern holds across asset classes and income groups. The similarity between the levels of capital inflows and outflows over time reveals that for each country, the demand for domestic financial assets and foreign financial assets are quite similar over time. This is consistent with the findings from Broner et al. (2013), who find that when foreigners invest in a country, domestic agents invest abroad, and vice versa. Moreover, capital flows, in general, do not exhibit any significant upward or downward trends. The relatively stable movements of capital flows over time suggest that non-stationarity will be less of a time-series-property concern in estimation. The levels of capital flows, however, do seem to rise before the Global Financial Crisis and drop substantially during the crisis, suggesting that cross-border capital movements are more active in times of crisis, a finding that is also consistent with Broner et al. (2013). They find that during crises, total gross flows collapse and there is a retrenchment in both inflows by foreigners and outflows by domestic agents.

Turning to the capital control variable, Figure 5-3 plots the evolution of average inflow and outflow capital control indices of all countries (Panel A) since 1995 and by income groups (Panel B and Panel C). It can be seen from Panel A that both the average aggregate inflow and outflow capital control index exhibit a downward trend from the late 1990s to the early 2000s, but climb up after 2007. The trend seems to

confirm the claims that capital controls are regaining their popularity, especially after the global financial crisis in 2008 (Gallagher, 2011). Panel B further separates the entire sample into different income groups and shows that higher-income countries on average have fewer restrictions on capital inflows. Similarly, higher-income countries on average also have fewer restrictions on capital outflows, a pattern that is shown in Panel C.

Turning to the spillover effect variables, Figure 5-4 shows the movements of these variables via different linkages in selected countries (Argentina, Brazil, and Canada). $S_{i,t,T}^+$ and $S_{i,t,T}^-$ are the inflow and outflow spillover variables via trade linkages (column 1); $S_{i,t,G}^+$ and $S_{i,t,G}^-$ are the inflow and outflow spillover variables via geographic linkages (column 2); $S_{i,t,F}^+$ and $S_{i,t,F}^-$ are the inflow and outflow spillover variables via financial linkages (column 3). Column 1 of Figure 5-4 shows that in Canada and Brazil, the movements of $S_{i,t,T}^+$ are relatively stable and the values are small. This is because both Canada and Brazil have close trade relationships with the United States, which has a fairly open financial market over time. In contrast, in Argentina, the levels $S_{i,t,T}^+$ is larger and fluctuates more. This is because Argentina's largest trading partner is Brazil, which has experienced financial liberalization in the early 2000s and tightened its capital controls in the late 2000s. Hence, both $S_{i,t,T}^+$ and $S_{i,t,T}^-$ in Argentina fell in the early 2000s and rose in the late 2000s. Column 2 Figure 5-4 shows that in Argentina and Brazil, $S_{i,t,G}^+$ and $S_{i,t,G}^-$ are identical. This is because the two countries belong to the same region. In Canada, $S_{i,t,G}^+$ and $S_{i,t,G}^-$ are smaller. This is because Canada is in a region (North America) where capital markets are fairly open. In fact, according to the way the region is defined in the dataset used by this study, the United States and Canada are the two countries in that region. Column 3 of Figure 5-4 shows that $S_{i,t,F}^+$ and $S_{i,t,F}^-$ fluctuate more compared to the other two types of spillover variables via trade linkages and geographic linkages. This is because the weights used to construct financial spillover variables change over time, while bilateral trade volumes and geographic classification remain similar.

5.6 Empirical Results

I first estimate the benchmark models *without* instrumental variables; Table 5-2 shows the results. As noted previously, capital flows are broken down into debt, equity, and FDI. Each model includes the corresponding capital control index as well as the other explanatory variables discussed previously. In all models, country fixed effects are included.

Table 5-2 shows that institutional quality has different effects on capital inflows and outflows. On the one hand, the positive signs observed in models (1) to (3) suggest that greater institutional quality encourages foreign investment. On the other hand, countries with greater institutional quality tend to

observe fewer capital outflows, consistent with the negative (though not significant) signs noted in the outflow model (4) to model (6). This perhaps reflects better opportunities for domestic residents to invest locally when the institutional quality is higher. The three explanatory variables that play consistent roles in each model are private credit, stock market capitalization, and natural resources. In almost all cases, greater financial development (measured by either higher private credit or higher stock market capitalization) is positively and significantly associated with higher capital inflows and capital outflows. In cases where the estimated coefficients are not significant, the sign remains positive. Trade openness provides some explanation for certain flows but not consistently across all models. While in principle one might wish to pare these models down to exclude insignificant repressors, for simplicity, all controls are kept throughout all models.

The principal results of interest concern the effects of capital controls on capital flows themselves. For capital inflows, inflow capital controls have no significant effect, as is seen from model (1) to model (3); in contrast, outflow controls significantly reduce capital outflows, as is seen from model (4) to model (6). Such results are consistent with Bicini et al. (2010). They find that, on average, countries do not seem to be able to reduce capital inflows through inflow controls, which may reflect systematic evasion of legal restrictions. They also find that countries, on average, are able to reduce outflows and so may be effective at reducing capital flight. Overall, the signs and statistical significance of the regressors are broadly consistent with those reported in Binici et al., which establishes a reasonable reference point to the existing literature.

I now proceed to address the potential endogeneity problem by re-estimating the benchmark models *with* instrumental variables. Table 5-3 reports the results. The bottom of Table 5-3 has a set of results regarding the instrumental variables. First, the Hausman (1978) test assesses the existence of the endogeneity issue. Under the null, the endogeneity problem is not present and both the OLS estimators and the IV estimators are consistent. Rejecting the null would provide the premise for using instrumental variable (IV) estimators instead of ordinary least squares (OLS) estimators. Second, the Hansen (1982) test examines the overidentification condition that IV estimators are based upon. Under the null, the overidentification condition holds. Third, the weak identification test evaluates the relevance of the instruments for the potential endogenous variable in the model. If the proposed instruments only weakly correlate with the endogenous regressors, then the instrumental estimators will perform poorly.¹¹ Under the null, the instruments and the potential endogenous variable are weakly related (Greene, 2003).

¹¹ Two-Stage-Least-Squares (2SLS) estimators will be biased in the direction of OLS estimators, and the distributions will be non-normal which affect inference using Wald testing procedures (see e.g. Bound et al. 1995; Staiger and Stock, 1997; and Stock et al., 2002).

The bottom of Table 5-3 shows that for all models, except model (4), the null of exogeneity is rejected at significance levels of 10%. This suggests that endogeneity is indeed a legitimate concern and estimators without proper instruments (such as those used by Bicini et al, 2010) will be inconsistent and biased. Meanwhile, the weak identification tests show that for all of the models, the null that instruments are weakly identified is all rejected (the critical value of 10% maximal IV size is 19.93), suggesting the instruments are reasonably strong and the estimation results are less likely to exhibit poor statistical properties as just discussed.^{12 13} Taken together, the specification tests above support the concern that capital flows may be endogenous and $I_{i,0}^+ * t$ is a strong instrument for $I_{i,0}^+$. I hence proceed to use instrumental variable estimators for the rest of the analyses.

The main results of Table 5-3 show that while the signs and magnitude of other explanatory variables remain broadly similar to those reported in Table 5-2, the sign of the capital control variables has changed. Notably, in each case, the signs now turn significantly negative. The results stand in contrast with Bicini et al. (2010), suggesting that not only outflow controls, but also inflow controls, may affect capital flows. Also, note that the standard errors of the estimated coefficients on capital control variables have increased. This should not come as a surprise. Indeed, this is a standard result of instrumental variable estimation compared to OLS estimators.¹⁴

Next, I examine the potential spillover effects of capital controls by adding the spillover variables ($S_{i,t}^+$ and $S_{i,t}^-$) to the benchmark models. Table 5-4 to Table 5-6 report the regression results from estimating Equation (5.3) to Equation (5.5), respectively.

Table 5-4 reports the results from examining whether inflow controls imposed in foreign countries would reduce the domestic outflows (i.e., the outflow-reduction hypothesis, or Hypothesis 1). Column (1) to column (3) are the results of using trade linkages, while column (4) to column (6) are the results from using geographic linkages. Table 5-4 shows that for both equity outflows and FDI outflows, inflow controls remain negatively significant, consistent with the previous results from Table 5-3. Turning to the spillover variables, regardless of the linkages, the domestic outflows are negatively and significantly associated with the inflow control spillover variables in all cases but column (5). The negative relationship between the

¹² On the other hand, the Hausman test suggests that $I_{it}^{(+)}$ and $I_{it}^{(-)}$ may not be good instruments. Hence, the results are not reported.

¹³ The Stata output from the command `xtivreg2` provides the critical value.

¹⁴ The problem of larger standard errors can be mitigated by enlarging the sample size, which has already been done in this paper by extending Schindler's (2009) indexes from 2005 to 2011.

domestic inflows and the outflow control spillover variables suggest that inflow controls imposed in foreign countries would reduce the domestic outflows.

Table 5-5 reports the results from examining whether outflow controls imposed in foreign countries reduce domestic inflows (i.e., the domestic-inflow-reduction hypothesis, or Hypothesis 2). Column 1 to column 3 are the results using trade linkages, and column 4 to column 6 are the results using the geographic linkages. Table 5-5 shows that domestic inflow controls remain negatively significant. Once again, this is consistent with the previous results shown in Table 5-3. Turning to the spillover effect variables, the outflow control spillover effect variables via trade linkages are negatively significant, but spillover effect variables via geographic linkages do not seem to provide much explanatory power. Overall, there is some evidence that foreign-implemented outflow controls would reduce domestic inflows via trade linkages.

Table 5-6 reports the results from examining whether foreign-implemented inflow controls divert capital flows to another country with similar characteristics (i.e., the deflection hypothesis, or Hypothesis 3). Column 1 to column 3 are the results of using financial linkages, and column 4 to column 6 are the results of using geographic linkages. Table 5-6 shows that domestic inflow controls remain negatively significant, which again is consistent with the previous results from Table 5-3. Turning to the spillover effect variables, Table 5-6 shows that when the financial linkages are used, debt inflows, equity inflows, and FID inflows are all negatively and significantly associated with the inflow control spillover effect variables. When geographic linkages are used, the estimated coefficients are not significant. The negative relationship between capital inflows and inflow control spillover variables suggest that inflows to countries with similar characteristics are *complements* to each other. In addition, the results suggest that financial-linkages are the main transmission mechanism.

Comparing to and contrasting with the previous studies on the spillover effects of capital controls and a broader literature on financial contagion, the results from this chapter merit some further discussion. First, previous studies on the spillover effects of capital controls mainly focus on the indirect spillover effects of inflow capital controls (i.e., the deflection hypothesis). By modeling the spillover effects through direct bilateral linkages such as the trade linkages and the geographic linkages (i.e., the domestic-outflow-reduction-hypothesis and the domestic-inflow-reduction hypothesis), the results from this chapter add a new dimension to the existing literature by revealing that on top of inflow controls, outflow controls can also generate spillover effects on countries. Indeed, the finding that a shock can influence other countries through trade and geographic linkages is consistent with evidence from studies on financial contagion.

Turning to the indirect spillover effects that previous work has focused on, the results of this chapter provide evidence in favor of the diverting-away argument, which stands in contrast with Forbes et al. (2016) and IMF (2011b), who find evidence in favor of both arguments. The difference may be driven by the fact

that I use capital flow data that is aggregated on a country-level, and capital control indices that include a much broader range of capital controls. In light of such differences, the findings of this chapter in this regard should be interpreted as evidence supporting the diverting-away argument on a larger level, rather than evidence that contradicts other existing studies.

5.7 Concluding Remarks

In this chapter, I have combined the literature on the efficacy of capital controls and the literature on financial contagion. I examined the domestic effects as well as the spillover effects of capital controls. The domestic effects of capital controls refer to how domestic capital controls affect domestic capital flows; the spillover effects of capital controls refer to how capital controls implemented in foreign countries affect domestic capital flows. In terms of the domestic effects, I show that domestic inflow capital controls reduce domestic inflows, while domestic outflow controls reduce domestic outflows. In terms of the spillover effects, I take a more general approach to examine how the effects of capital controls transmit through multilateral relationships among countries. Specifically, I propose—from a domestic country’s perspective—that foreign-implemented capital controls can affect domestic capital flows in the following ways. First, foreign-implemented inflow controls may reduce domestic outflows going into these foreign countries (the domestic-outflow-reduction hypothesis, or Hypothesis 1). Second, foreign-implemented outflow controls may reduce domestic inflows coming from these foreign countries (the domestic-inflow-reduction hypothesis, or Hypothesis 2). Third, foreign-implemented inflow controls—in addition to Hypothesis 1—may divert capital flows to the domestic country (the deflection hypothesis, or Hypothesis 3). The findings of this chapter support the existence of spillover effects. For the three hypotheses, I find that tightening foreign-implemented inflow controls—measured by increases in trade-weighted and geographic-proximity-weighted inflow control indices of other countries in the rest of the world—reduces domestic outflows, while tightening foreign-implemented outflow controls—measured by increases in trade-weighted and geographic-proximity-weighted outflow control indices of other countries in the rest of the world—reduces domestic inflows. Such results suggest that the effects of capital controls can propagate across countries through reductions in bilateral capital flows via trade- or geographic-linkages, although the evidence for trade-linkages is stronger than that for geographic-linkages.

In addition to the direct spillover effects of foreign implemented capital controls through bilateral reductions in capital flows, tightening of foreign-implemented inflow controls—measured by finance-weighted capital control indices of other countries in the rest of the world—diverts capital inflow away from the domestic country. The results suggest that foreign-implemented capital controls have signaling effects on domestic capital flows via common lenders. When one country implements inflow capital

controls, the policy actions prompt the common lenders to perceive that other countries with similar borrowing patterns are likely to become less supportive of foreign investment. As such, foreign investors retreat their investments, leading to reductions in domestic inflows.

The findings of this chapter have some policy implications. First, the results from examining Hypothesis 3 show little evidence to support the view that foreign-implemented capital controls would divert capital flows into the domestic economy of a similar nature. Instead, the results are in favor of the diverting-away argument. As a result, there seems to be little ground to support the argument that capital controls would eventually lead to a global shrinkage of capital flows (i.e., the ratchet effect). Second, despite the lower likelihood of the ratchet effect, the results from this chapter support the view that capital controls have multilateral effects, either through bilateral relationships (i.e., the results from the domestic-outflow-reduction hypothesis and the domestic-inflow-reduction hypothesis) or through a signaling effect (i.e., the results from the deflection hypothesis). This view is consistent with the findings that in an open economy, policy actions taken by foreign countries could have implications for the domestic economy. In the context of capital flow management, it means that capital controls implemented in foreign countries work as one of the relevant factors in determining domestic capital flows. When designing policies to manage capital flows, policymakers should take into consideration the influence of foreign-implemented capital controls on domestic flows. For example, one of the results from this chapter suggests that foreign-implemented outflow controls would reduce domestic capital inflows. From the perspective of the domestic country, this means that when foreign countries implement outflow controls, it is possible that external financing may decrease. Accordingly, policymakers may seek to encourage domestic investment should the loss of external financing be a concern. From a multilateral perspective, it further means that capital flows management could take place at both the recipient countries and at the source countries. This would be particularly useful when the ability to take policy actions at one end is limited due to a weak institutional or administrative capacity to enact capital controls (Ghosh et al., 2014). To the extent that capital controls affect the global allocation of capital flows, capital controls implemented in a country create externalities for others, providing the basis for taking coordinated actions.

5.8 Tables Used in Chapter 5

Table 5-1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Max	Min
<i>LHS variables</i>					
Debt Outflows/GDP	1232	0.11	0.32	7	0
Debt Inflows/GDP	1232	0.11	0.32	7	0
Debt Outflows/GDP	1232	0.05	0.23	6	0
Equity Inflows/GDP	1232	0.06	0.36	9	0
Equity Outflows/GDP	1232	0.09	0.77	24	0
FDI Inflows/GDP	1232	0.07	0.72	22	0
<i>Capital controls variables</i>					
Inward capital controls	1258	0.27	0.33	1	0
Outward capital controls	1258	0.36	0.39	1	0
Equity inward capital controls	1258	0.27	0.37	1	0
Equity outward capital controls	1258	0.36	0.42	1	0
Debt inflows controls	1258	0.25	0.36	1	0
Debt outflows controls	1258	0.38	0.41	1	0
FDI inward capital controls	1258	0.3	0.46	1	0
FDI outward capital controls	1255	0.3	0.46	1	0
<i>Spillover effects variables</i>					
Inward capital controls spillover(Geo)	1258	0.29	0.2	1	0
Outward capital controls spillover(Geo)	1258	0.36	0.23	1	0
Inward capital controls spillover (Trade)	1236	0.08	0.08	0	0
Outward capital controls spillover (Trade)	1236	0.13	0.09	1	0
Inward capital controls spillover (Finance)	962	0.29	0.17	1	0
Outward capital controls spillover(Finance)	962	0.37	0.2	1	0
<i>Control variables</i>					
GDP per capita	1232	8.69	1.54	11	5
Institutional quality	1258	61.56	25.39	100	8
Trade openness	1246	0.87	0.59	4	0
Private credit	1198	61.24	50.36	285	3
Stock market capitalization	1160	53.84	62.58	569	0
Natural resources	1224	0.16	0.2	1	0

Table 5-2: Benchmark Models without Instruments

	Capital Inflows			Capital Outflows		
	(1)	(2)	(3)	(4)	(5)	(6)
	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP	Debt Outflows/GDP	Equity Outflows/GDP	FDI Outflows/GDP
Debt inflows controls	-0.489 (0.330)					
Equity inward capital controls		-0.0735 (0.408)				
FDI inward capital controls			-0.192 (0.262)			
Debt outflows controls				-0.931** (0.342)		
Equity outward capital controls					-0.908** (0.235)	
FDI outward capital controls						-0.997** (0.220)
Institutional quality	0.0361** (0.0152)	0.0248 (0.0168)	0.0468** (0.0160)	-0.0271 (0.0172)	-0.0141 (0.0127)	-0.00370 (0.0127)
Trade openness	-0.813* (0.461)	1.174** (0.515)	-0.283 (0.491)	-0.707 (0.524)	0.506 (0.389)	-0.156 (0.386)
Private credit	0.0121** (0.00269)	0.00982** (0.00301)	0.000116 (0.00285)	0.00532* (0.00307)	0.0160** (0.00228)	0.00710** (0.00227)
Stock market capitalization	0.0121** (0.00262)	0.00730** (0.00293)	0.0153** (0.00278)	0.00410 (0.00297)	0.00916** (0.00221)	0.0111** (0.00220)
Natural resources	1.836* (1.083)	2.783** (1.208)	2.451** (1.150)	2.418* (1.233)	1.870** (0.912)	1.374 (0.906)
Constant	-6.013** (0.938)	-8.306** (1.034)	-6.371** (1.014)	-2.633** (1.090)	-4.379** (0.813)	-5.113** (0.791)
R2	0.31	0.33	0.24	0.25	0.54	0.51
nobs	1062	1062	1062	1062	1062	1062

Notes: (1) Robust Standard errors in parentheses. (2) Results significant at 1,5, and 10% levels are indicated by ***, **, and *.

Table 5-3: Benchmark Models with Instruments

	Capital Inflows			Capital Outflows		
	(1)	(2)	(3)	(4)	(5)	(6)
	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP	Debt Outflows/GDP	Equity Outflows/GDP	FDI Outflows/GDP
Debt inflows controls	-4.097** (1.401)					
Equity inward capital controls		-5.685** (1.369)				
FDI inward capital controls			-3.954** (1.395)			
Debt outflows controls				0.130 (0.954)		
Equity outward capital controls					-2.881** (0.643)	
FDI outward capital controls						-2.719** (0.536)
Institutional quality	0.0128 (0.0185)	0.00589 (0.0165)	0.0302** (0.0150)	-0.0196 (0.0180)	-0.0266** (0.0123)	-0.0198 (0.0124)
Trade openness	-0.808* (0.473)	1.032 (0.660)	-0.0493 (0.569)	-0.731 (0.584)	0.616 (0.417)	-0.0619 (0.498)
Private credit	0.00926** (0.00333)	0.00537 (0.00351)	-0.00154 (0.00466)	0.00641 (0.00405)	0.0135** (0.00267)	0.00422 (0.00280)
Stock market capitalization	0.0103** (0.00336)	0.00346 (0.00393)	0.0138** (0.00421)	0.00434 (0.00405)	0.00787** (0.00269)	0.00959** (0.00236)
Natural resources	2.671** (1.264)	3.506** (1.494)	2.086* (1.136)	2.128* (1.156)	2.166** (1.015)	1.023 (1.057)
Hausman endogeneity test	9.467	28.053	16.229	0.850	10.367	14.988
p-value	0.002	0.000	0.000	0.356	0.001	0.000
Weak identification test	40.650	52.729	23.433	58.700	64.897	105.182
Hansen overidentification test	2.929	1.198	0.000	17.003	0.023	0.024
p-value	0.087	0.274	0.994	0.000	0.880	0.876
nobs	1061	1061	1061	1061	1061	1061

Notes: (1) Robust Standard errors in parentheses. (2) Results significant at 1,5, and 10% levels are indicated by ***, **, and *.

Table 5-4: The Effects of Foreign-Implemented Inflow Controls on Domestic Outflows, Hypothesis 1

	Trade Linkages			Geographic Proximities		
	(1)	(2)	(3)	(4)	(5)	(6)
	Debt Outflows/GDP	Equity Outflows/GDP	FDI Outflows/GDP	Debt Outflows/GDP	Equity Outflows/GDP	FDI Outflows/GDP
Debt outflows controls	0.348 (0.972)			-2.519** (1.220)		
Equity outward capital controls		-2.558** (0.673)			-2.566** (0.846)	
FDI outward capital controls			-2.401** (0.522)			-2.256** (0.557)
Inward capital controls spillover (Trade)	-4.196** (1.764)	-3.759** (1.387)	-4.033** (1.570)			
Inward capital controls spillover(Geo)				-9.643** (1.803)	-1.691 (1.604)	-3.153** (0.998)
Institutional quality	-0.0207 (0.0179)	-0.0248** (0.0123)	-0.0177 (0.0121)	-0.0227 (0.0181)	-0.0281** (0.0120)	-0.0220* (0.0120)
Trade openness	-0.891 (0.590)	0.507 (0.416)	-0.203 (0.489)	-1.104* (0.603)	0.542 (0.425)	-0.191 (0.490)
Private credit	0.00565 (0.00408)	0.0129** (0.00266)	0.00375 (0.00278)	0.00480 (0.00404)	0.0132** (0.00257)	0.00366 (0.00270)
Stock market capitalization	0.00400 (0.00406)	0.00767** (0.00271)	0.00931** (0.00235)	0.00347 (0.00398)	0.00783** (0.00268)	0.00953** (0.00230)
Natural resources	1.835 (1.159)	2.050** (1.017)	0.751 (1.015)	1.038 (1.211)	2.042** (1.021)	0.975 (1.017)
Hausman endogeneity test	1.352	7.093	11.495	5.869	6.933	10.014
p-value	0.245	0.008	0.001	0.015	0.008	0.002
Weak identification test	54.158	58.460	99.818	40.487	38.925	84.100
Hansen overidentification test	13.292	0.094	0.201	6.188	0.039	0.193
p-value	0.000	0.759	0.654	0.013	0.844	0.661
nobs	1048	1048	1048	1061	1061	1061

Notes: (1) Robust Standard errors in parentheses. (2) Results significant at 1,5, and 10% levels are indicated by ***, **, and *.

Table 5-5: The Effects of Foreign-Implemented Outflow Controls on Domestic Inflows, Hypothesis 2

	Trade Linkages			Geographic Proximities		
	(1)	(2)	(3)	(4)	(5)	(6)
	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP
Debt inflows controls	-3.410** (1.356)			-3.928** (1.650)		
Equity inward capital controls		-5.608** (1.323)			-6.073** (1.540)	
FDI inward capital controls			-3.503** (1.328)			-4.116** (1.710)
Outward capital controls spillover (Trade)	-4.579** (2.248)	1.091 (2.039)	-3.908** (1.889)			
Outward capital controls spillover(Geo)				-1.351 (1.489)	1.377 (1.479)	0.569 (1.729)
Institutional quality	0.0147 (0.0178)	0.00671 (0.0168)	0.0283** (0.0144)	0.0100 (0.0180)	0.00853 (0.0169)	0.0311** (0.0152)
Trade openness	-0.863* (0.473)	1.071 (0.670)	-0.237 (0.565)	-0.827* (0.470)	1.041 (0.664)	-0.0312 (0.583)
Private credit	0.00865** (0.00331)	0.00572 (0.00353)	-0.00220 (0.00458)	0.00888** (0.00329)	0.00559 (0.00355)	-0.00140 (0.00472)
Stock market capitalization	0.0103** (0.00335)	0.00335 (0.00392)	0.0140** (0.00410)	0.0103** (0.00335)	0.00330 (0.00398)	0.0137** (0.00426)
Natural resources	2.114* (1.257)	3.389** (1.516)	1.754 (1.145)	2.617** (1.281)	3.571** (1.530)	2.076* (1.149)
Hausman endogeneity test	6.425	27.898	12.899	6.277	24.825	12.173
p-value	0.011	0.000	0.000	0.012	0.000	0.000
Weak identification test	38.459	55.156	22.370	29.651	41.002	15.648
Hansen overidentification test	2.465	1.086	0.001	3.494	1.217	0.000
p-value	0.116	0.297	0.978	0.062	0.270	0.993
nobs	1048	1048	1048	1061	1061	1061

Notes: (1) Robust Standard errors in parentheses. (2) Results significant at 1,5, and 10% levels are indicated by ***, **, and *.

Table 5-6: The Effects of Foreign-Implemented Inflow Controls on Capital Flow Deflection, Hypothesis 3

	Financial Linkages			Geographic Proximities		
	(1)	(2)	(3)	(4)	(5)	(6)
	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP	Debt Inflows/GDP	Equity Inflows/GDP	FDI Inflows/GDP
Debt inflows controls	-11.56** (4.344)			-4.567** (1.930)		
Equity inward capital controls		-13.45** (5.194)			-5.707** (1.601)	
FDI inward capital controls			-8.332** (3.605)			-4.260** (1.938)
Inward capital controls spillover (Finance)	-2.625* (1.507)	-2.850* (1.500)	-3.304** (1.404)			
Inward capital controls spillover(Geo)				0.642 (2.077)	0.129 (1.828)	0.932 (2.231)
Institutional quality	-0.0567 (0.0458)	-0.0165 (0.0312)	0.00873 (0.0293)	0.0111 (0.0190)	0.00609 (0.0164)	0.0307** (0.0154)
Trade openness	0.713 (0.933)	1.227 (0.972)	0.220 (0.863)	-0.786 (0.484)	1.035 (0.662)	0.000484 (0.604)
Private credit	0.00519 (0.00616)	0.00523 (0.00683)	-0.00349 (0.00793)	0.00917** (0.00334)	0.00541 (0.00349)	-0.00128 (0.00479)
Stock market capitalization	0.00711 (0.00533)	-0.00317 (0.00655)	0.0117 (0.00807)	0.0102** (0.00337)	0.00346 (0.00395)	0.0138** (0.00430)
Natural resources	4.298* (2.249)	2.949 (2.540)	1.684 (1.502)	2.809** (1.382)	3.515** (1.509)	2.099* (1.162)
Hausman endogeneity test	19.795	24.873	15.525	6.901	19.885	10.950
p-value	0.000	0.000	0.000	0.009	0.000	0.001
Weak identification test	14.652	14.137	9.340	24.664	34.547	12.504
Hansen overidentification test	0.634	0.631	0.022	2.602	1.202	0.000
p-value	0.426	0.427	0.881	0.107	0.273	0.983
nobs	824	824	824	1061	1061	1061

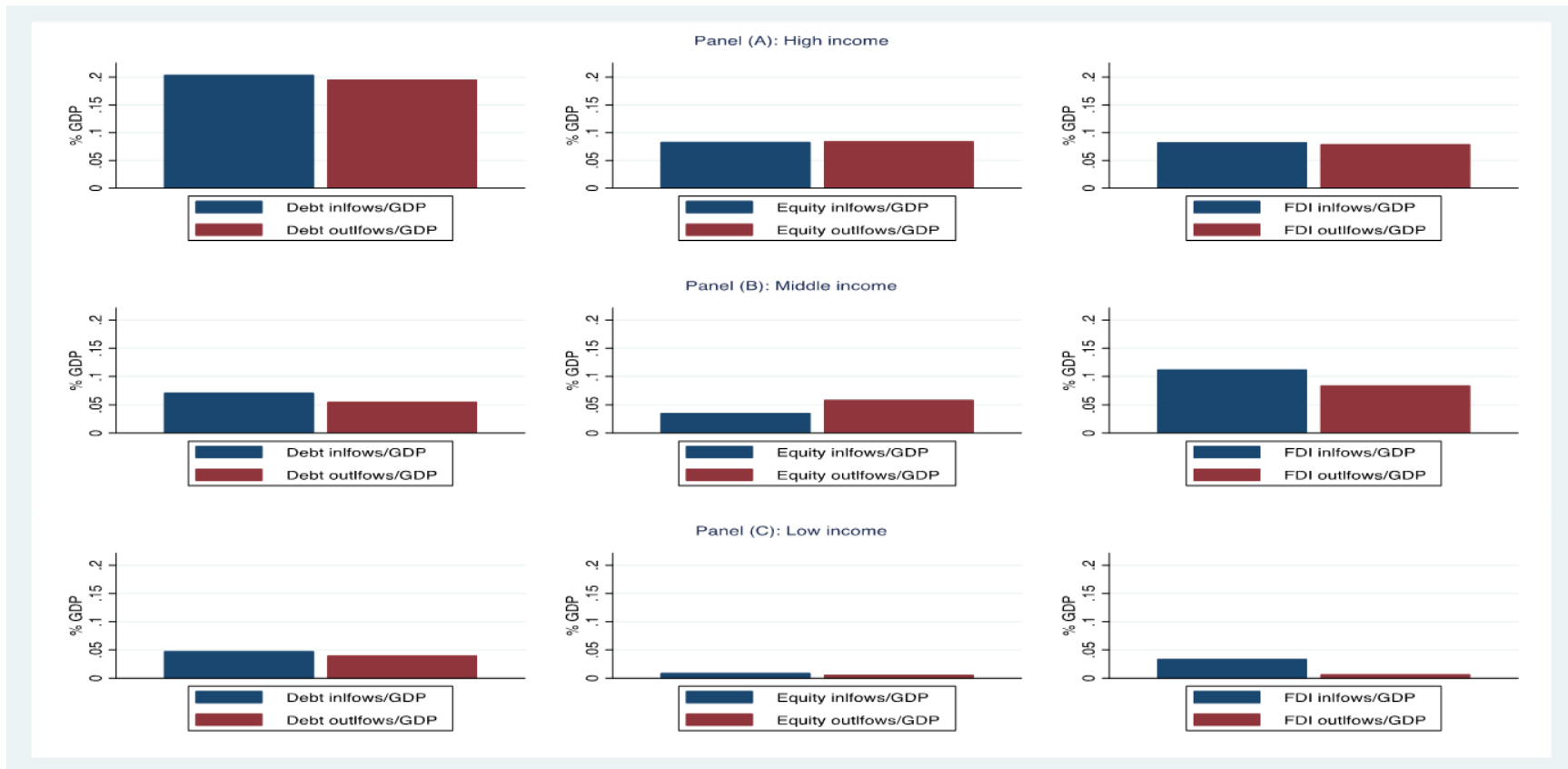
Notes: (1) Robust Standard errors in parentheses. (2) Results significant at 1,5, and 10% levels are indicated by ***, **, and *.

Table 5-7: Variable Definitions and Data Sources

Variable	Description	Source
Capital Flows	Debt, FDI and equity flow relative to GDP	Lane and Milesi-Ferretti (2007)
Chinn-Ito Capital Control Index	Index of capital controls (range: 0–1, from least to most regulated)	Chinn and Ito (2008)
Schindler's Capital Control Indices	Index of capital controls (range: 0–1, from least to most regulated)	Schindler (2009)
Trade Linkages	The importance of country <i>i</i> to country <i>j</i> in terms of trade	Bank for International Settlements
Financial Linkages	Weights measuring the importance of country <i>i</i> to country <i>j</i> in terms of common lenders	Bank for International Settlements
Geographic Linkages	Weights measuring whether country <i>i</i> and country <i>j</i> belong to the same region	Global Financial Development database
Trade Openness	Weights measuring the importance of country <i>i</i> to country <i>j</i> in terms of bilateral trade	World Bank, World Development Indicators database
Natural Resources	Sum of fuel, ores and metal export/ total export	World Bank, World Development Indicators database
Private Credit	Private credit by deposit money banks/GDP	World Bank, Financial Structure database
Stock Market Capitalization	Stock market capitalization/GDP	World Bank, Financial Structure Dataset
Institutional Quality	Average of the percentile rank of six indicators: voice and accountability, political stability, government institutional quality effectiveness, regulatory quality, rule of law, control of corruption (range: 0–100, where a higher score means better institution).	Kaufmann et al. (2011)

5.9 Figures Used in Chapter 5

Figure 5-1: Debt, Equity, and FDI Flows by Income Groups



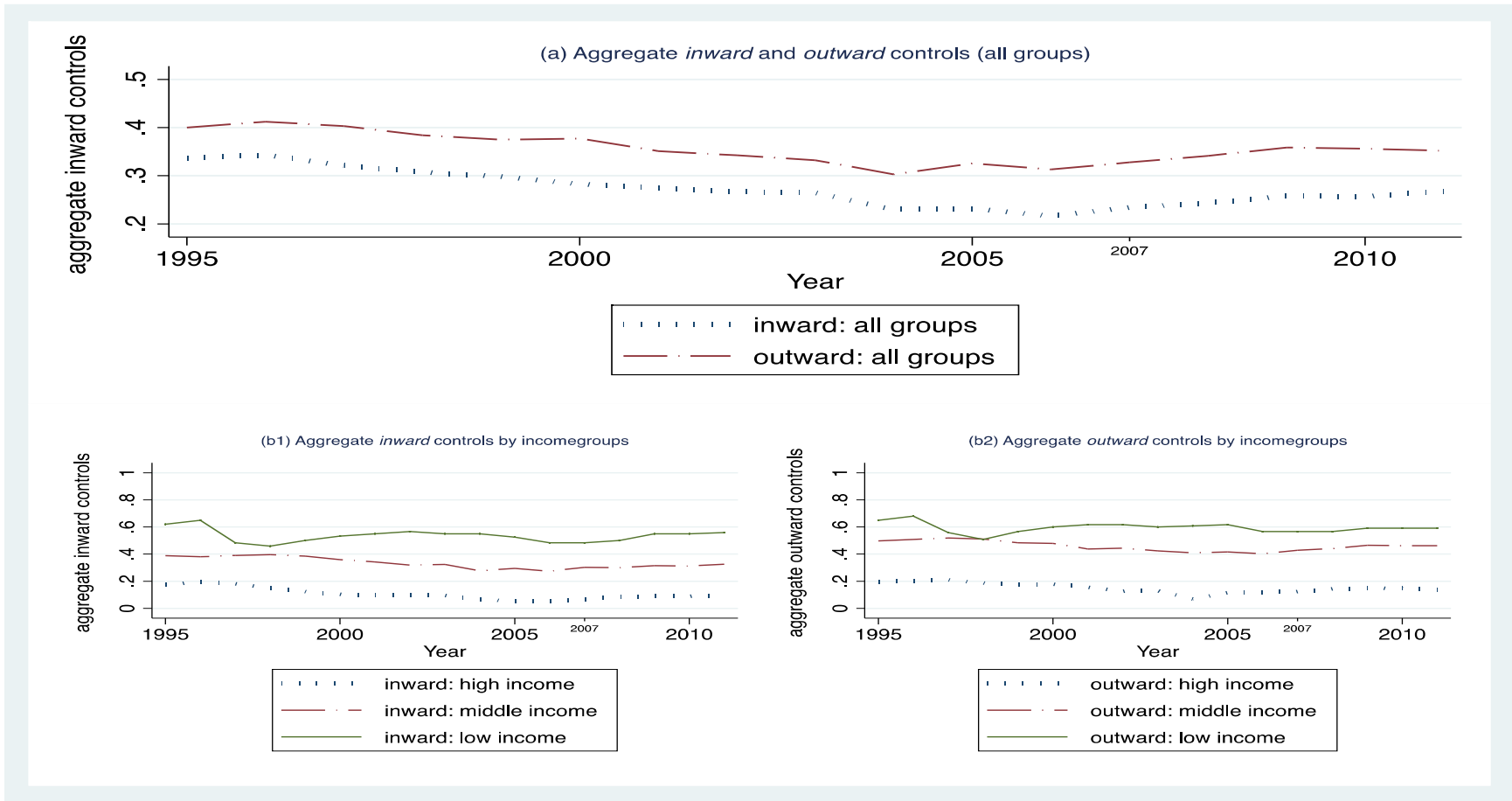
Note: (1) Source: Author's calculation.

Figure 5-2: Debt, Equity, and FDI Flows by Income Groups and Year



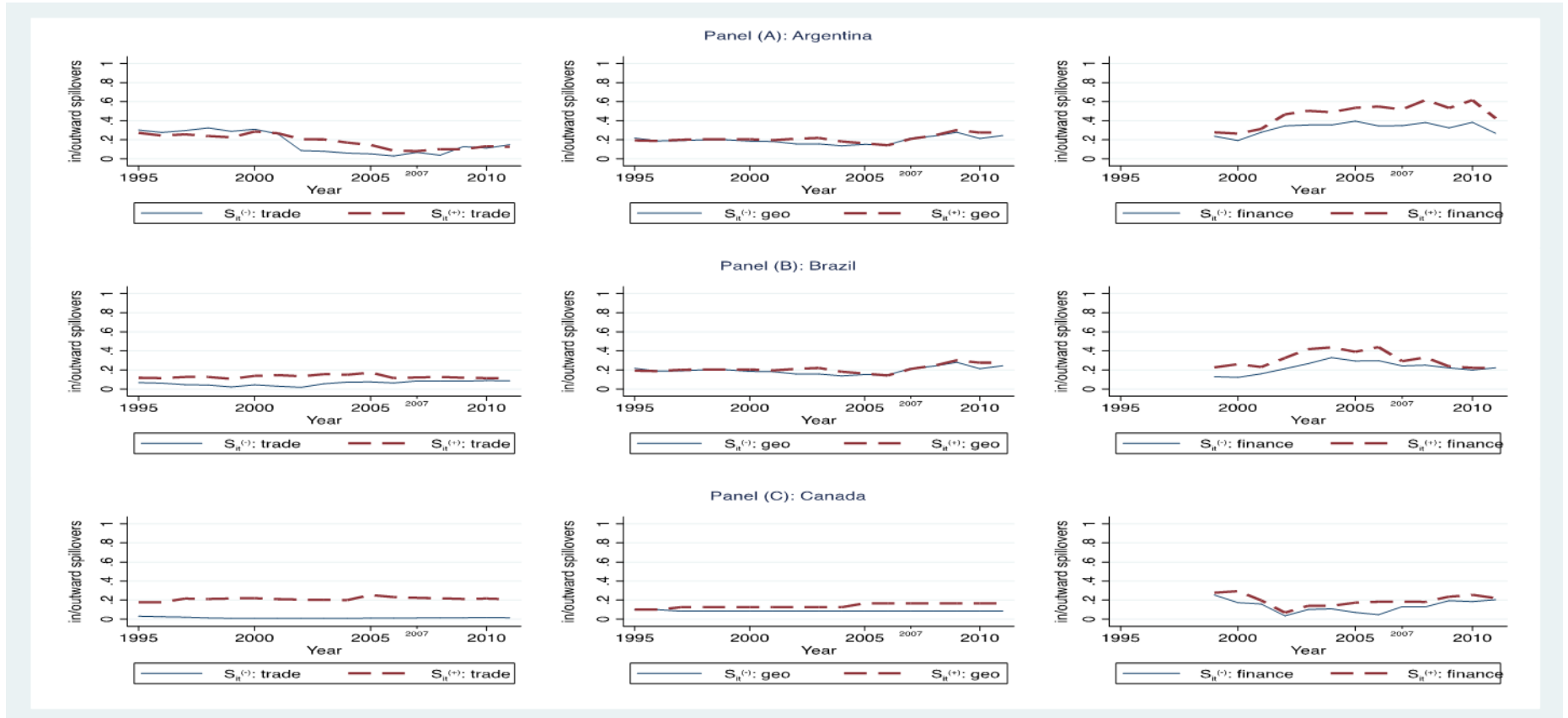
Note: (1) Source: author's calculation.

Figure 5-3: Evolution of Inflow and Outflow Capital Controls Indices



Note: (1) Source: author's calculation.

Figure 5-4: Spillover Variables by Linkages



Note: (1) Source: author's calculation.

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