



HAL
open science

Four essays on the optimal regulation of short-term international capital flows

Ilhame Lagrine

► **To cite this version:**

Ilhame Lagrine. Four essays on the optimal regulation of short-term international capital flows. Economics and Finance. Université de Rennes, 2020. English. NNT : 2020REN1G018 . tel-04187939

HAL Id: tel-04187939

<https://theses.hal.science/tel-04187939>

Submitted on 25 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

THESE DE DOCTORAT DE

L'UNIVERSITE DE RENNES 1

ECOLE DOCTORALE N° 597
Sciences Economiques et sciences De Gestion
Spécialité : « *Sciences Economiques* »

Par

Ilhame LAGRINE

Four essays on the optimal regulation of short term international capital flows

Thèse présentée et soutenue à Rennes, le 10 Décembre 2020
Unité de recherche : Centre de Recherche en Economie et Management (CREM)

Rapporteurs avant soutenance :

Sophie BRANA Professeur des Universités, Université de Bordeaux
Frédéric DUFOURT Professeur des Universités, École d'Économie d'Aix-Marseille

Composition du Jury :

Président : Jean-Sébastien PENTECOTE Professeur des Universités, Université de Caen Normandie
Examineurs : Sophie BRANA Professeur des Universités, Université de Bordeaux
 Frédéric DUFOURT Professeur des Universités, École d'Économie d'Aix-Marseille

Dir. de thèse: Jean-Christophe POUTINEAU Professeur des Universités, Université Rennes 1

The views expressed in this Ph.D. thesis are those of the author and do not necessarily reflect those of The University of Rennes 1 or any other institution.

(...) when there is a single accident on a highway, one suspects that the driver's attention may have lapsed. But when there are dozens of accidents at the same bend in the same highway, one needs to re-examine the design of the road.

I suggested that one might compare capital account liberalization to putting a race car engine into an old car and setting off without checking the tires or training the driver. Perhaps with appropriate tires and training, the car might perform better; but without such equipment and training, it is almost inevitable that an accident will occur. One might actually have done far better with the older, more reliable engine: performance would have been slower, but there would have been less potential for an accident. Similarly, the international economic architecture must be designed to "work" not just in the presence of perfect economic management, but with the kind of fallible governments and public officials that in fact occur in democratic societies.

Capital Market Liberalization, Economic Growth, and Instability ([Stiglitz \[2000\]](#))

Acknowledgments

First and foremost, I would like to express my deep gratitude to my advisor, Professor Jean-Christophe POUTINEAU for accepting to supervise this thesis and providing the help, the guidance, the support and the understanding I needed. I am honored to have the opportunity to work with him.

I would like to convey special thanks to the members of my defense committee, Professor Sophie BRANA, Professor Frédéric Dufourt and Professor Jean-Sébastien PENTECOTE. I am deeply grateful to all my Professors since primary school. Specially, Professor Essahel Said who taught me the basics of pure mathematics and helped me to enhance significantly my mathematical knowledge. Professor Eric Girardin for initiating me to research in macroeconomics. Thanks to him, I believe I am today a critical researcher using my engineering background.

I am also indebted to Professor Franck Moraux and Professor Thierry Pénard for their support and recommending me.

I would like to thank participants at IMAC and MACROFI Seminars. Their thorough comments on chapters 1 and 2 significantly improved the quality of my research. I am also indebted to participants at the doctoral workshops and “Journée de recherche du pôle PPVD” seminar for providing me with new insights on chapters 3 and 4.

I would like to thank Hélène Jean and Anne L’Azou for the administrative support.

last but not least, I am deeply grateful to my husband, my family and friends for all the support they have brought me.

Remerciements

Tout d'abord, je tiens à exprimer ma profonde gratitude à mon directeur de thèse Professeur Jean-Christophe POUTINEAU, qui a accepté de superviser cette thèse et m'apporter l'aide, le conseil et le soutien dont j'avais besoin. Je suis honorée de travailler sous sa direction.

Je tiens à remercier également, les membres de jury, Professeure Sophie BRANA, Professeur Fréd Dufourt et Professeur Jean-Sébastien PENTECOTE.

Je suis profondément reconnaissante à tous mes Professeurs depuis l'école primaire. En particulier, Professeur Essahel Said qui m'a inculqué les bases des sciences mathématiques et m'a aidé à améliorer significativement mes connaissances dans ce domaine. Professeur Eric Girardin pour m'avoir initié à la recherche en macroéconomie. Grâce à lui, je suis devenue aujourd'hui ingénieur et chercheuse avec un esprit critique plus développé.

Je suis également redevable au Professeur Franck Moraux et au Professeur Thierry Pénard pour leur soutien et leurs recommandations.

Je tiens à remercier les participants aux séminaires de "IMAC" et de "MACROFT". Leurs commentaires sur les chapitres 1 et 2 ont considérablement amélioré la qualité des résultats. Je suis également redevable aux participants aux ateliers doctoraux et au séminaire de la "Journée de recherche du pôle PPVD" de m'avoir donné de nouvelles idées sur les chapitres 3 et 4.

Je tiens à remercier Hélène Jean, Cécile Madoulet et Anne L'Azou pour le soutien administratif.

Je suis profondément reconnaissante à mon mari Florian qui m'a soutenu et supporté le long de cette aventure. Grâce à son soutien et son amour, j'ai pu aller jusqu'au bout.

Je remercie infiniment ma famille, ma belle-famille et mes amis pour le soutien et les encouragements.

Je dédie ce modeste travail à ma grand-mère et mes parents en guise de reconnaissance et de gratitude.

Contents

Acknowledgments	i
Remerciements	iv
General introduction	1
1 Sudden Stops across countries and decades: An empirical investigation	15
1.1 Introduction	15
1.2 From Capital Flow Reversals to Sudden Stops	17
1.3 Are all sudden stops alike ?	26
1.4 Econometric analysis	30
1.4.1 Model and estimation results	30
1.4.2 Sensitivity analysis	35
1.5 Conclusion	35
2 Optimal vs. simple capital control rules in a sudden stop environment	43
2.1 Introduction	43
2.2 Economic dynamics under Laissez-faire	46
2.2.1 First order conditions and equilibrium dynamics	47
2.3 Capital control policies	50
2.3.1 The Ramsey economy	50
2.3.1.1 The cyclical behavior of the optimal capital control tax	52
2.3.2 A simple macro-prudential policy rule	55
2.3.3 A capital control tax to address households' impatience	56

2.4	Welfare analysis	58
2.5	Quantitative analysis	58
2.5.1	The long run macroeconomic dynamics	61
2.5.2	Crises frequency and severity	63
2.5.3	Macroeconomic volatility	64
2.5.4	Boom-bust cycles under endogenous endowments shocks	70
2.5.5	Typical crisis under exogenous endowments shocks	71
2.6	Conclusion	72
3	Sterilization and capital control policies for managing debt-creating capital inflows	77
3.1	Introduction	77
3.2	The Model	80
3.2.1	Households	81
3.2.2	Domestic Firms	83
3.2.3	Capital flows and capital control policy	84
3.2.4	Monetary authority	85
3.2.5	The foreign sector	86
3.2.6	Optimal equilibrium and market clearing conditions	87
3.3	Solution Strategy	88
3.3.1	Model calibration	89
3.3.2	Optimal parameters for alternative policy rules	92
3.3.3	The constrained vs. unconstrained economy	92
3.3.4	Occasionally vs. permanent binding collateral constraint	94
3.4	Interaction between monetary policy and alternative policies	96
3.4.1	The cyclicity of alternative policies	96
3.4.2	Macroeconomic volatility	97
3.4.3	Sensitivity analysis	99
3.5	Conclusion	100

4	Financial acceleration and optimal prudential capital controls in a SOE subject to floods and sudden stops	111
4.1	Introduction	111
4.2	The model	113
4.2.1	Households	115
4.2.2	Firms	117
4.2.2.1	Production firms	118
4.2.2.2	Importing firms	120
4.2.2.3	Unfinished capital producers	120
4.2.3	Entrepreneurs	121
4.2.4	Financial sector	123
4.2.4.1	Capital inflows	123
4.2.4.2	Financial intermediaries	124
4.2.5	Public policies	124
4.2.5.1	Macroprudential policy	125
4.2.5.2	Capital control policy	125
4.2.5.3	Monetary policy	126
4.2.6	The rest of the world	126
4.3	General Equilibrium and Balance-of-Payments Dynamics	127
4.4	Model Parametrization and solution	128
4.4.1	Calibration	128
4.5	Optimal policy responses and welfare evaluation	129
4.5.1	Do Alternative Policies Perform?	132
4.5.2	Macroeconomic and financial stability	137
4.6	Conclusion	137
	General conclusion	139
A	Data and sensitivity analysis	143
A.1	Countries of interest	143

A.2	Sudden stops episodes by country	144
A.3	Data source and definition	149
A.4	Sensitivity analysis	153
A.5	Sensitivity analysis	154
B	Proofs and numerical solutions	161
B.1	The optimal capital tax solution	161
B.2	Numerical Solution Method for unregulated, Ramsey and regulated economies: Endowment shocks driven economy	163
B.3	Traded endowment and foreign interest rate shocks driven economy	164
B.4	Traded endowment and international interest rate shocks	165
B.4.1	Bonds decision rules and long term distribution	166
B.4.2	Crises frequency and severity	167
B.4.3	Macroeconomic volatility	170
B.4.4	Boom-bust cycles under endowment and international interest rate shocks	173
B.4.5	Typical crisis under endowment and international interest rate shock	175
C	Model derivations and solutions of chapter 4	179
C.1	Households	179
C.2	Firms	180
C.2.1	Domestic production firms	180
C.2.2	Importing firms	181
C.2.3	Unfinished capital goods producers	181
C.3	Entrepreneurs	182
C.4	Capital inflows	187
	Bibliography	201
	List of Figures	201

General Introduction

The current Covid-19 pandemic is raising serious concerns about the future of globalization and the ability of countries to avoid, individually, a deep recession and, collectively, a new global financial crisis. Since its outbreak, a growing literature is figuring out the optimal public policy responses that would help public authorities to navigate the crisis (see for example [Chang and Velasco \[2020\]](#), [Jones et al. \[2020\]](#)).

However, the ongoing debate on the international economic and financial architecture and its consequences on national economies is far from being unprecedented. Indeed, the world economy has been frequently suffering from economic and financial crunches questioning each time the effectiveness of financial and economic liberalization, but leading to a better understanding of the crisis dynamics and the adequate policy responses.

In the recent past, the Global Financial Crisis (GFC) that began in 2007 triggered new debates on old beliefs by calling into question two pre-crisis widespread convictions, **(i)** the Efficient-Market Hypothesis (EMH)¹ failed to insure markets self-regulation putting an end to laissez-faire policies ([Minsky \[1992\]](#), [Whalen \[2007\]](#), [Krugman \[2009\]](#), [Fox and Sklar \[2009\]](#)), **(ii)** international financial integration and full capital account liberalization do not lead necessarily to higher economic growth and welfare ([Calvo et al. \[1994\]](#), [Stiglitz \[2000\]](#), [Korinek \[2018\]](#)).

¹The efficient market hypothesis (EMH) asserts that financial markets are efficient. An efficient market is a market in which prices always "fully reflect" available information set ([Malkiel and Fama \[1970\]](#)), i.e. if the price would be unaffected by revealing the information set to all market participants ([Malkiel \[1992\]](#)). See [Sewell \[2011\]](#) for a survey on the history of the Efficient Market Hypothesis.

Leaning against the wind: The promising role of macro-prudential policies

The first statement (i) has revived the "lean" versus "clean" debate² and has called into question the basic policy strategies used prior to the crisis to manage the economy, especially the conduct of monetary policy and the role of central banks to avoid financial instability. Indeed, a pre-crisis consensus view emerged among policy makers and academic economists alike, considering flexible inflation targeting³ as an efficient monetary policy framework allowing central banks to achieve macroeconomic stability by stabilizing inflation in medium term and output in short term around their target levels with no trade-off between stabilizing inflation or output (Bernanke and Mishkin [1997], Bernanke et al. [1999], Blanchard and Gali [2005], Blanchard et al. [2013]). This policy orientation assumed a clear dichotomy between macroeconomic and financial stability and thus has underestimated the role of the financial sector as one of the main drivers of business cycle (Mishkin [2011]). As a result, the prevailing pre-crisis financial policies acted inside two separate scopes of action:

- Monetary policy focused on price stability,
- Prudential regulatory supervisory arrangements focused on the stability of individual institutions rather than the financial system as a whole (Blanchard et al. [2010], Borio [2011]).

Consequently in the aftermath of the last GFC, monetary authorities have been called to intensify their interventions and to strengthen their regulatory and supervisory frameworks by adding a macro dimension to microprudential arrangements strongly focusing

²Should public authority intervene before or after the bursting of the bubble?

³Following Mishkin [2011]: the rationale for the flexible inflation targeting framework was provided by eight basic principles derived from the science of monetary policy (Goodfriend and King [1997]); 1) inflation is always and everywhere a monetary phenomenon; 2) price stability has important benefits; 3) there is no long-run trade-off between unemployment and inflation; 4) expectations play a crucial role in the determination of inflation and in the transmission of monetary policy to the macroeconomy; 5) real interest rates need to rise with higher inflation, i.e. the Taylor Principle; 6) monetary policy is subject to the time inconsistency problem; 7) central bank independence helps improve the efficiency of monetary policy; 8) commitment to a strong nominal anchor is central to producing good monetary policy outcomes; Mishkin [2011] has added the ninth principal related to financial frictions and business cycles ; 9) financial frictions play an important role in business cycles.

on systemic risk⁴. Therefore, monitoring systemic risk and financial stability is becoming an independent policy area known as macroprudential policies with its own objectives and tools (Constâncio [2016a]).

In a seminal paper, Borio [2003] delimited the scopes of macro and micro-prudential policies by defining the objectives and the characteristics of each policy.

- Macroprudential policies have to avoid real output significant losses resulting from financial crisis by limiting financial system-wide distress, taking account of the global behavior of financial institutions (endogenous risk) and the structure of the financial system structure (interconnection across financial institutions)
- Microprudential policy objective remains consumer protection by ensuring the safety and the soundness of individual institutions. The top-down approach of macroprudential policies, in contrast to the bottom-up approach of microprudential, consists on macro-stress tests that investigate the stability of financial institutions instead of individual ones in response to a shock.

Table 1: The macro- and microprudential perspectives compared Borio [2003]

	Macroprudential	Microprudential
Proximate objective	limit financial system-wide distress	limit distress of individual institutions
Ultimate objective	avoid output (GDP) costs	consumer (investor/depositor) protection
Model of risk	(in part) endogenous	exogenous
Correlations and common exposures across institutions	important	irrelevant
Calibration of prudential controls	in terms of system-wide distress; top-down	in terms of risks of individual institutions; bottom-up

Source: Borio [2003]

⁴Fund et al. [2009, 2016] define systemic risk as " *the risk of widespread disruption to the provision of financial services that is caused by an impairment of all or parts of the financial system, and which can cause serious negative consequences for the real economy* "

Towards a pragmatic approach of capital account liberalization: The promising role of capital control and macroprudential policies

Regarding the second statement (ii), the last GFC saw an unprecedented collapse in international capital flows after years of rising financial globalization. The sharp decline of capital inflows in some emerging market economies (EMEs), combined with the weakness of global demand, rises real concerns about their financial stability. This fact revived the debate on the limitation of capital account liberalization policies in ensuring the safety of domestic financial system and macroeconomic stability. Indeed, throughout most of the last four decades, a large strand of literature supports fully liberalized capital account policies in EMEs based on the argument of the Allocative Efficiency, i.e. enhancing international resources' allocation (see for example, Fischer [1998], Obstfeld [1998], Summers [2000]). Nevertheless, the debate on free international capital mobility has been taking another direction calling into question the main argument, and its implication in terms of optimal public policies. As a result, a new view on the effectiveness of capital control and macroprudential policies emerges, mainly as policies aiming at preventing financial crisis. Even the International Monetary fund, historically a strong supporter of free capital movement, adjusted its institutional view (IMF [2012]) to take account of potential regulation power of these policy measures to ensure macroeconomic and financial stability.

Pecuniary Externalities Do Matter

The new literature on capital control and macroprudential policies relies on their ability to restore the efficiency of resources allocation in a situation where financial frictions resulting from the presence of pecuniary externalities matter. Basically, externalities are defined as the consequences of an agent's economic activity on that of other agents who are not involved in such activity. Viner [1932] distinguishes pecuniary from technological externalities as follows:

- Technological externalities refer to a situation where an agent's activity has a direct effect on the utility or production function of another agent without influencing prices,
- Pecuniary externalities, by contrast, correspond to situations where this effect is indirect and transmitted only via prices⁵.

The relevance of externalities in economic welfare theory accounts for their implication in terms of competitiveness, optimal resource allocation and welfare. Indeed, [Bator \[1958\]](#) argues that the market failure is an outcome of the presence of externalities, under which the first fundamental theorem of welfare does not apply and so competitive equilibrium is not necessary Pareto optimal⁶. Consequently, pecuniary externalities could lead to Pareto inefficiency and significant welfare losses ([Greenwald and Stiglitz \[1986\]](#)). Accordingly, public interventions are desirable to correct the market failure and to optimize the resource allocation and welfare ([Pigou \[1932\]](#)).

In the context of free capital movement debate, two forms of pecuniary externalities are extensively investigated ([Rebucci and Ma \[2019\]](#)). A first strand of the literature focuses on pecuniary externalities arising from the presence of an endogenous borrowing constraint introduced by [Mendoza \[2002\]](#). In his paper, [Mendoza \[2002\]](#) supposes that banks intermediate capital inflows denominated in hard currencies into domestic loans generally denominated in national currencies and value the collateral in domestic asset prices. In such an environment, pecuniary externalities result from the endogenous borrowing constraint inhibiting private agents to carry an amount of debt higher than a fraction of aggregate output valued at domestic prices. Following a small negative shock, if leverage is high enough, the decline of output could lead to a binding collateral constraint. As a result, private agents reduce their aggregate absorption without internalizing the effect of their collective behavior on prices and thus on their collateral values, leading to a further

⁵See [Laffont \[1975\]](#) for an historical survey on external effects

⁶"Under the regime of free concurrence, prices are established in such a way to give each exchanger the maximum of (his) ophelimity. It is generally said the utility maximum" [Pareto \[1896\]](#). In other words, Pareto optimality stipulates that there does not exist an alternative feasible resource allocation which can make some individual better off without making someone else worse off ([Dobbs \[1981\]](#), [Greenwald and Stiglitz \[1986\]](#))

tightening of financial conditions and more pronounced output drop. Consequently, the presence of the endogenous borrowing constraint amplifies the shock through two main channels; fire sales and debt deflation spirals (Fisher [1933]). Using the same analytical framework, Korinek [2011, 2018] argue that these pecuniary externalities do matter for financial stability and thus financial regulation should focus on them. Jeanne and Korinek [2010b] suggest the use of a Pigouvian taxes that might induce private agents, mainly banks, to properly internalize externalities they create. Mendoza [2016] shows that macro-prudential policy is a powerful tool for preventing financial crises, in the sense that a constraint-efficient financial regulator can reduce significantly the severity and frequency of such crises. Bianchi [2011] shows that the pecuniary externality leads to over-borrowing and the optimal capital control tax is positive on average, while Schmitt-Grohé and Uribe [2017] state that the Ramsey optimal capital tax is pro-cyclical and thus can not be considered as a macro-prudential instrument. Bianchi and Mendoza [2018] show that in open economies with stock collateral constraints the unregulated economy over-borrow in comparison with regulated economy.

A second strand of the literature sheds light on aggregate demand externalities arising from the presence of nominal rigidities and constrained monetary policy. The constraint on monetary policy may result from a zero lower bound on interest rate or from the fixed exchange rate. In such an environment, the economy is demand-driven and private agents are, as in the case of the endogenous credit limit, too small to internalize the aggregate demand effects of their decisions. As a result, financial conditions become more pro-cyclical. They might boost aggregate demand excessively during the expansionary phase of the cycle leading to the build up of financial vulnerabilities. During bust cycle, the build up of financial imbalances could throw the economy into a severe recession. Within this framework, Farhi and Werning [2016] provide a general theory on the capacity of macroprudential and capital control policies to address the distortionary effect of aggregate demand externalities. Schmitt-Grohé and Uribe [2016b] argue that prudential capital control policies are desirable to address externalities arising from free capital mobility, in an economy with a fixed exchange rate and nominal rigidities in labor market.

Korinek and Simsek [2016] investigate the role of macroprudential policies in an economy with good price rigidities and a zero-lower bound on interest rates. As a main finding, macroprudential policies are welfare improving since they provide additional tools to deal with households excessive leverage ex-ante.

Another new motive for the use of capital control and macroprudential policies is derived from the ongoing debate on the existence and implications of Global Financial Cycle. In fact, Rey [2015] points out new empirical evidences on the pro-cyclicality of the global financial markets highlighted by a synchronous rise and fall in capital flows, asset prices, credit growth and leverage. Her main conclusion stipulates that the Global Financial Cycle transforms the *trilemma* into a *dilemma*, i.e. to ensure the independence of monetary policy, capital flows should be managed directly by using capital control policies, or indirectly by implementing macroprudential measures, regardless of the exchange rate regime. In fact, as global financial cycle is determined by exogenous global factors⁷ that are beyond the control of government, domestic economic policies become constrained by the evolution of those factors. Thus, implementing capital account management policies aims at enhancing the effectiveness of domestic public policies (Angeloni and Faia [2009], Kannan et al. [2012]). Nevertheless, using a standard New Keynesian model of a small open economy with nominal rigidities, Farhi and Werning [2014] find that the exchange rate regime is key, and capital controls lean against the wind even when the exchange rate is flexible.

Thesis Statement and Contributions

This new literature on prudential capital control policies provides new directions for public policies based on the theoretical advancements and empirical evidences presented in the previous section. In particular, it sheds a new light on the roots behind Currency Crises⁸ in emerging market economies, and optimal policies that should be undertaken

⁷Rey [2016] provides evidence that US monetary policy shocks are transmitted internationally and affect financial conditions even in inflation targeting economies with large financial markets.

⁸Currency crisis, also called Balance-of-Payments crisis, is a crisis resulting in a speculative attacks on country's currency that lead to excessive exchange rate depreciation and sovereign debt default

to prevent them. Before the East Asian crisis of 1997 – 1998, the dominant approach in the related literature focused on the distortionary effect of public policies that jeopardise the sustainability of exchange rate regime (first generation models, [Krugman \[1979\]](#), [Flood and Garber \[1984\]](#)). Indeed, most Latin American countries hit by the debt default crisis that occurred between 1982 – 1989, pursued unsustainable macroeconomic policies, i.e. an accommodating fiscal policy financed by domestic money creation incompatible with a pegged exchange rate regime. Nevertheless, the series of speculative attacks targeting most of the European monetary system currencies during 1992 – 1993 called into question the basic idea that seigniorage is the sole underlying cause of currency instability. Thus, another point of view arose explaining crisis as the product of investors' expectation about exchange rate regime sustainability and doubt on whether a government is willing to maintain its exchange rate peg or to pursue a more expansionary monetary policy (second generation models, [Obstfeld \[1994\]](#)). The main finding of these models emphasizes possible self-fulfilling crises coming from a feedback loop between investors' confidence and currency fluctuations, i.e. a deterioration of investor confidence driven by fears about the exchange rate sustainability generates a currency depreciation feeding further investor pessimism and leading, in fine, to currency attacks.

In the aftermath of the East Asian crisis of 1997 – 1998, a third generation models added new features that were not included so far. [Krugman \[2001\]](#) organizes the third generation models into three main variants. The first version stresses moral hazard driven investment. In these models, special attention is given to currency mismatch and moral hazard that lead banks to engage on excessive risk taking and over-borrowing ([McKinnon and Pill \[1996\]](#), [Corsetti et al. \[1998\]](#), [Krugman \[1999\]](#)). The second version, largely associated to [Chang and Velasco \[1999\]](#)' work, advocates the role of international illiquidity-driven channel as a main factor of currency crashes. Finally, the third variant emphasizes the role of financial amplification effect that arises from balance sheets deterioration associated to a decline of asset prices ([Krugman \[1999\]](#), [Aghion et al. \[2004\]](#)).

This thesis in line with the third generation models investigates the effectiveness of prudential capital policies in preventing and reducing the frequency of Currency Crisis in

emerging market economies. Special focus is given to the optimal conduct of monetary, capital control and macroprudential policies and their macroeconomic outcomes, in preventing currency crisis driven by sudden stops in capital flows. Sudden Stops are defined as episodes where a sudden reversal in the dynamics of international capital flows is followed by a sharp drop in output, a fall in asset prices and a contraction in domestic credit to private sector (Calvo et al. [1996], Mendoza [2002]).

The thesis is organized along four chapters:

- **Chapter 1** investigates the main empirical regularities of sudden stops using quarterly data on an extended dataset comprising 75 developed and emerging market economies over the time period 1960Q1 – 2017Q4 and explores the relationship between the probability of such episodes and a number of domestic and international factors. We measure Net Capital inflows following Calvo et al. [2004]. Using a time-varying filter, we isolate 443 capital retrenchment episodes, among which 149 give rise to a sudden stop. We find some similar time path for macroeconomic variables over 8 quarters surrounding a typical sudden stop episode but with sharper negative consequences for emerging countries in the pre Asian crisis period. However, after 1997 the situation of developed countries worsens. Regarding the econometric analysis, our results assign a key role to foreign reserves flows and the exchange rate stability index in explaining the likelihood of sudden stops during the pre 1997 era in emerging market economies. However, a high and a positive domestic credit-to-GDP gap and a low financial openness index is associated with a higher probability of experiencing a sudden stop during the post 1997 period. In advanced countries, before the Asian crisis the likelihood of such events is significantly affected by the stability of exchange rate and foreign reserve flows, while during the period after only global and domestic real economic growths in addition to credit-to-GDP gap remain significant.
- **Chapter 2** analyzes the outcomes of three prudential capital control policies in a Small Open Economy Dynamic Stochastic General Equilibrium (SOE-DSGE) model with pecuniary externalities due to flow collateral constraints (Mendoza

[2002], Bianchi [2011]). We propose a solution for the optimal capital tax that suffers from indeterminacy during crisis periods. Based on this solution, we provide an explanation for its pro-cyclical behavior during a typical boom-bust cycle as stressed in Schmitt-Grohé and Uribe [2017]. However, by contrast to Schmitt-Grohé and Uribe [2017], our results suggest that the optimal tax should be lowered during a typical crisis. In addition, we investigate the outcomes of two alternative policies, i.e. a fixed debt-tax on foreign debt and a simple macroprudential policy based on foreign debt-to-GDP ratio targeting. Our results show that the implementation of the simple macroprudential policy leads to a welfare gain relatively higher than that of the regulated economy with fixed debt-tax and more than seven times higher than that of Ramsey economy.

- **Chapter 3** extends the analytical framework of the previous chapter by introducing a monetary authority and an endogenous production technology. We then investigate the outcomes of sterilization and capital control policies in an economy with pecuniary externalities arising from the presence of a borrowing constraint. In this model, the monetary authority has the ability to use sterilization and capital control policies in addition to a Taylor rule based monetary policy. Our main finding suggests that the optimal policy response of both sterilization and capital control, combined with monetary policy, lean against the wind by smoothing out capital flows. In fact, when the economy experiences a surge of capital flows, the optimal response of capital control and sterilization policies is to avoid households from accumulating a large amount of debt by either increasing government bond supply to absorb the increase of domestic liquidity or by raising capital control tax.
- **Chapter 4** draws special attention to the impact of capital flows on private investment dynamics in an economy strongly dependent to external financing. To this end, we adopt a SOE-DSGE model with financial frictions a la Bernanke et al. [1999]. Our main finding suggests that the optimal policy depends on the source of exogenous shocks. When the economy is hit by a domestic exogenous shock on productivity, implementing monetary policy delivers the higher welfare gain. When the

economy is subject to an unexpected foreign exogenous shock, alternative policies including an augmented Taylor rule targeting credit growth, enhance significantly the aggregate welfare. In addition, a sudden stop in foreign capital inflows, induced by either a negative exogenous shock on capital flows or an unexpected increase in foreign interest rate, brings the economy into a crisis. Indeed, an unexpected decline in capital inflows leads to a drop in domestic credit supply. As a result, entrepreneurs reduce their debt accumulation by lowering their aggregate expenditure on investment. Consequently, private investment and aggregate output shrink significantly. Following this shock, the optimal capital control policy is countercyclical and leans against the wind by stabilizing capital flows and thus mitigating their impact on the private investment. The welfare gain of using such a policy is significantly high. The adoption of a broad measure of macroprudential policy, by contrast, delivers a similar welfare gain as in a scenario where only Taylor-rule based monetary policy is implemented. It calls also for leaning against the wind by lowering the regulation premium on entrepreneurial external financing when the economy is experiencing capital outflows.

A Brief History of Macroprudential Policy

The conceptual aspect of the macroprudential term has developed over time, reflecting in each period the preoccupations of bank supervisors and central bankers, related to financial markets and banking system development. Indeed, the quarterly review published by the International Bank of Settlements (Clement [2010]) shows that its origin is not as recent as one might think and dates back to early 80s. In 1979, WP Cooke the chairman of the Cook committee stressed the emergence of some macroeconomic vulnerabilities in the international banking system (...) *at the point where micro-prudential problems became what could be called macro-prudential ones*^a. The second appearance of the macroprudential term was recorded the same year in a document of Bank of England revealing the limits of the microprudential approach in the control and the monitoring of aggregate lending. In this document, macroprudential approach (...) *considers problems that bear upon the market as a whole as distinct from an individual bank, and which may not be obvious at the micro-prudential level* (Clement [2010]).

The use of the macroprudential term in these two documents did not arise a particular public interest until 1986; when it reappeared in a publicly published document prepared by a study group^b exploring the impact of financial innovations on the soundness of financial markets, the conduct and the effectiveness of monetary policy (for International Settlements [1986]). The report provides a comprehensive analysis of how off-balance-sheet innovations affect financial stability by shifting financial market structure and facilitating its worldwide integration^c. The report focused on the development of a range of new financial instruments^d in derivative and securitization markets, seen as the main drivers of credit growth and capital markets activities. Risk assessment of these new instruments revealed a number of vulnerabilities that might threaten financial stability.

^aThis declaration took place in a meeting held to review and discuss policy options to address risks associated with the rapid increase of loans to developing countries concomitantly with a sharp increase of oil prices, which threatened the solvency of those countries.

^bThis study was requested by the governors of the central banks of G10.

^cThe report stressed that as innovations facilitate the development and the emergence of new hedging and trading instruments, mostly taking the form of off-balance-sheet commitments, they lessen the importance of banks as a channel of direct credit intermediation (for International Settlements [1986, P235])

^dThe instruments studied in this document are: Note issuance facilities (NIFs), currency and interest rate swaps, foreign currency and interest rate options and forward rate agreements.

It concerns mainly their ability (i) to transfer risk within agents which might lead to an increase of concentration risk in the financial sector (for [International Settlements \[1986, P2\]](#)), (ii) to encourage some agents on more credit exposures^a, and (iii) to promote short term trading opportunities rather than long term credit quality. The report main conclusions highlight the need for a flexible regulatory framework, including macroprudential policy that ensures "*(...) the safety and soundness of the broad financial system and payments mechanism*" (for [International Settlements \[1986, P2\]](#)). This document could be considered so far as the first public report which shed more lights on the roots of systemic risk, it has shown in a very comprehensive way how financial structure has developed over time and the resulting regulatory challenges arising from this development.

Afterward and in response to the Asian crisis of 1997, the International Monetary Fund (IMF) published a document entitled "*Towards a framework for financial stability*" calling to enhance banks transparency and insisting on the need for more strengthened analytical framework taking into account the evolution of a set of macro-financial data to monitor financial risk. It was emphasized that "*(...) Macro-prudential analysis is based on market intelligence and macroeconomic information, and focuses on developments in important asset markets, other financial intermediaries, and macroeconomic developments and potential imbalances*"([Folkerts-Landau and Lindgren \[1998, P13\]](#)). This document was followed by another report published in 2000 introducing macro-prudential indicators used in the Financial Sector Assessment Program (FSAP) of the fund ([FM \[2000\]](#)) until today.

During the same year, [Crockett \[2000\]](#) defined macroprudential policies, by their objective rather than their instruments, as policies aiming at limiting the systemic risk, e.g. the failure of a significant portion of financial system and its corresponding costs on real economy, while micro-prudential policies objective is to lessen the likelihood of the failure of an individual financial institution.

^aBecause risks related to credit exposure are difficult to measure because of, first, the complexity and the opacity of these new instruments might result in a high aggregate default probability of banks leading to a large domino effect, and second, innovations disintermediated the traditional channel of credit which lead to facilitating credit access (for [International Settlements \[1986, P242\]](#))

Crockett [2000] introduced two aspects of the macroprudential approach. The first aspect is based on the monitoring of different financial institutions at a point in time, with a special focus on systemically important institutions whose failure might threaten the stability of the market as a whole and trigger a financial crisis. This aspect is known as the cross-sectional dimension of macroprudential policies. The second perspective focuses on the measurement and mitigation of the systemic risk over time, i.e. the time-dimension of macroprudential policies. This aspect aims at reducing the pro-cyclicality of financial conditions and the buildup of financial imbalances over time, mainly by implementing counter-cyclical measures.

Since the last GFC, many public definitions of macroprudential policy have been emerging. Bank of England (Saporta [2009]) defines macroprudential policy as a policy aiming at ensuring financial stability by maintaining a stable provision of financial services to the wider economy - payments services, credit supply, and insurance against risk. International Monetary Fund jointly with Bank of International Settlement and Financial Stability Board (Fund et al. [2009, 2016]) specify macroprudential policies based on three key elements : " (i) *Its objective*: to limit systemic risk, i.e. the risk of widespread disruptions to the provision of financial services that have serious negative consequences for the economy at large. (ii) *Its scope*: the focus is on the financial system as a whole (including the interactions between the financial and real sectors) as opposed to individual components (that take the rest of the system as given). (iii) *Its instruments and associated governance*: it uses primarily prudential tools calibrated to target the sources of systemic risk. Any non-prudential tools that are part of the framework need to clearly target systemic risk ". The European Central Bank has adopted a similar definition; macroprudential policy ultimate objective is preventing and mitigating systemic risk, which is defined " as the risk that financial instability significantly impairs the provision of necessary financial products and services by the financial system to a point where economic growth and welfare may be materially affected " (Constâncio [2016b]).

Chapter 1

Sudden Stops across countries and decades: An empirical investigation

1.1 Introduction

The increased financial mobility experienced by both developed and emerging market economies over the last decades has been characterized by recurrent episodes of capital flow retrenchments, some of them ending in painful sudden stops. Four main empirical regularities (Mendoza [2002], Calvo et al. [2004], Mendoza [2010], Calvo et al. [2008]) characterize this pathology: (1) a sudden reversal in the dynamics of international capital flows (i.e. a quick switch from a deficit of the current account to a surplus at the outset of the crisis), (2) a sharp drop in output, (3) a fall in asset prices and (4) a contraction in domestic credit to private sector.

The Focus on such episodes was initiated by Calvo et al. [1996]. Since then, a growing number of research has been devoted to the understanding of such troubles and to the appropriate policy responses to counter them (Mendoza [2002], Korinek [2010], Jeanne and Korinek [2010a], Bianchi [2011], Korinek and Mendoza [2014]). Empirically many progresses have been made over the last two decades (Edwards [2004], Calvo et al. [2008], Cavallo and Frankel [2008]) underlying the key role of both domestic (push) factors as well as foreign (pull) factors. Among the main findings, more financial and trade openness

seems to reduce the probability of sudden stops occurrence. By contrast, countries with high domestic financial vulnerabilities, such as liability dollarization and a low of official foreign exchange reserves, have more chance to be hit by sudden stops. In addition, more recent studies highlight the role of global factor and contagion in explaining the likelihood of such episodes ([Forbes and Warnock \[2012\]](#), [Comelli \[2015\]](#), [Ghosh et al. \[2016\]](#)).

The aim of this chapter is to review the empirical regularities of sudden stops in Net Capital inflows using an extended data-set comprising quarterly data on 75 developed and emerging market economies over the time period 1960 – 2017 and to explore the relationship between the probability of occurrence of such episodes and a number of domestic and global factors, such as terms of trade, trade and financial openness in addition to global economic growth. We measure Net Capital inflows following [Calvo et al. \[2004\]](#). With regard to the above literature, the value added of our study rest on the adoption of a time-varying filter based on a rolling window to isolate periods of capital flow retrenchments that give rise to sudden stop episodes. The advantage of adopting such an approach is that we can get more insight on the short run aspects of financial disorders that may give rise to sharp macroeconomic troubles. Furthermore, the rolling window allows us to overcome problems encountered with a fixed threshold filter as we are able to account for structural changes affecting the dynamics of financial flows over 228 quarters resulting in financial markets development and more liberalized external accounts in the world. Indeed adopting a fixed filter such as in [Calvo et al. \[2004\]](#) may introduce a bias as a high volatility of capital flows in a given period may affect the threshold of the filter over the entire sample which may reduce the number of sudden stop episodes to account for.

This methodology provides us with 443 capital retrenchment episodes, among which 149 give rise to a sudden stop ($1/3$ in developed countries and $2/3$ in emerging economies). The quarterly approach of our study is useful to disentangle short run adjustment dissimilarities in the macroeconomic and financial aggregates depending on whether countries belong to the group of developed or emerging market economies. In particular, even if we find some similar time path for macroeconomic variables over the quarters surrounding

the episode, the crisis is sharper and more disruptive on average for emerging countries. However, we observe a worsening of the situation of developed countries experiencing a sudden stop in the post 1997 era.

Regarding the econometric analysis, we estimate a panel logit model with country fixed effects that approximates the conditional probability of falling into a sudden stop as a function of a set of domestic and global factors typically used in the literature as determinants of such crises. The results show clear differences in the explanatory variables across country groups in the pre 1997 period. Things are different after 1997. In particular, we find that the probability of a sudden stop significantly depends on the three main variables: real economic growth and global real GDP growth while the effect of financial variables is mainly channeled through the credit to GDP gap.

The rest of the chapter is organized as follows. Section 1.2 isolates sudden stops from capital retrenchment episodes using a rolling window filter. Section 1.3 explores the characteristics of sudden stops depending on the type of economies (developed or emerging market) and on the time period (pre and post 1997 era). Section 1.4 conveys the econometric analysis. Section 1.5 concludes.

1.2 From Capital Flow Reversals to Sudden Stops

In this section we disentangle sudden stop episodes from an extended sample of capital retrenchment periods obtained using a time-varying filter. Following Calvo et al. [2004], we measure Net Capital inflows (NCF) as minus the current account balance. When current account data is not available, we substitute it by the external trade balance and reserve data. We then normalize our net capital inflows measurement by GDP. Finally, we calculate the year-over-year difference to eliminate seasonal fluctuations. We extract current account, trade balance and foreign reserves data at a quarterly frequency, from the IMF's International Financial Statistics (IFS) database as well as annual GDP data from the World Bank's World Development Indicators (WDI) database interpolated at quarterly frequency over the period of 1960 to 2017. We conduct our analysis on 75

countries (47 are emerging economies, 28 are developed economies)¹.

The international financial background of the paper is summarized in Figure 1.3. Figure 1.1 displays the evolution of net financial flows towards developed and emerging countries. As underlined, the pre 2000 era is characterized by a moderate increase in net international financial flows (at least since the mid 70s), while the post 2000 period is affected by sharp swings in financial flows, with a peak value in net capital inflows reached before the last Global Financial Crisis for developed economies.

Figure 1.2 reports the decade-by-decade composition of international capital flows,

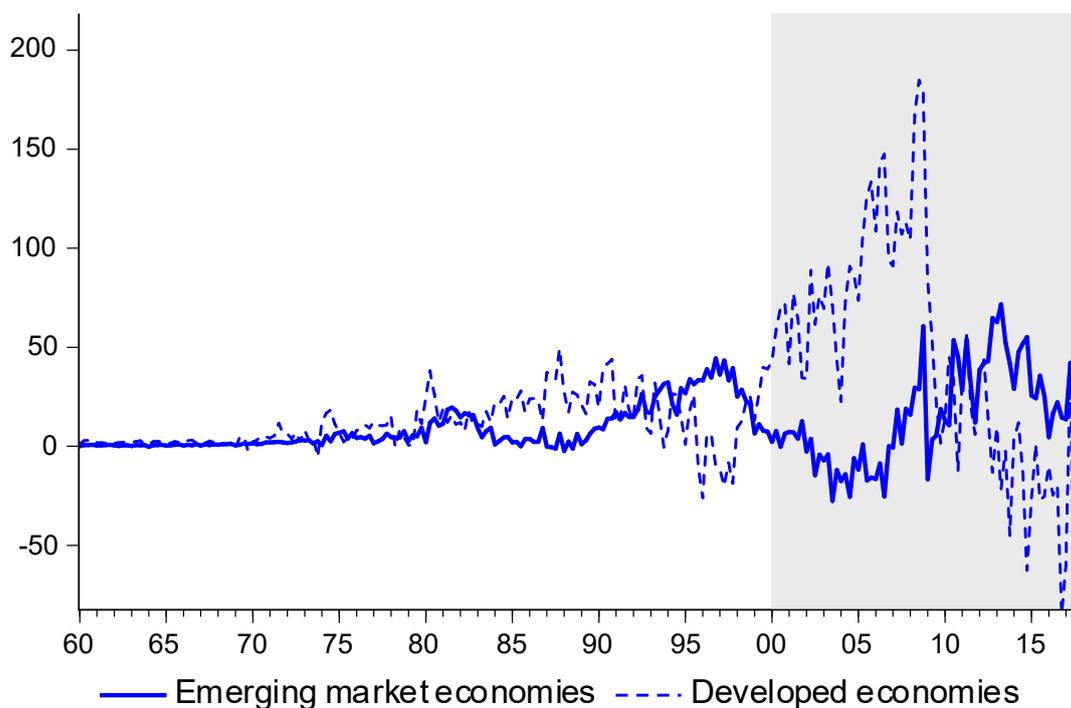


Figure 1.1: NCF in emerging and developed countries (in billions of dollars, excluding China)

namely the relative size of capital entry (if positive) or exit (if negative) flows in developed and emerging market countries. The total amount of net capital inflow is normalized to 100%. As reported in this figure, pre 2000 and post 2000 decades display a different picture of net international financial flows. In pre 2000 decades both groups of countries have benefited of net entry flows, even if before the 1990 decade, net capital inflows to

¹Data sources and definitions are reported in Appendix A.3.

wards developed countries clearly dominates. From the 60s to the end of the 80s, the underdevelopment of financial markets and restricted capital account policies led to a low capital flows across countries. During this period, the average share of capital inflows to advanced countries exceeds that in destination to emerging markets. By contrast, during the 90s, emerging market economies have benefited from significantly large capital inflows with an average share of about 61.6% of total capital instead of 27% a decade earlier (as a consequence of the Brady solution in 1989, followed by Asian countries' attractiveness up to 1997 before the 1997 – 1998 crisis). The post 2000 era offers a different picture: the Asian and South American turmoils induced significant capital outflows from emerging countries and inflows to advanced countries. An opposite phenomenon is reported from 2010 to 2017. Since the last Global Financial Crisis, easing monetary policy in most advanced countries is leading to massive capital inflows in destination of emerging economies.² The

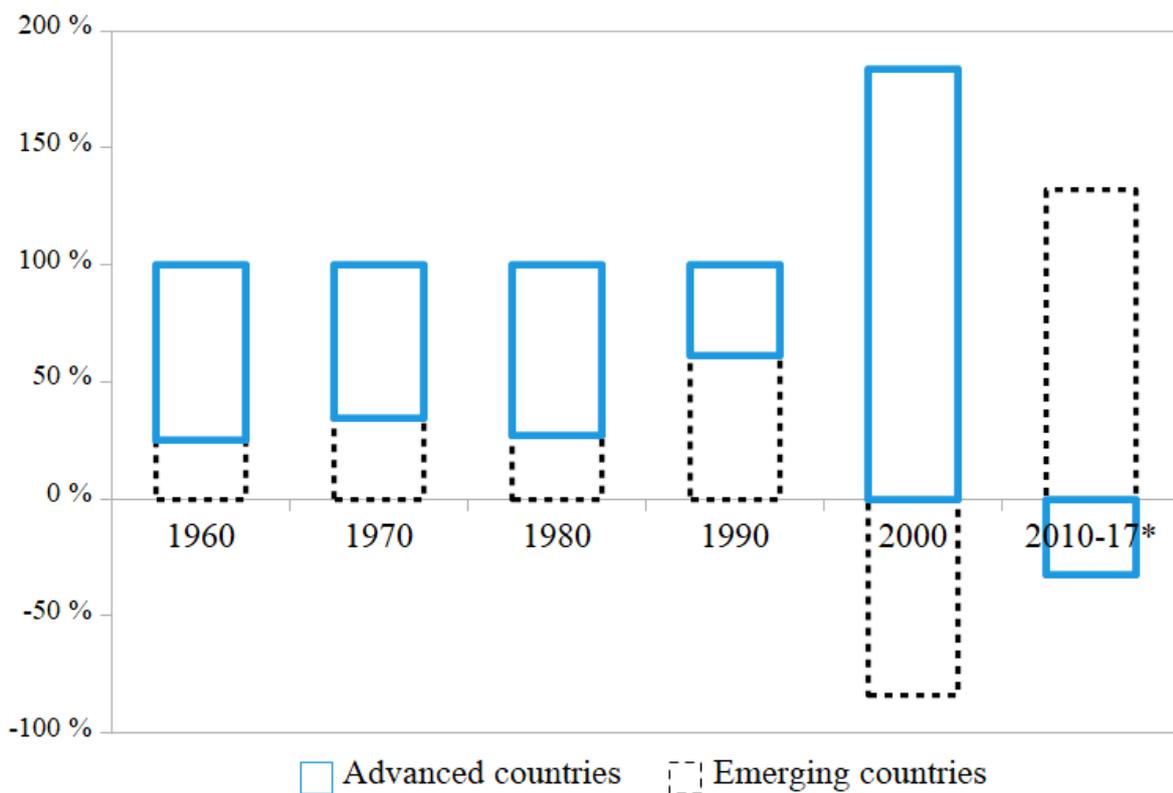


Figure 1.2: Composition of the NCF by group of countries across decades (*excluding China)

²China has been displaying a large net capital outflows mainly since the last Global Financial Crisis which hides an opposite fact in the rest of emerging market economies that have been receiving capital flows during that period

figures clearly reflect different relationships between net capital inflows in emerging and advanced countries in the pre and post 2000. To further highlight this fact, Figure 1.3 displays the correlation coefficient between net capital flows in emerging and developed countries using a rolling window of an increasing size. It distinguishes two periods:

- During the period from 1965 to the first quarter of 1997, the correlation coefficient is positive, suggesting a co-movement in NCF of the two groups of countries,
- From the second quarter of 1997, the correlation coefficient becomes negative. During such a period, an opposite movement in NCF characterizes the relationship between capital flows in emerging and developed economies.

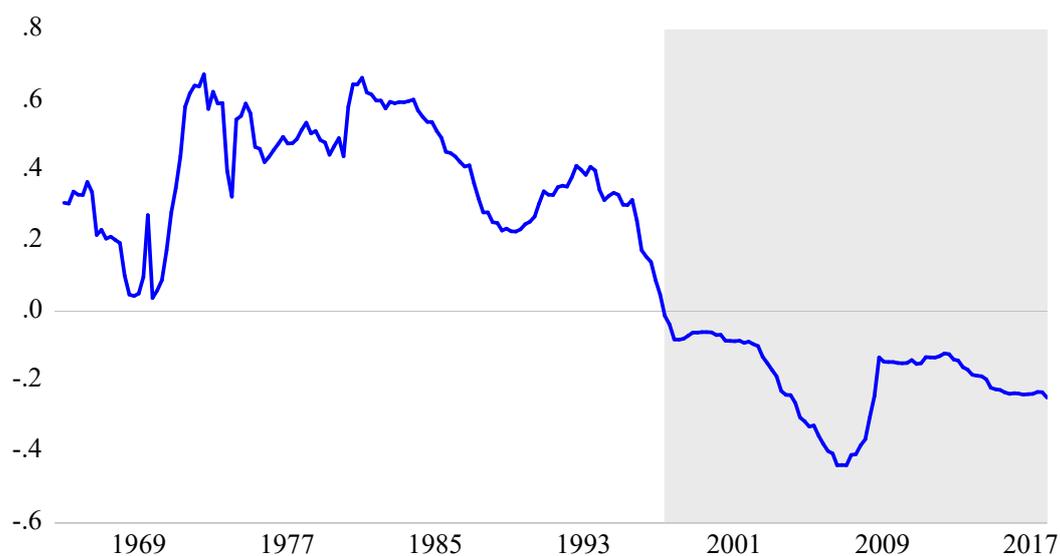


Figure 1.3: Correlation between NCF towards emerging and developed countries (excluding China)

According to the figure, the Asian crisis which started in the third quarter of 1997 presents a turning point shifting the long run dynamic of the international capital flows and marking a new era during which the two groups of countries behave in a distinct and a substitutable way. Indeed, in the aftermath of the Asian crisis, emerging market economies were subject to a large capital outflows while advanced countries experienced a significant net entry of capital. However after the last Global Financial Crisis, an opposite

movement is observed, i.e. a large surge of capital flows to emerging market economies and outflows from developed countries.

This evolution in NCF has been characterized by sharp episodes of capital flow retrenchment/reversals, some of them ending in a sudden stop. The key defining characteristic of a sudden stop is a sharp, abrupt reversal in international capital flows, which is typically measured by a decline in CF. A second empirical regularity are large, negative deviations from trend in the main macroeconomic aggregates (GDP, private consumption and investment) that follow the reversal in capital flows. That is, sudden stops are typically associated with deep recessions. A third characteristic are sharp changes in relative prices, including exchange rate depreciation and declines in asset prices in both equity and housing markets (Korinek and Mendoza [2014]). To isolate such episodes we follow the strategy of Calvo et al. [2004], Korinek and Mendoza [2014], Cavallo and Frankel [2008]: we first apply a filter to get sharp episodes of net capital flow and, in a second step, we select episodes from this sample that coincide with a recession in the same quarter or in the following four quarters. We use a time-varying filter instead of a standard fixed threshold as in Calvo et al. [2004]. Below the computed threshold value a drop in capital inflows (CF) is considered as a potential sudden stop PSS_t . We then define PSS_t as an episode that contains at least one observation where the year-over-year fall in capital inflows is below the threshold τ_t given by,

$$\tau_t = \mu_{t-1-12} - 2 \sigma_{t-1-12},$$

where μ_{t-1-12} and σ_{t-1-12} are the mean and the standard deviation of capital inflows (CF) over a rolling window of 12 quarters. Notice that the current period observation is not included in the computation of τ_t for two reasons. First, an unexpected variation in CF during the current period induces a shift in the standard deviation which would hide a potential sudden stop episode taking place during that period. Second, it reduces the problem of data availability and time inconsistency in the assessment of such a phenomenon. Thus a potential sudden stop episode occurring in period t (PSS_t) is defined

as,

$$\begin{aligned} PSS_t &= 1 \text{ if } CF_t < \tau_t, \\ PSS_t &= 0 \text{ otherwise.} \end{aligned}$$

Most empirical studies on sudden stops use a time invariant threshold τ_f such as in [Calvo et al. \[2004\]](#), defined as,

$$\tau_f = \mu - 2 \sigma,$$

where μ and σ are the mean and the standard deviation of capital inflows (CF) for the whole sample. This measure may underestimate the potential number of sudden stops. Indeed, a temporary high volatility during a given - although a short - period in CF lowers the value of the τ_f threshold. Consequently, the probability of missing significant sudden stop episodes rises. A time varying filter corrects this potential bias: (1) it dampens the impact of the sample size on the effectiveness of capital reversal filter; (2) it takes into account structural changes affecting the dynamics of CF associated to the development of financial markets and the liberalization of capital accounts. In addition, adopting a rolling window over three years gives a good compromise between having a relatively high freedom degree, mainly for countries where data is scarce, and taking account structural changes in CF.

We can illustrate the differences between the two filters by providing a simple graphical illustration of the outcomes in the case of two countries: Argentina and the United Kingdom. In both figures the fixed filter is displayed as a dotted line, while the time varying filter is reported as a broken line. The plain line reports the historical evolution of capital inflows (CF) associated to each country between 1960Q1 and 2017Q4. As reported, Argentina experienced a sharp exit of net capital in 2001 and 2002 that has a significant and permanent effect on the value of the fixed filter. Without this particular event, the value of τ_f would not have been that lower for the whole time span of the analysis and a greater number of financial retrenchment episodes would have been selected. Similarly, the United Kingdom experienced a sharp net exit of capital in 1981 that also affects the

value of the threshold value used to detect episodes in the previous and following periods. A time varying filter corrects this aspect, as we identify 7 more episodes of capital flows retrenchment for Argentina and 6 for the United Kingdom (grey areas). The second

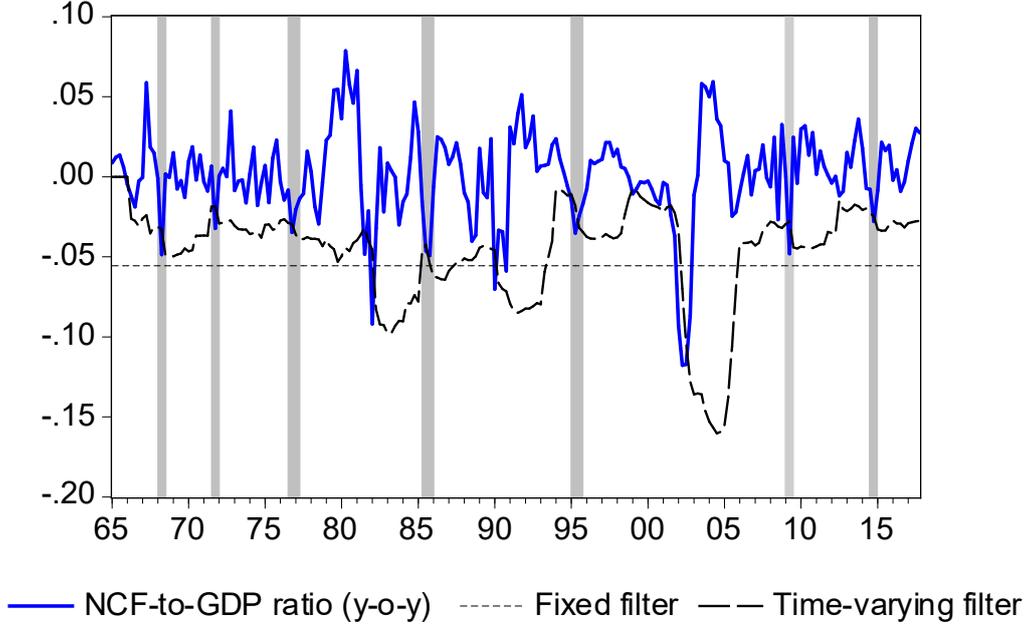


Figure 1.4: Time-varying vs. fixed filter in NCF: Argentina

step of our identification overlaps the selected potential sudden stops episodes with a recession occurring during the same quarter or the following four quarters. Therefore, a sudden stop episode SS_t satisfies,

$$SS_t = 1 \text{ if } \{PSS_t = 1 \text{ and } g_{t+i} < 0, \text{ for } i \in (0, 4)\},$$

$$SS_t = 0 \text{ otherwise,}$$

where g_{t+i} denotes the real economic growth rate (year-over-year) for a given country in the quarter $t + i$.

As a final step, we define a sudden stop window as in [Korinek and Mendoza \[2014\]](#) to explore at a quarterly frequency the empirical regularities during sudden stop episodes. Formally, the window starts the first quarter preceding the selected SS when CF are

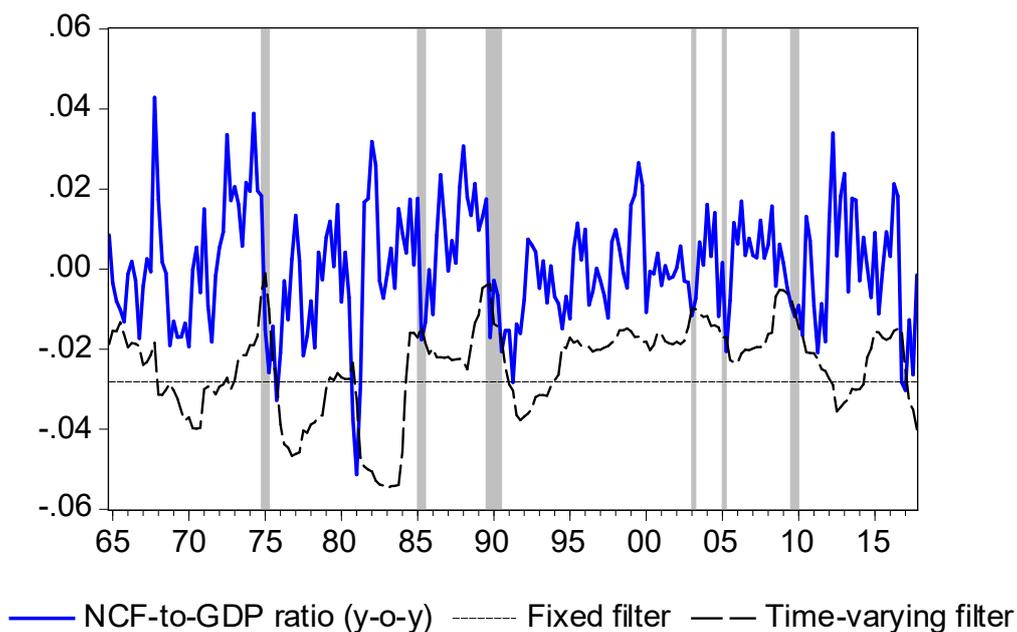


Figure 1.5: Time-varying vs. fixed filter in NCF: United Kingdom

below $\tau_{2,t}$, where,

$$\tau_{2,t} = \mu_{t-1-12} - \sigma_{t-1-12}.$$

The capital inflow reversal phase ends once CF exceeds $\tau_{2,t}$ and the quarter with the largest fall is the peak quarter. This will generally introduce persistence and symmetry, a common fact of sudden stops. In case of two adjacent windows with peak quarters closer than three years, we combine them and select the largest peak as the peak quarter for the new window.

The results of the filtering procedure are reported in table 1.1 and in Figures 1.6 and 1.8. Over all the time period, we observe 443 episodes of capital flow retrenchment (around 60% observed in emerging market economies and 40% in developed economies). Among them, we get 149 sudden stops in which 91 occurred in emerging markets and 58 in developed economies. Remarkably, we get the same proportion of sudden stops with respect to the number of capital inflow reversal episodes in both groups as 33% of such episodes end in a sudden stop. The average duration of sudden stops is almost the same for both economies (less than 2.5 quarters). The distribution of such episodes is heterogeneous

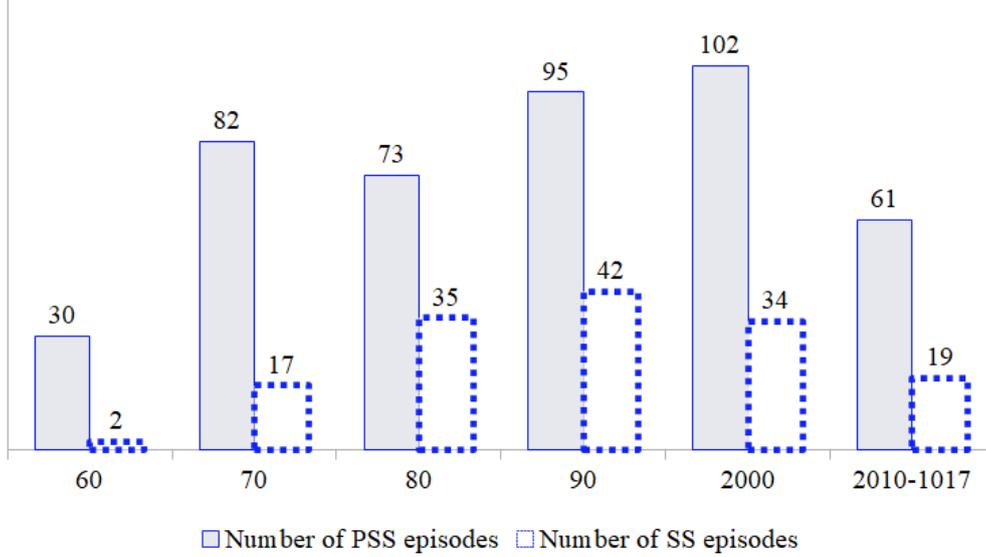


Figure 1.6: Number of potential (PSS) and observed Sudden Stops (SS)

Table 1.1: NCF reversals and SSs: episodes and duration

	Baseline	Emerging	Developed
Number of NCF reversal episodes	443	270	173
Number of SS episodes	149	91	58
Average duration of SS (quarters)	2.38	2.34	2.45
SS to NCF reversal episode ratio	33.6	33.8	33.7
min duration of SS (quarters)	1	1	1
max duration of SS (quarters)	13	12	13

Source: Authors' calculations

across decades. As reported in Figures 1.8 and 1.7, during the 60s and 70s only a few capital retrenchment episodes lead to sudden stops (6.67% in the 60s and 20.73% in the 70s). However, the picture is different for the 80s (48%) and the 90s (44.20%), while the post 2000 era is characterized by a moderate decrease in the percentage of such episodes (33.33% in the 2000s and 31.14% since 2010). Putting aside the 60s and 70s, we find a clear difference in the dataset: on the one hand countries affected by sudden stop in the 80s and 90s are mostly emerging market countries (respectively 60% and 75% of the total number of episodes), while, on the other hand, the number of episodes is almost equally shared between emerging and developed countries in the post 2000 period.

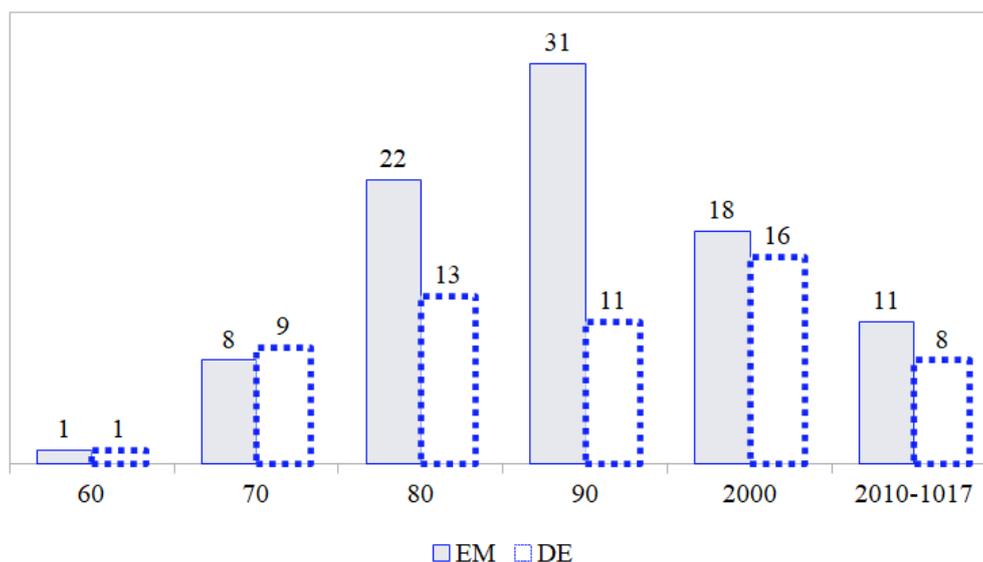


Figure 1.7: Number of SS by decades and group of countries

1.3 Are all sudden stops alike ?

In this section we explore some empirical regularities characterizing sudden stop episodes, and evaluate the differences between emerging market economies and developed economies. As displayed in Table 1.2, over the total time period of our analysis, the duration of such episodes is almost the same across the two groups of countries. However, on average, sudden stop episodes have been more disruptive in EM economies over the 57 years of the data set, as the maximum output loss in this group is almost twice of what is observed in developed economies (-2.04% vs -1.06%). Accordingly, the contraction in the current account - and the corresponding capital inflow shortage - observed for the whole time period of the analysis- is particularly sharp for emerging economies (2.17% vs 0.33% of GDP). This sharp reduction is similarly accompanied by a large contraction in aggregate absorption, mainly in emerging market economies where investment falls by more than 10% (against 7.6% in advanced countries), and private consumption declines by 1.7% (0.95% in developed countries).

However, the analysis of sub-periods outlines a sharp deterioration in the case of developed economies in the post 1997 era. Noticeably the negative consequences of such episodes on the macroeconomic situation of these economies. For most indicators the situation in developed economies becomes in line with emerging countries experience. By contrast,

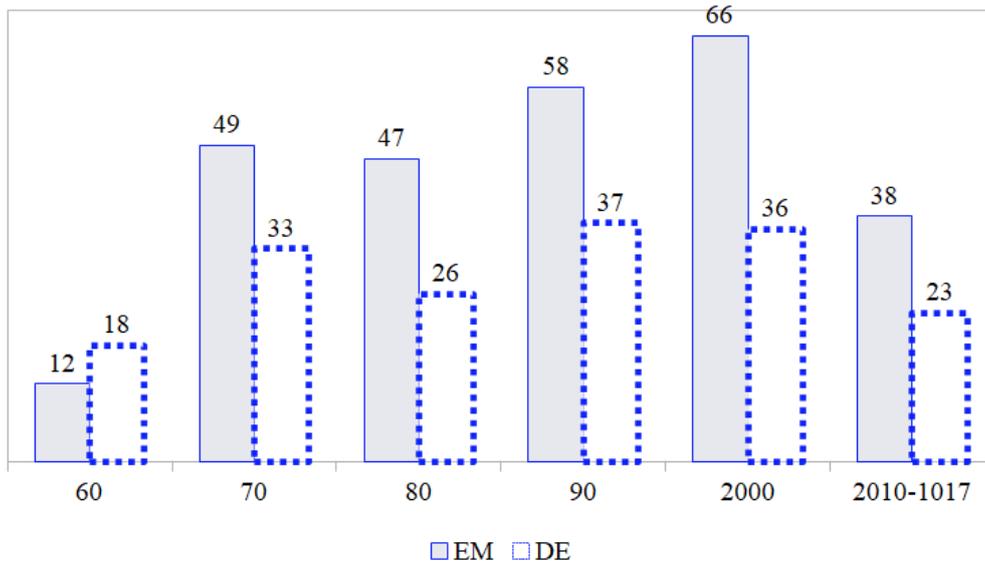


Figure 1.8: Number of PSS by decades and group of countries

the situation of emerging countries remains unchanged, except for net capital outflows, that have been divided by two, for an almost unchanged macroeconomic outcome. This observation combined with the fact that the net capital outflow from developed economies has slightly increased with an associated worsening of macroeconomic performances with regard to the pre 1997 period. Combining these elements for both groups of countries, we can conclude that the macroeconomic situation of the world economy has become more sensitive to international financial crises with sudden stop episodes having more devastating effects on both output, investment and consumption.

Table 1.2: Sudden Stop duration and severity

	Baseline	EM	EM (pre-1997)	EM (post-1997)	DE	DE (pre-1997)	DE (post-1997)
Number of SS	149	91	47	44	58	32	26
Average duration of SS (quarters)	2.38	2.34	1.77	3.02	2.45	2.34	2.58
Net capital inflows to GDP (% $y-\alpha y$)	-8.78	-10.54	-13.3	-7.56	-6.00	-5.88	-6.16
Maximum average output loss (%)	1.65	2.04	2.40	2.28	1.06	0.03	2.40
Maximum average investment loss (%)	9.07	10.20	9.24	12.12	7.45	5.46	10.44
Maximum average consumption loss (%)	1.43	1.79	2.12	2.03	0.95	-0.06	2.14
Average current account balance (% of GDP)	1.33	2.17	4.06	1.01	0.33	0.09	0.58
σ_Y^a (%)	1.50	1.83	1.54	2.31	1.00	0.89	1.31
σ_C (%)	1.51	1.97	2.30	2.22	0.88	0.74	1.14
σ_I (%)	3.79	4.40	6.08	6.45	2.28	2.34	2.67
σ_{REER} (%)	2.44	4.68	5.17	4.44	0.55	0.91	0.67

Source: Authors' calculations

^a σ_x : standard deviation of variable x. Y denotes output, C private consumption, I investment and REER real exchange rate

Beneath results reported in Table 1.2 we provide a closer evaluation of the consequences of sudden stop episodes between emerging and developed countries following an event window analysis, centered on the quarter t corresponding to the maximum value of the capital inflow shortage. In Figures 1.9 to 1.11, the situation of emerging market countries is described with dotted lines and that of developed countries with plain lines. Figure 1.9 reports the short run adjustment of the main macroeconomic indicators. As observed one year before the episode, output growth, consumption and investment are fueled by capital inflows, as reported by the deficit of the current account. The reversal in capital flows is particularly sharp up to t for emerging economies with associated negative macroeconomic consequences over the year preceding the capital flow reversal. Sudden stops are more disruptive in emerging markets as the average decline of real growth reaches 1.86% against -0.89% in advanced economies. The time profiles of the main macroeconomic aggregates are almost similar for both groups of economies, although with sharper fluctuations in the case of emerging market countries. Over this four quarter window, we clearly observe the contraction in the net capital inflow (as the current account is balanced at the time of the sudden stop episode) that has a sharp negative consequence on all three macroeconomic indicators. The sharp correction in the net capital inflow and in investment (from an annual rate of growth of 4% to an annual decrease of almost 10%). Noticeably, the recovery of these economies takes some time (4 quarters to stop the disinvestment, two quarters for consumption). The macroeconomic adjustment of developed economies is much smoother since the sudden stop does not prevent them to participate to the international financial market, as the current account remains negative (although with a lower value) between 1 and 2% corresponding to a decrease in net capital inflows rather than a net capital outflow. Turning to Figure 1.9, we observe that most indicators related to prices are more volatile during sudden stops in emerging markets. In those countries, the real exchange rate growth rate is particularly volatile, as it initially declines during the fourth quarter before the episode, then it becomes negative underlying a clear depreciation of the currency in real terms during for five quarters, before experiencing a new positive growth rate value three quarter after the sudden stop. At its peak value

in period t it declines by more than 6% on average. By contrast, the real exchange rate remains almost unaffected in developed economies (the growth rate declines uniformly before experiencing a small negative value at the end of the time period reported in the window). The inflation record of emerging economies is also affected by the sudden stop events: as reported there is a sharp increase in the inflation rate in the quarters preceding the financial outflow (in line with the real depreciation); we then observe a high stable inflation rate after the capital outflow. The inflation rate in developed economies is almost stable before declining after the SS episode. Finally the stock market index adjustment precedes the sudden stop episode by two quarters in both types of economies before remaining almost unchanged during six quarters (2 before and 4 after the sudden stop). Finally Figure 1.11 displays the time path of some main financial indicators. First as reported by the credit to GDP ratio, sudden stops in emerging markets are preceded by a boom in credit up to the previous quarter preceding the episode. Then there is a clear tightening in financial conditions up to the fourth quarter. Accordingly, there is a clear depletion in foreign exchange reserves in emerging market countries up to period t before a sharp recovery as their level begins to decrease two quarters before the sudden stop before recovering sharply one quarter after the sudden stop. Developed economies do not experience such an exchange rate reserve depletion (even if there is a decrease in the foreign reserve entry flow it remains almost positive). Another main difference between emerging market and developed economies concerns the credit to the private sector to GDP ratio: it decreases uniformly over the 8 quarters of the window, without any noticeable effect of the sudden stop event on its time profile for emerging countries.

1.4 Econometric analysis

1.4.1 Model and estimation results

As in Edwards [2004], Calvo et al. [2008], Cavallo and Frankel [2008], we estimate a panel binary model that approximates the conditional probability of falling into a sudden stop

as a function of a set of pull (internal) and push (global) factors usually used in the literature as determinants of such crises. Similarly, as a standard choice, we select a logit model with country fixed effects, rather than a probit model, to estimate the unobservable country effects without any assumption about how they are linked to the vector of the explanatory variables. Given the probability $Pr [SS_{i,t} = 1]$ of observing a sudden stop at time t for a country i , we can define an underlying latent response variable $ss_{i,t}$,

$$ss_{i,t} = \beta x_{i,t} + \alpha y_t + \mu_i + \epsilon_{i,t},$$

such that,

$$\begin{aligned} SS_t &= 1 \quad \text{if } ss_{i,t} > 0, \\ SS_t &= 0 \quad \text{otherwise.} \end{aligned}$$

In this relation, $x_{i,t}$ and y_t are vectors of pull and push explanatory variables respectively. β and α are vectors of coefficients to be estimated. μ_i denotes the estimates of country specific effects and $\epsilon_{i,t}$ the error terms that are iid. The probability that $SS_{i,t} = 1$ is related to the latent variable as follows,

$$\begin{aligned} Pr [SS_{i,t} = 1 | x_{i,t}, y_t] &= Pr [ss_{i,t} > 0 | x_{i,t}, y_t] \\ &= Pr [\beta x_{i,t} + \alpha y_t + \mu_i + \epsilon_{i,t} > 0 | x_{i,t}, y_t] \\ &= Pr [\epsilon_{i,t} > -\beta x_{i,t} - \alpha y_t - \mu_i | x_{i,t}, y_t] \\ &= \psi (ss_{i,t}), \end{aligned}$$

where $\psi (ss_{i,t})$ denotes the cumulative distribution function (CDF). For the logit model, $\psi (ss_{i,t})$ is the CDF of the logistic distribution,

$$Pr [SS_{i,t} = 1 | x_{i,t}, y_t] = \frac{\exp(\beta x_{i,t} + \alpha y_t + \mu_i)}{1 + \exp(\beta x_{i,t} + \alpha y_t + \mu_i)}. \quad (1.1)$$

Using equation (1.1), we regress the selected sudden stop episodes on a set of push and pull factors using a fixed-effect panel logit model. According to the existing literature, we take variables that have been acknowledged as main determinants as regressors. Control variables include the current account balance to GDP ratio and real economic growth. Indeed, the potential role of large current account deficits as a source of sudden stops is repeatedly emphasized in the literature (Calvo et al. [1996], Calvo [1998], Corsetti et al. [1998], Ferretti and Razin [2000], Edwards [2004]). However, we introduce real economic growth which is scarcely used as a factor driving sudden stop, to explore how domestic economic performance affect the likelihood of experiencing such episodes.³ In addition, we take account of three additional country-specific macroeconomic variables such as real exchange rate growth, terms of trade growth and trade openness considered as traditional drivers of sudden stops (Ferretti and Razin [2000], Calvo et al. [2003], Cavallo and Frankel [2008]). As country-specific financial factors, we focus on the potential relationship between sudden stop occurrence probability and the credit cycle measured by domestic credit to GDP gap, as well as foreign reserves flows (y-o-y change) normalized by GDP. Most previous studies highlight a negative correlation between foreign reserves (to GDP ratio as in Edwards [2004], or in months of imports as in Cavallo and Frankel [2008]) and the probability of sudden stop. Nevertheless, none of them, in our knowledge, explores the relation between the credit cycle and the likelihood of sudden current account reversals. Our choice to include this variable is mainly motivated by the above event analysis that clearly points out that a typical sudden stop episode occurs during a bust cycle in domestic credit.

Following Forbes and Warnock [2012], Comelli [2015] among others, we use Aizenman et al. [2008] indexes for exchange rate stability and monetary policy independence as well as the measure of financial openness calculated in Chinn and Ito [2008]. It helps us to assess the time evolution of the potential explanatory power of those variables mainly during pre and post 1997 where we notice a different dynamics of capital flows and sudden stop episodes. To account for domestic and global economic uncertainty, we

³most of the related studies use real GDP per-capita Ferretti and Razin [2000] for example

consider two main variables: (1) a measure of the global business cycle (the global real output gap, given by the composite leading indicator for G7 as calculated in [Gyomai and Wildi \[2012\]](#)) and (2) a measure of economic uncertainty, the Economic Policy Uncertainty Index (EPU) constructed by ?. The EPU is obtained by counting the frequency of the word “uncertainty” in the quarterly Economist Intelligence Unit country reports. All the explanatory variables are lagged by one quarter except trade openness.

Table 1.3: Panel logit regressions: baseline pre and post 1997Q2

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-7.24** (2.96)	-10.26 (8.11)	-8.22** (3.90)
Real economic growth	-16.77*** (3.19)	-28.49*** (7.23)	-12.33*** (4.18)
Country-specific macroeconomic indicators			
Real Exchange rate growth	0.78 (1.33)	0.25 (2.74)	0.51 (1.66)
Terms of trade growth	0.55 (1.41)	3.00 (3.17)	-1.13 (1.80)
Trade openness	-1.05 (1.12)	-5.94 (3.90)	-0.91 (1.33)
Country-specific financial indicators			
Foreign reserve flow	-4.23*** (1.30)	-10.25*** (2.74)	-2.01 (1.42)
Credit to GDP gap	0.06*** (0.01)	0.06* (0.03)	0.08*** (0.02)
Trilemma indicators			
Exchange rate Stability index	-1.51** (0.61)	-3.52** (1.54)	0.68 (1.05)
Monetary Independence index	-0.76 (0.74)	1.39 (1.71)	-1.97* (1.14)
Chinn-Ito index of financial openness	-0.34*** (0.13)	-0.40 (0.26)	-0.62** (0.24)
Economic uncertainty			
Economic Uncertainty Index	1.60 (2.07)	-0.89 (5.55)	0.77 (2.48)
Global real GDP index growth	-29.70*** (6.16)	-31.70** (13.92)	-36.41*** (7.88)
Observations	3684	1125	2105
*** Significant at the 1% level ** Significant at the 5% level * Significant at the 10% level Standard errors in parenthesis			

Baseline estimates are reported in Table 1.3. We run regressions over the whole panel

of 75 countries - over the entire time span of 228 quarters, then by isolating the pre and post 1997Q2 eras. Taking into account the whole dataset, we find that the probability of a sudden stop is significantly affected by both pull (i.e. internal) factors and a push variable, i.e. global real economic growth. As reported, all control variables (the national current account and real economic growth), all the country specific financial indicators (foreign reserve flows and the credit to GDP ratio) and the global real GDP index growth have the expected sign and affect significantly the probability of a sudden stop. However, separating the pre 1997Q2 and post 1997Q2 era our results underline some clear differences between the key variables that affect the sudden stop probability. In the pre 1997Q2 era, national economic growth, foreign reserve flows and the exchange rate stability affect significantly the probability of sudden stop episodes. In contrast, in the post 1997Q2 era, foreign reserve flows and the exchange rate stability index are no longer significant. Instead, monetary policy independence index and financial openness become significant. Noticeably, over all the three estimates, we find that the EPU index is never significant, while the credit to GDP gap plays a significant role as a financial indicator over the three versions to affect positively the probability of a sudden stop. Tables 1.4-1.5 contrast the situation of developed and emerging market economies. Taking the whole time span of the study, sudden stops in advanced countries are significantly driven by internal factors such as domestic real economic growth and the credit-to-GDP gap, in addition to the global real economic growth. However and in the pre 1997Q2 period, foreign reserves flows play a significant role in explaining the probability of occurrence of such episodes. Regarding emerging market economies, only trade openness and foreign reserves flows explain significantly the likelihood of sudden stops during the period before the Asian crisis. After the crisis, trade openness becomes insignificant while financial factors such as monetary policy independence index, financial openness and domestic credit-to-GDP gap are significantly affecting the probability of experiencing a sudden stop. Including the whole dataset, more independent monetary policy and a higher degree of financial openness are associated with a low probability of sudden stops' (this result is in line with the one reported by [Comelli \[2015\]](#) for emerging countries). A

low probability of sudden stop occurrence is also linked to a low domestic credit-to-GDP gap and a high foreign reserves flow.

1.4.2 Sensitivity analysis

We perform a range of sensitivity tests to check the robustness of our results. We proceed in two ways. First, we run the regression using only control variables and one set of country-specific variables. This analysis assesses how the significance of different variables is affected when the number of co-variables is reduced. Second, we use a complementary log-log model (clog-log model) to capture the asymmetric distribution of sudden stops. Indeed, as stressed by [Forbes and Warnock \[2012\]](#), sudden stops are irregular which could lead to an asymmetric cumulative distribution function ($\psi(ss_{i,t})$).

The results are reported in Appendix [A.5](#). Tables [A.4-A.9](#) confirm the baseline results discussed above. Reducing the number of co-variables does not affect the significance of the main key variables. The result for credit to GDP gap is robust when keeping only control variables and foreign reserves, and also when using clog-log model estimation. Particularity, it remains highly significant for emerging market economies in post 1997 period. The real exchange rate stability matters for financial stability mainly in the pre-1997. After 1997, financial openness index becomes significant.

1.5 Conclusion

This chapter aimed at reviewing the main empirical regularities of sudden stops using an extended dataset comprising 75 developed and emerging market economies over the time period 1960Q1 to 2017Q4 and at exploring the relationship between the probability of occurrence of such episodes and a number of domestic and global factors, such as terms of trade, trade and financial openness in addition to global economic growth. Using a time-varying filter we have isolated 443 capital retrenchment episodes, among which 149 give rise to a sudden stop (1/3 for developed countries and 2/3 for emerging economies). As a main result, we underline the changing features of sudden stop between the groups

of countries, in the post 1997 era. In particular, we observe a worsening of the situation of developed countries experiencing a sudden stop after 1997. Our econometric analysis linking the probability of a sudden stop episode to key national and external/world variables leads to the same kind of conclusion. While our results show clear differences in the explanatory variables across country groups in the pre 1997 period, we find that the probability of a sudden stop significantly depends on the three main variables: real economic growth and global real GDP growth and the effect of financial variables is mainly channeled through the credit to GDP gap. Our results are robust with regards to a series of sensitivity tests.

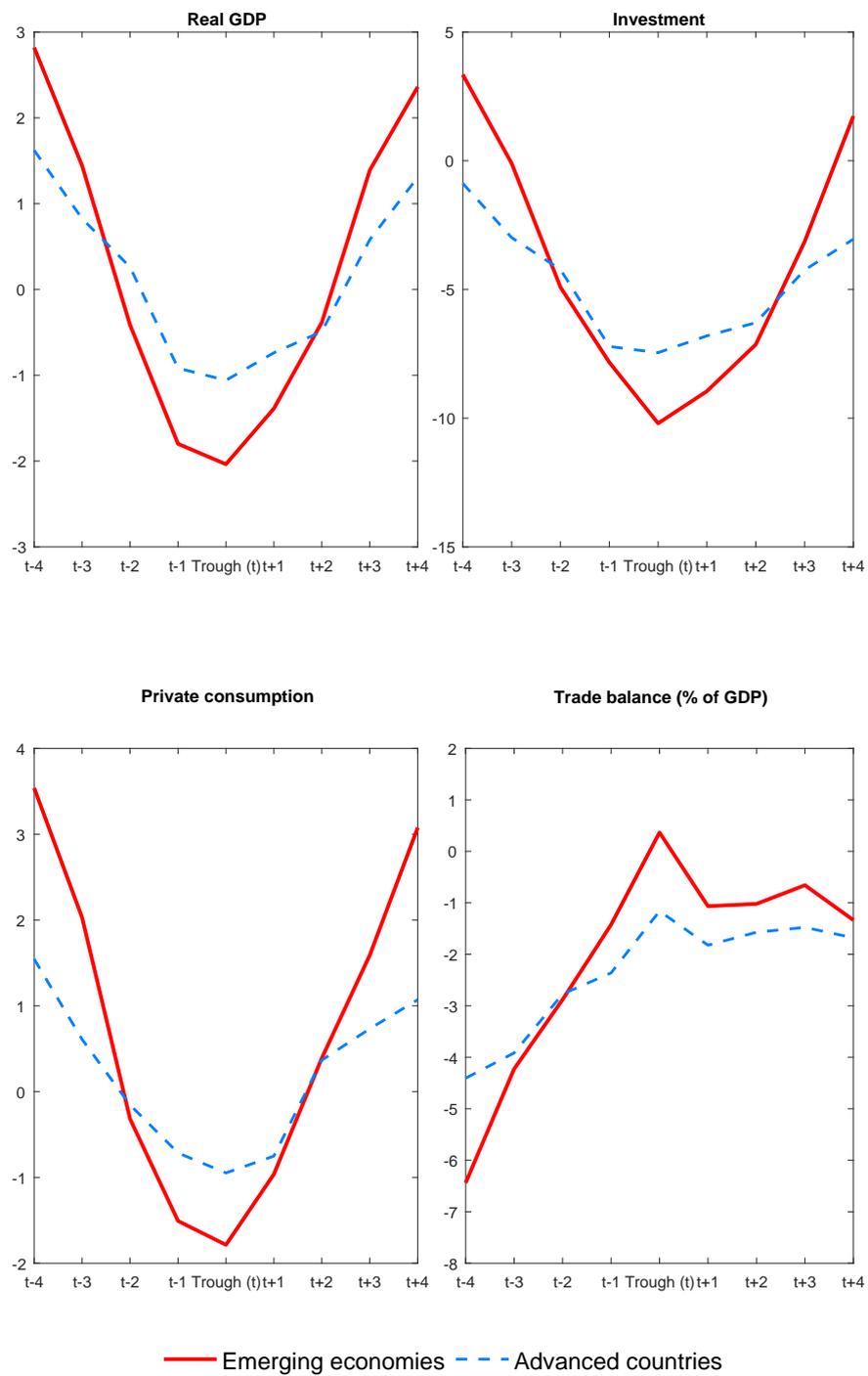


Figure 1.9: Macroeconomic dynamic during a typical sudden stop episode

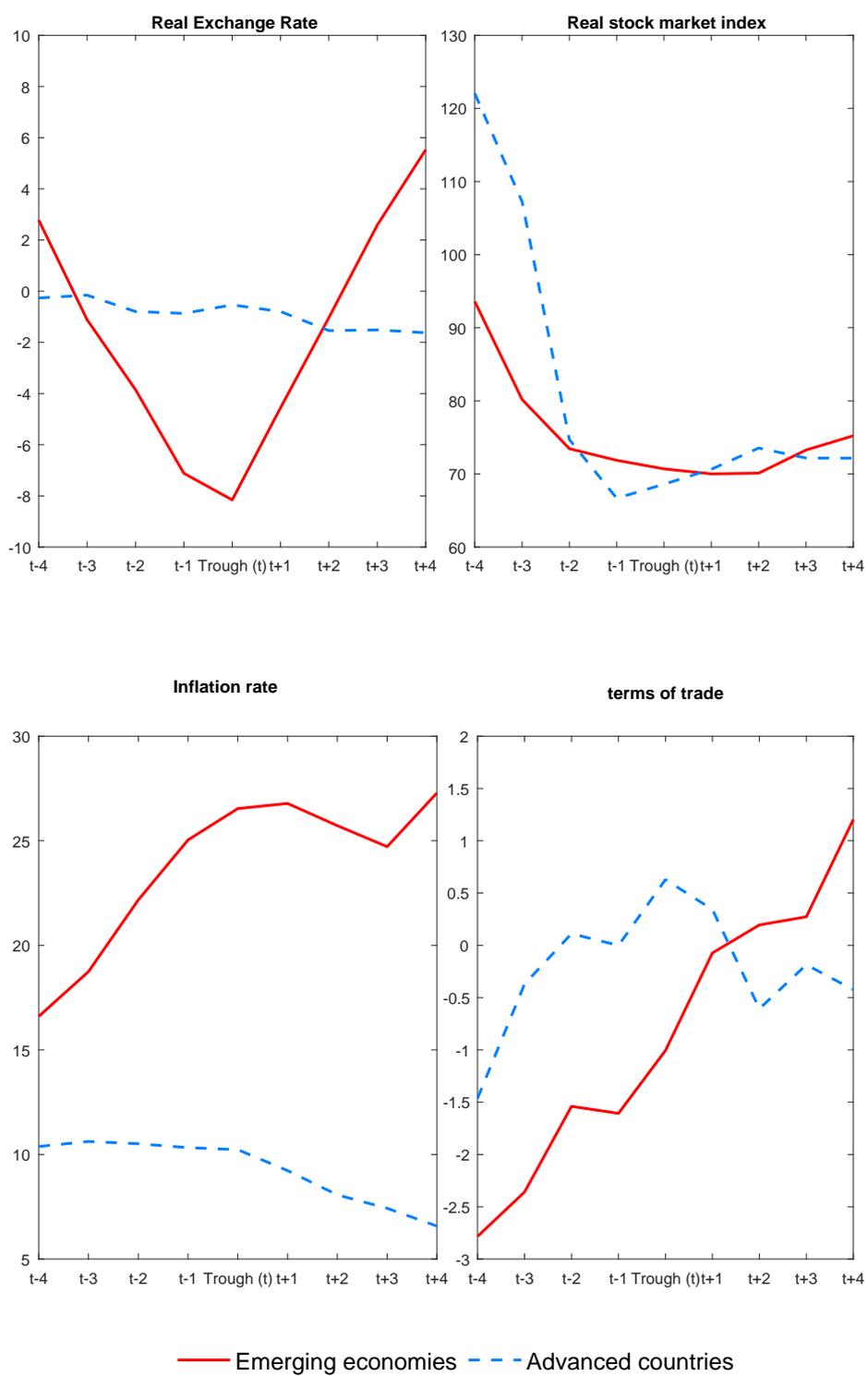


Figure 1.10: Asset price dynamics during a typical sudden stop episode

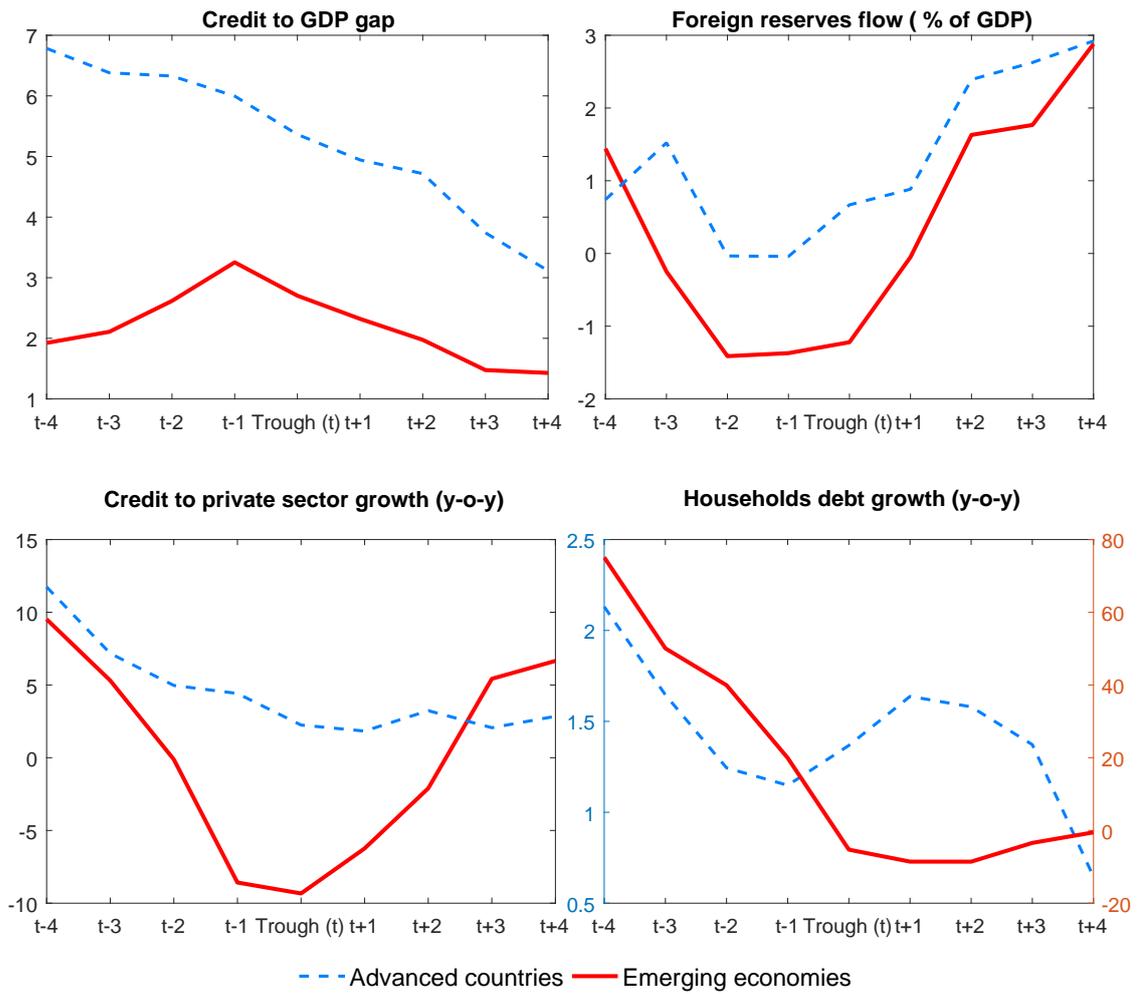


Figure 1.11: Financial conditions during a typical sudden stop episode

Table 1.4: Panel logit regressions: Developed economies

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-5.99 (4.17)	-13.25 (9.63)	-3.74 (5.78)
Real economic growth	-29.59*** (4.90)	-55.37*** (11.29)	-22.29*** (7.25)
Country-specific macroeconomic indicators			
Real Exchange rate growth	-1.08 (2.50)	-3.94 (3.72)	2.34 (4.17)
Terms of trade growth	1.17 (2.17)	5.22 (4.17)	-0.24 (3.49)
Trade openness	-0.19 (1.79)	1.68 (4.52)	-0.31 (2.10)
Country-specific financial indicators			
Foreign reserve flow	-2.47 (1.85)	-7.68** (3.52)	1.02 (1.64)
Credit to GDP gap	0.03** (0.02)	0.07* (0.04)	0.04* (0.02)
Trilemma indicators			
Exchange rate Stability index	-1.44 (0.89)	-4.40** (1.97)	2.11 (2.97)
Monetary Independence index	0.44 (1.07)	1.98 (1.96)	-1.17 (2.09)
Chinn-Ito index of financial openness	-0.18 (0.17)	-0.13 (0.29)	-0.49 (1.31)
Economic uncertainty			
Economic Uncertainty Index	0.64 (3.30)	-7.60 (6.98)	2.63 (4.26)
Global real GDP index growth	-27.32*** (7.89)	-51.85*** (17.11)	-33.03*** (11.76)
Observations	2598	927	1249
*** Significant at the 1% level ** Significant at the 5% level * Significant at the 10% level Standard errors in parenthesis			

Table 1.5: Panel logit regressions: Emerging market economies

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-4.77 (4.86)	-5.78 (28.45)	-13.15** (6.55)
Real economic growth	-5.61 (4.54)	-23.57 (25.71)	-3.68 (5.43)
Country-specific macroeconomic indicators			
Real Exchange rate growth	2.51 (1.80)	2.09 (9.95)	1.47 (2.16)
Terms of trade growth	-0.71 (1.90)	3.09 (8.96)	-1.26 (2.29)
Trade openness	-0.95 (1.65)	-34.83* (20.66)	-1.95 (2.01)
Country-specific financial indicators			
Foreign reserve flow	-7.87*** (2.33)	-45.01* (24.84)	-5.45** (2.54)
Credit to GDP gap	0.15*** (0.04)	0.23 (0.26)	0.17*** (0.04)
Trilemma indicators			
Exchange rate Stability index	-1.12 (0.90)	-1.54 (3.84)	1.01 (1.20)
Monetary Independence index	-2.10* (1.26)	-1.11 (7.51)	-2.52* (1.52)
Chinn-Ito index of financial openness	-0.44* (0.24)	-1.60 (1.51)	-0.82*** (0.30)
Economic uncertainty			
Economic Uncertainty Index	3.36 (2.71)	16.03 (18.88)	-0.03 (3.48)
Global real GDP index growth	-36.72*** (11.53)	85.29 (71.22)	-47.00*** (12.75)
Observations	1086	198	856
*** Significant at the 1% level ** Significant at the 5% level * Significant at the 10% level Standard errors in parenthesis			

Chapter 2

Optimal vs. simple capital control rules in a sudden stop environment

2.1 Introduction

The aim of this chapter is to examine the cyclicity and welfare outcomes of prudential capital control policies in a Sudden Stop environment. Our analytical framework is based on a Small Open Economy Dynamic Stochastic General Equilibrium (SOE-DSGE) model with output-based endogenous borrowing constraint introduced in open economy models by [Mendoza \[2002\]](#). In this model, the endogenous collateral constraint generates pecuniary externalities. Indeed, according to [Mendoza \[2002\]](#), domestic banking sector intermediates capital inflows denominated in hard currencies into domestic loans denominated in national currency and value the collateral in domestic asset prices. At the aggregate level, the collateral value depends on the aggregate output that is itself a function of the real exchange rate. Thus, a negative shock on endowment or a depreciation of the real exchange rate reduces the collateral value. The resulting balance sheet effect amplifies the shock in the economy by cutting-off access to external finance, forcing private agents to reduce their aggregate demand, which in turn reduces collateral values and contract further aggregate spending. This mechanism describes the pecuniary externality amplification effect that arises from the presence of the endogenous borrowing

constraint.

A growing literature provides a rational use of prudential capital controls aiming at mitigating the effects of pecuniary externalities on systemic risk, reducing the macroeconomic volatility and recovering the optimal resource allocation in the economy. [Korinek \[2011\]](#) emphasizes the promising role of macroprudential policies in reducing pecuniary externalities effects on financial stability and on resource allocation efficiency. [Jeanne and Korinek \[2010a\]](#) find that externalities are likely to be large during booms when risk builds up and prudential controls should be raised during such times. [Mendoza \[2016\]](#) shows that macro-prudential policy is a powerful tool for preventing financial crises, in the sense that a constrained-efficient financial regulator can reduce significantly the severity and frequency of such crises. [Bianchi \[2011\]](#) shows that the pecuniary externality related to flow collateral constraint a la [Mendoza \[2002\]](#) leads to over-borrowing and that the optimal capital control tax on foreign debt is positive on average, while [Schmitt-Grohé and Uribe \[2017\]](#) state that the Ramsey optimal capital tax is pro-cyclical and thus can not be considered as a macro-prudential instrument. In addition, [Schmitt-Grohé and Uribe \[2016a\]](#) demonstrate that models with a collateral constraint in the style of [Mendoza \[2002\]](#) displays multiple equilibria underlying the possibility of a self fulfilling crisis. They show that under different parameters calibration the economy features under-borrowing instead of over-borrowing. [Bianchi and Mendoza \[2018\]](#) show that in open economies with stock collateral constraints the unregulated economy over-borrows in comparison with the regulated economy with an optimal capital control policy. This policy features a time-inconsistency with a state-contingent macroprudential debt tax that is strictly positive at date t if a crisis has positive probability at $t + 1$.

In this chapter, we adopt a theoretical and analytical framework similar to [Bianchi \[2011\]](#). First, as the optimal tax suffers from indeterminacy, we propose a solution that leads to the same Ramsey resource allocation and explains the pro-cyclicality stressed in [Schmitt-Grohé and Uribe \[2017\]](#). According to this solution, during good times, especially when the collateral constraint is not binding in current and immediate following state, the optimal tax is null. In such states, resource allocations in the Ramsey and the private

economy are the same. The Ramsey planner sets a positive tax only when the economy is about to hit the credit limit in the immediate following state. Indeed, during a bust cycle, resource allocation in the Ramsey economy differs from what private agents would have chosen as they fail to internalize the cost of increasing foreign debt holding today on their future ability to acquire further credit. By contrast to [Schmitt-Grohé and Uribe \[2017\]](#), our results suggest that the optimal capital control tax should be lowered to reach negative values during a typical crisis period. During such a situation, private agents undervalue wealth and setting a negative tax would encourage them to increase their debt holdings to the feasible maximum level, which reduces the severity of the crisis. However, our results highlight that implementing a debt tax based on our solution or that of [Schmitt-Grohé and Uribe \[2017\]](#) imply the same crisis severity which suggests that the optimal capital tax is not relevant during crisis.

Second, we investigate macroeconomic outcomes of two alternative capital control policies. A macroprudential policy, by implementing a simple rule based on private debt-to-output ratio targeting, and a simple debt-tax rule that aims at reducing the desire of private agents to front-load consumption by accumulating a large amount of debt. Our results suggest that debt-to-output ratio targeting is the second-best policy that generates high economic welfare and reduces both the volatility of the economy and the frequency of crises. It leads to a welfare gain relatively higher than that of the regulated economy with a simple debt-tax rule and more than seven times higher than that of Ramsey planner.

The rest of the chapter is organized as follows: Section [2.2](#) presents the theoretical framework and the laissez-faire equilibrium conditions. Section [2.3](#) introduces three policy instruments set by a social planner that seeks to maximize households life-utility taking into account the externality related to the presence of the endogenous collateral constraint. Section [2.4](#) derives the welfare function. Section [2.5](#) presents a quantitative analysis under endowment exogenous shocks and section [2.6](#) provides conclusion.

2.2 Economic dynamics under Laissez-faire

We adopt a Small Open Economy (SOE) model with two good sectors (tradable and nontradable) similar to that studied in [Mendoza \[2002\]](#) and [Bianchi \[2011\]](#). The economy is populated by a continuum of identical, infinitely-lived households of measure unity. Households preferences are given by the utility function of a representative agent as follows:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t) \quad (2.1)$$

With $E(\cdot)$ is the expectation operator conditional on information available in period 0, c_t denotes consumption in period t , $U(\cdot)$ denotes an increasing and concave period utility function and β is the discount factor. The period utility function $U(\cdot)$ has the constant-relative-risk-aversion (CRRA) form:

$$U(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}$$

With $\sigma > 0$ the risk aversion parameter. We assume that consumption basket c_t is an Armington-type CES aggregator with elasticity of substitution ζ between tradable c_t^T and nontradable goods c_t^N given by:

$$c_t = A(c_t^T, c_t^N) = \left[a c_t^{T^{1-\frac{1}{\zeta}}} + (1-a) c_t^{N^{1-\frac{1}{\zeta}}} \right]^{\frac{1}{1-\frac{1}{\zeta}}}$$

With $a \in (0, 1)$ is the weight of tradables in CES aggregator and $\zeta > 0$ is the elasticity of substitution between tradable and nontradable goods.

In each period, the representative agent receives an exogenous endowments of tradable goods y_t^T and nontradable goods y_t^N . The vector of endowments is supposed to follow a first-order Markov process. As in [Bianchi \[2011\]](#), endowment shocks are the only source of uncertainty in the model.

Private agents in the domestic economy are assumed to have access to a single internationally-traded bond denominated in terms of tradable goods that pays an interest rate R_t when it is held from period t to period $t+1$. Normalizing the price of tradables to 1 and denoting

the price of nontradable goods by p_t^n , the representative agent faces the following budget constraint:

$$c_t^T + p_t^n c_t^N + d_t = y_t^T + p_t^n y_t^N + \frac{d_{t+1}}{R_t} \quad (2.2)$$

d_{t+1} denotes the amount of debt assumed in the beginning of the period t and maturing in $t + 1$. p_t^n denotes the relative price of nontradables in terms of tradables.

In the same way as in standard Sudden Stop models e.g. [Mendoza \[2002, 2006, 2016\]](#), [Bianchi \[2011\]](#), the model counts for a second feature of the international credit market incompleteness as borrowing requires collateral in the form:

$$d_{t+1} \leq \kappa (y_t^T + p_t^n y_t^N) \quad (2.3)$$

Only a fraction κ of the agent's income is pledgeable as collateral, and as a result, the agent cannot borrow more than this fraction of total income in units of tradables. So that, the pecuniary externality characterizing this model is highlighted by the endogenous character of the borrowing constraint because individual private agent takes the real exchange rate as exogenously determined, while in equilibrium the collective absorption is a key determinant of the relative price. The trade balance (tb_t) is given by:

$$tb_t = y_t^T - c_t^T$$

The balance of payment identity implies that the real value of current account balance (in terms of traded goods price) equals the net foreign capital outflows. Thus, the current account balance (ca_t) equals the difference between the matured and newly issued foreign debt:

$$ca_t = d_t - \frac{d_{t+1}}{R_t}$$

2.2.1 First order conditions and equilibrium dynamics

The representative household chooses a set of processes $\Gamma_t = \{c_t^T, c_t^N, c_t, d_{t+1}\}$ to maximize equation (2.1) subject to equation (2.2) and equation (2.3), given the exogenous

processes $\{y_t^T, y_t^N, R_t\}$ and the initial debt position d_0 . The first-order conditions are:

$$c_t = A(c_t^T, c_t^N) = \left[a c_t^{T1-\frac{1}{\zeta}} + (1-a) c_t^{N1-\frac{1}{\zeta}} \right]^{\frac{1}{1-\frac{1}{\zeta}}} \quad (2.4)$$

$$c_t^T + p_t^n c_t^N + d_t = y_t^T + p_t^n y_t^N + \frac{d_{t+1}}{R_t} \quad (2.5)$$

$$\lambda_t = U' \left(A(c_t^T, c_t^N) \right) A' \left(c_t^T, c_t^N \right) \quad (2.5)$$

$$p_t^n = \left(\frac{1-a}{a} \right) \left(\frac{c_t^T}{c_t^N} \right)^{\frac{1}{\zeta}} \quad (2.6)$$

$$\left(\frac{1}{R_t} - \mu_t \right) \lambda_t = \beta E_t \lambda_{t+1} \quad (2.7)$$

$$d_{t+1} \leq \kappa(y_t^T + p_t^n y_t^N), [\kappa(y_t^T + p_t^n y_t^N) - d_{t+1}] \mu_t = 0, \mu_t \geq 0 \quad (2.8)$$

In equilibrium, the market for nontradables must clear. That is, $c_t^N = y_t^N$. Then, a competitive equilibrium is a set of processes $\{c_t^T, d_{t+1}, \mu_t\}$ satisfying:

$$c_t^T + d_t = y_t^T + \frac{d_{t+1}}{R_t} \quad (2.9)$$

$$\lambda_t = a \left(\frac{c_t^T}{c_t} \right)^{\frac{-1}{\zeta}} c_t^{-\sigma} \quad (2.10)$$

$$p_t^n = \left(\frac{1-a}{a} \right) \left(\frac{c_t^T}{c_t^N} \right)^{\frac{1}{\zeta}} \quad (2.11)$$

$$(1 - R_t \mu_t) = \beta R_t E_t \frac{\lambda_{t+1}}{\lambda_t} \quad (2.12)$$

$$d_{t+1} \leq \kappa(y_t^T + p_t^n y_t^N), [\kappa(y_t^T + p_t^n y_t^N) - d_{t+1}] \mu_t = 0, \mu_t \geq 0 \quad (2.13)$$

Equation (3.7) equates total household expenditure to income measured in units of tradable good. Equation (3.8) equates the current shadow value of wealth to the marginal utility of tradable consumption. Equation (3.10) equalizes the marginal rate of substitution between tradable and nontradable consumption with the relative price. Equation (2.12) is the Euler equation that equalizes the marginal benefit with the marginal cost of increasing consumption of tradables in current period. The representative household faces a borrowing limit given by the market value of the collateral, the marginal utility of increasing debt falls to $\left(\frac{1}{R_t} - \mu_t \right)$, reflecting a shadow penalty for trying to increase debt when the collateral constraint is binding.

Equation (2.13) is the complementary slackness condition. It highlights an important feature that characterizes the economy during a financial crisis, i.e. binding collateral constraint periods, which is reflected by the presence of the relative price p_t^n in the collateral constraint. Indeed, when the economy is hit by a negative shock leading to a drop in output, households' ability to acquire further debt becomes limited as the collateral value declines. As a result, households may cut back on consumption leading to a depreciation in the real exchange rate and thus a further decline of the market value of the collateral. Consequently, the economy could be plunged into a deep recession generated by the feedback loop between the endogenous borrowing constraint and the economic activity. The feedback loop dynamic is described by the equilibrium conditions given in Equation (2.12) and by replacing p_t^n using Equation (3.8):

$$d_{t+1} \leq \kappa \left(y_t^T + \left(\frac{1-a}{a} \right) (c_t^T)^{\frac{1}{\xi}} y_t^{N^{1-\frac{1}{\xi}}} \right) \quad (2.14)$$

It follows that foreign debt is a strictly increasing function of c_t^T , then a decrease of consumption of tradables tightens households' financial conditions leading to a more reduction in d_{t+1} and then in c_t^T via the budget constraint (Equation (3.7)). In turn as

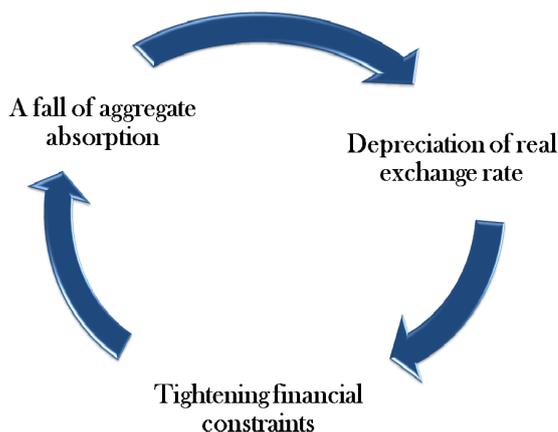


Figure 2.1: Feedback loop of the endogenous borrowing constraint

it is described in Figure.2.1, the new decrease of c_t^T accentuates the depreciation of the real exchange rate which tightens more the credit constraint and decreases more c_t^T .

2.3 Capital control policies

We introduce a social planner that seeks to correct the effect of the externality resulting from the presence of the endogenous collateral constraint on resource allocation and welfare. First, we examine the economic dynamics of a Ramsey economy in which the social planner optimizes the resource allocation taking into account the effect of the endogenous credit limit on the relative price. As the value of the optimal debt-tax in the Ramsey economy is undetermined, we propose a solution that explains the pro-cyclicality stressed in [Schmitt-Grohé and Uribe \[2017\]](#). Second, we examine the macroeconomic and welfare outcomes of two alternative policies, a macroprudential policy targeting the equilibrium level of foreign debt-to-output ratio and a simple capital control policy.

2.3.1 The Ramsey economy

As in [Bianchi \[2011\]](#), we consider a Ramsey planner that seeks to maximize the well-being of the representative household. We suppose that it has the ability to choose directly the level of debt and to allow goods market to clear competitively. The social planner is also subject to the collateral constraint and internalize the financial amplification effect arising from the endogenous credit constraint. The social planner problem is equivalent to the following maximization problem¹:

$$\text{Max } E_0 \sum_{t=0}^{\infty} \beta^t U(A(c_t^T, y_t^N))$$

subject to

$$\begin{aligned} c_t^T + d_t &= y_t^T + \frac{d_{t+1}}{R_t} \\ d_{t+1} &\leq \kappa \left(y_t^T + \left(\frac{1-a}{a} \right) (c_t^T)^{\frac{1}{\zeta}} y_t^{N^{1-\frac{1}{\zeta}}} \right) \end{aligned}$$

¹The social planner maximize life-time utility function subject to equations [3.7-2.16](#), [Schmitt-Grohé and Uribe \[2017\]](#) show that the set of equations can be reduced to only two equations [3.7](#) and [2.14](#)

The optimal conditions of Ramsey problem are summarized below:

$$\lambda_t = a \left(\frac{c_t^T}{c_t} \right)^{\frac{-1}{\zeta}} c_t^{-\sigma} \quad (2.15)$$

$$\lambda_t = \lambda_t^{SP} (1 - \mu_t^{SP} \psi_t) \quad (2.16)$$

$$\left(\frac{1}{R_t} - \mu_t^{SP} \right) \lambda_t^{SP} = \beta E_t \lambda_{t+1}^{SP} \quad (2.17)$$

$$\left[\kappa \left(y_t^T + \left(\frac{1-a}{a} \right) (c_t^T)^{\frac{1}{\zeta}} y_t^{N^{1-\frac{1}{\zeta}}} \right) \right] \mu_t^{SP} = 0; \mu_t^{SP} \geq 0 \quad (2.18)$$

With λ_t corresponds to the Lagrangian multiplier of the regulated economy with an appropriate policy instrument and SP denotes Lagrangian multiplier related to the social planner optimization and ψ_t represents the externality term given by:

$$\psi_t = \kappa \left(\frac{1-a}{a} \right) \frac{1}{\zeta} \left(\frac{c_t^T}{y_t^N} \right)^{\frac{1}{\zeta}-1} \quad (2.19)$$

The key difference between the unregulated economy and Ramsey equilibrium conditions is described by Equation (2.17). Indeed, the current shadow value of wealth of the social planner is higher than that of the decentralized economy when the collateral constraint is binding $\mu_t^{SP} \neq 0$. In such a state, an increase in tradable consumption increases the price of nontradables and relaxes the credit constraint of all households by ψ_t , which has a shadow value of μ_t^{SP} . When the collateral constraint is not binding in current and immediate following state, both unregulated economy and Ramsey allocations coincide. Afterward, we introduce a policy instrument that helps to achieve the Ramsey allocation. As in the existing literature, we study the case of an optimal capital control tax on external borrowing, which is the variable directly affected by the pecuniary externality. The aim of this policy is to induce the representative household to internalize the effect of the aggregate absorption on the relative price of nontradables and therefore on the value of the collateral. Following Bianchi [2011], let τ_t the proportional tax on debt imposed in period t. If τ_t is positive, it represents a proper capital control tax, whereas if it is negative it has the interpretation of a borrowing subsidy. The revenue from capital control taxes is given by $\frac{\tau_t}{R_t} d_{t+1}$. We assume that government consumes no goods and that it rebates

all revenues from capital controls to the public in the form of lump-sum transfers (lump-sum taxes if $\tau_t < 0$), denoted ℓ_t . The budget constraint of the representative household becomes:

$$c_t^T + d_t = y_t^T + (1 - \tau_t) \frac{d_{t+1}}{R_t} + \ell_t \quad (2.20)$$

The new competitive equilibrium conditions of private agents is given by:

$$c_t^T + d_t = y_t^T + \frac{d_{t+1}}{R_t} \quad (2.21)$$

$$\lambda_t = a \left(\frac{c_t^T}{c_t} \right)^{\frac{-1}{\zeta}} c_t^{-\sigma} \quad (2.22)$$

$$p_t^n = \left(\frac{1-a}{a} \right) \left(\frac{c_t^T}{y_t^N} \right)^{\frac{1}{\zeta}} \quad (2.23)$$

$$\left(\frac{1-\tau_t}{R_t} - \mu_t \right) \lambda_t = \beta E_t \lambda_{t+1} \quad (2.24)$$

$$d_{t+1} \leq \kappa (y_t^T + p_t^n y_t^N), [\kappa (y_t^T + p_t^n y_t^N) - d_{t+1}] \mu_t = 0, \mu_t \geq 0 \quad (2.25)$$

Given a policy process τ_t , exogenous endowments y_t^T and y_t^N , and the initial condition d_0 . Ramsey planner sets capital control taxes to maximize households lifetime utility subject to the restriction that the optimal allocation be supportable as a competitive equilibrium. When $\tau_t > 0$, the interest rate perceived by households becomes $\frac{R_t}{1-\tau_t}$ which is higher than R_t . The aim of capital controls in this case is to discourage households from borrowing, as one unit of debt payable in $t+1$ increases consumption of tradables by $\frac{1-\tau_t}{R_t}$ units in period t and utility by $\frac{1-\tau_t}{R_t} \lambda_t$ instead of $\frac{1}{R_t}$ and $\frac{\lambda_t}{R_t}$ respectively. When $\tau_t < 0$, households receive more incentive to borrow as they perceive a lower interest rate $\frac{R_t}{1-\tau_t} < R_t$.

2.3.1.1 The cyclical behavior of the optimal capital control tax

When the borrowing constraint is binding, the optimal capital tax is undetermined as stressed by [Schmitt-Grohé and Uribe \[2017\]](#). Any linear combination of (μ_t, τ_t) that makes Euler equation (2.22) hold is a solution. It means that during financial crisis the implementation of the optimal tax is ambiguous and we cannot conclude how the social planner should set capital control tax to restore the constrained efficient allocation.

In what follows, we derive a solution of the optimal tax that helps to explain the pro-

cyclical behavior stressed by [Schmitt-Grohé and Uribe \[2017\]](#) in boom-bust cycles and accordingly we emphasize the tax behavior during crisis periods. Indeed, $(\mu_t = \mu_t^{SP}, \tau_t = \tau_t^{\mu_t = \mu_t^{SP}})$ is a solution to (μ_t, τ_t) that delivers the same resource allocation in the regulated economy (described by equation (2.21) to Equation (2.25)) as in the Ramsey economy² (described by equations 2.15-2.18). The solution is unique when the borrowing collateral constraint is not binding. When the credit constraint is binding, $(\mu_t = \mu_t^{SP}, \tau_t = \tau_t^{\mu_t = \mu_t^{SP}})$ implies the same resource allocation in the private and in the Ramsey economy. Then optimal tax is given by:

$$\tau_t = \tau_t^{\mu_t = \mu_t^{SP}} = \beta R_t \left[\frac{E_t(\lambda_{t+1}^{SP})}{\lambda_t^{SP}} - \frac{E_t(\lambda_{t+1})}{\lambda_t} \right] \quad (2.26)$$

The optimal tax rate expression given in equation (2.26) provides a relevant explanation for the pro-cyclical behavior of the optimal tax. In fact, the social planner sets the optimal tax rate according to the difference between the marginal cost-to-benefit ratio of holding an additional unit of foreign debt in the Ramsey and private economy.

Equation (2.26) can be expressed as follows:

$$\tau_t^{\mu_t = \mu_t^{SP}} = \beta R_t \frac{E_t(\lambda_{t+1}^{SP})}{\lambda_t^{SP}} \left[1 - \frac{1 - E_t(\mu_{t+1}^{SP} \psi_{t+1})}{1 - \mu_t^{SP} \psi_t} \right]$$

Accordingly, four scenarios emerge:

- During a boom cycle, as emphasized by [Schmitt-Grohé and Uribe \[2017\]](#), the collateral constraint is slack in the current state and in all the immediate following states ($\mu_{t+1}^{SP} = \mu_t^{SP} = 0$), the optimal capital control tax is zero. In this case, households marginal cost-to-benefit ratio of holding an extra unit of debt coincides with that of Ramsey planner leading to the same resource allocation in both private and Ramsey economy.
- During a bust cycle, specially when the borrowing limit is not binding in the current state and the probability of hitting it in the immediate successor state is positive,

²See Appendix A for proof

i.e. $\mu_{t+1}^{SP} \neq 0$, the optimal tax becomes:

$$\tau_t^{\mu_t=\mu_t^{SP}} = \beta R_t \frac{E_t(\lambda_{t+1}^{SP})}{\lambda_t^{SP}} E_t(\mu_{t+1}^{SP} \psi_{t+1})$$

In such a state, the tax rate is positive as the marginal cost of holding an extra unit of debt for the Ramsey planner is higher than that of the representative household ($\lambda_{t+1}^{SP} > \lambda_{t+1}$). Accordingly, the Ramsey planner sets a positive tax rate to avoid a large amount of debt holding in current period that will result in a large decline of c_{t+1}^T in the following state when the collateral constraint will bind.

- During a typical crisis period, specially when the collateral constraint is binding during the current state and it will not be in the immediate following state, equation (2.26) suggests a negative tax rate:

$$\tau_t^{\mu_t=\mu_t^{SP}} = -\beta R_t \frac{E_t(\lambda_{t+1}^{SP})}{\lambda_t} \mu_t^{SP} \psi_t$$

In such a state, private agents undervalue wealth ($\lambda_t < \lambda_t^{SP}$). Indeed, households marginal benefit from an increase of tradable goods consumption includes only the direct increase in utility λ_t and not the indirect increase in utility $\mu_t^{SP} \psi_t$ that arises from relaxing the collateral constraint (via the increase of the relative price and the collateral value). The Ramsey planner is called to set a negative tax to incite households to increase their debt holding in current period by internalizing the collateral constraint effect on the current shadow value of wealth λ_t . However, during crisis periods private agents borrow up to the credit limit, it seems that the only way for the social planner to affect current consumption of tradables depends on ex-ante policy. In fact, the budget constraint implies:

$$c_t^T = y_t^T + \frac{\kappa}{R_t} \left(y_t^T + \left(\frac{1-a}{a} \right) \left(\frac{c_t^T}{y_t^N} \right)^{1/\zeta} y_t^N \right) - d_t \quad (2.27)$$

Under exogenous traded and non traded endowment, this relationship shows prima-facie that the larger is past foreign debt the lower would be the current consumption

which calls for a positive optimal capital tax in period $t - 1$ in line with the result derived from equation (2.26). It suggests that a high leverage in periods when the borrowing constraint is not binding would increase the financial vulnerability of the economy to exogenous shocks mainly if the economy hits the credit limit during the immediate following period.

- In the case of a crisis lasting more than two periods, the sign of the optimal debt tax rate depends on, (i) today and future macroeconomic conditions mainly nontradable goods endowment and tradable goods consumption, (ii) model parametrization, specially the elasticity of substitution between tradables and nontradables (ζ) and the risk aversion parameter (σ).

In what follows, we compare our results and the outcomes of the solution discussed in [Schmitt-Grohé and Uribe \[2017\]](#). To this end, we define τ_t^{SU} :

$$\tau_t^{SU} = 1 - E_t \left(\frac{\lambda_{t+1}}{\lambda_{t+1}^{SP}} \right) \quad (2.28)$$

2.3.2 A simple macro-prudential policy rule

In practice, the implementation of the optimal policy such as τ_t is not free from difficulties and challenges. We investigate whether a simple macro-prudential policy rule of the same esprit of Taylor rule could help to achieve a better-off welfare. Let τ_t^{MP} a debt-tax on foreign borrowing d_{t+t} that varies with the aggregate debt level according to the following rule:

$$\tau_t^{MP} = \left(\frac{d_{t+t}/R}{y_t/R} / \frac{\bar{d}}{R\bar{y}} \right)^\psi - 1 \quad (2.29)$$

With $\frac{\bar{d}}{R\bar{y}}$ the debt-to-GDP ratio target and ψ is the elasticity of the debt-tax with respect to debt-to-GDP ratio variations. Targeting debt-to-GDP ratio rather than debt gap is two-fold.

- The credit-to-GDP ratio is a better indicator than the credit gap as the latter misses too many crises as underlined in [Mitra et al. \[2011\]](#).

- When the economy is hit by a positive productivity shock leading to an increase of current income relaxing the credit constraint and easing households' financial conditions, foreign debt holding would increase naturally without endangering financial stability. Increasing the debt-tax rate in this case will be welfare reducing.

In addition, the implementation of such a policy when debt-to-GDP ratio deviates from its equilibrium level is equivalent to the activation of Counter-Cyclical-Buffers (CCB). As recommended by the IMF [2013], the CCB should be imposed if the credit-to-GDP ratio exceeds its trend value and consists on increasing regulatory capital requirements. Since capital requirements are linked to the amount of credit supply, banks may cut lending to satisfy the requirements. Consequently, the cost of borrowing increases which is translated in our model by a higher debt-tax rate.

The cyclical behavior of τ_t^{MP} depends on the cyclical behavior of debt-to-GDP ratio. During boom cycle debt-to-GDP ratio decreases as GDP increases and thus the debt-tax decreases. By contrast, during bust cycle the debt-tax would be pushed up due to the decline of GDP. We explore numerically cyclical behaviors of policy instruments in section 2.5.

2.3.3 A capital control tax to address households' impatience

The theoretical environment of such a Sudden Stop model features two important characteristics. The presence of the endogenous collateral constraint creates a feedback loop between the economic activity and households' financial conditions as described previously. In addition, as the model is designed for emerging market economies, households are impatient so that they discount the future at a higher rate than the rest of the world ($\beta R < 1$). This fact is translated into a permanent desire of domestic agents to front-load consumption by accumulating a large amount of external debt. To assess how this characteristic contributes to the increase of the domestic economy vulnerability, we explore macroeconomic outcomes of a debt tax that makes households as patient as the rest of the world by setting:

$$\tau_t^{IM} = 1 - \beta R_t \quad (2.30)$$

Consequently, the Euler equation under this debt-tax becomes:

$$E_t \frac{\lambda_{t+1}}{\lambda_t} = \left(1 - \frac{\mu_t}{\beta}\right)$$

When the collateral constraint is not binding, implementing τ_t^{IM} enforces households to carry a lower amount of debt than that in the unregulated economy. We can show that the new Euler equation (2.31) implies:

$$\ln \left[\frac{c_{t+1}^T}{c_t^T} \right] = (1 - \zeta \sigma) \ln \left[\frac{c_{t+1}}{c_t} \right]$$

Accordingly, the correlation between c_t^T and c_t depends on the value of ζ and σ :

1. When the elasticity of substitution between tradables and nontradables equals the inverse of risk aversion; $\zeta = \frac{1}{\sigma}$, consumption of tradable goods becomes constant $c_t^T = c_{t+1}^T$ and depends strongly on the initial value of foreign debt;
2. When $\zeta > \frac{1}{\sigma}$, c_t^T and c_t are negatively correlated and thus c_t^T and y_t^N are too;
3. A value of ζ less than $\frac{1}{\sigma}$ implies a positive correlation between c_t^T and y_t^N .

However, implementing such a tax policy could have an adverse effect on welfare and resource allocations depending on parameter values and initial debt position.

Table 2.1 recapitulates the policy instruments taken into consideration in our analysis.

Table 2.1: Policies to correct the pecuniary externality of the endogenous collateral constraint

	Policy rule τ_t
Ramsey economy	
Baseline optimal capital control tax	$\beta R_t \left[\frac{E_t(\lambda_{t+1}^{SP})}{\lambda_t^{SP}} - \frac{E_t(\lambda_{t+1})}{\lambda_t} \right]$
Schmitt-Grohé and Uribe [2017] optimal capital tax	$1 - E_t \left(\frac{\lambda_{t+1}}{\lambda_{t+1}^{SP}} \right)$
Simple macroprudential policy	$\left(\frac{d_{t+t}}{R y_t} / \frac{\bar{d}}{R \bar{y}} \right)^\psi - 1$
Capital control tax to address households' impatience	$1 - \beta R_t$

2.4 Welfare analysis

Following Lucas [2003], the welfare cost of correcting the externality in the present model can be measured by a compensation parameter γ that equals the expected life-time utility of the representative household in the unregulated economy and that in the regulated economy under different policies as follows:

$$E_0 \sum_{t=0}^{\infty} \beta^t U((1 + \gamma(b, y)) c_t^{de}) = E_0 \sum_{t=0}^{\infty} \beta^t U(c_t^{re}) \quad (2.31)$$

With c_t^{de} and c_t^{re} represent the historical optimal choices of consumption in the unregulated and in regulated economies respectively given the initial state of the economy (b, y) . Indeed, γ represents a quantitative measure of the welfare gain in moving from the unregulated economy to the regulated economy, or equivalently, the welfare cost of not correcting the externality. Alternatively, equation (2.31) can also be interpreted as a measurement of the compensation, in units of percentage of consumption given by the parameter γ , that would make the representative household indifferent between remaining in the unregulated economy and correcting the externality. Because of the homotheticity of the utility function, the welfare gain γ of a state (b, y) is given by:

$$(1 + \gamma(b, y))^{(1-\sigma)} V^{de}(b, y) = V^{re}(b, y) \quad (2.32)$$

With V^{de} and V^{re} value functions related to the unregulated and regulated economies respectively.

2.5 Quantitative analysis

In order to evaluate quantitatively policy implications on the macroeconomic volatility, resource allocations and the social welfare, we solve the competitive equilibria of the unregulated and regulated economies numerically using global non-linear methods described in Appendix B. A period in the model represents a year. We investigate the quantitative results in an economy driven by exogenous tradable and non tradable endowment

shocks. As the main results do not significantly change in an economy driven by traded endowment and world interest rate shocks, we present related results in Appendix B.4. We adopt exactly the same calibration as in Bianchi [2011] to evaluate the quantitative implications of the cyclical behavior of policy instruments. Table 2.2 presents the baseline calibration. Bianchi [2011] exploits data from Argentina to model endowment shocks that are assumed to follow a bi-variate auto-regressive process $AR(1)$:

$$\begin{bmatrix} \ln y_t^T \\ \ln y_t^N \end{bmatrix} = \begin{bmatrix} 0.901 & -0.453 \\ 0.495 & 0.225 \end{bmatrix} \begin{bmatrix} \ln y_{t-1}^T \\ \ln y_{t-1}^N \end{bmatrix} + \epsilon_t; \epsilon_t \sim N \left(0, \begin{bmatrix} 0.00219 & 0.00162 \\ 0.00162 & 0.00167 \end{bmatrix} \right)$$

ϵ_t is assumed to be identically independently distributed. This process implies unconditional standard deviations of 6% and serial correlations of about 0.53 and 0.61 for traded and non-traded endowments respectively, and a contemporaneous correlation of 0.8. Following Bianchi [2011], we discretize the above driving process using 4 distinct values for the natural logarithm of traded and non-traded endowments leading to 16 distinct pairs $(\ln y^T, \ln y^N)$. The endogenous state, d_t/R , is discretized using 800 evenly spaced points ranging from 0.4 to 1.02.

The three remaining parameters $\{\beta, a, \kappa\}$ are calibrated to match Argentina historical data. The parameter a represents the tradable share in the CES aggregator and it is set at 0.31 so that the share of tradable sector in aggregate output is 32%. The discount factor is set at 0.91. Accordingly, the average net foreign asset position-to-GDP ratio equals -29 percent of GDP, a historical average observed in Argentina. The world interest rate R is set at 0.04 and assumed to be constant. We set κ at 0.32 R the same value used in Bianchi [2011], Schmitt-Grohé and Uribe [2017] and that delivers a frequency of crisis of about 5.5%.

Table 2.2: Calibration of the Economy

Parameter	Value	Description
κ	0.3328	Parameter of the collateral constraint
β	0.91	Subjective discount factor
R_t	1.04	World interest rate
σ	2	Inverse of intertemporal elasticity of substitution
α	0.31	Weight on tradables in CES aggregator
ζ	0.83	The elasticity of substitution between tradable and nontradable goods
ψ	1	The baseline calibration of the elasticity of the debt-tax with respect to debt-to-GDP ratio change
$\frac{\bar{d}}{R^N \bar{y}}$	23.5%	Debt-to-GDP ratio equilibrium
y^N	1	Steady-state nontradable output
y^T	1	Steady-state tradable output
$n_{y_t^T}$	4	Number of grid points for y_t^T
$n_{y_t^N}$	4	Number of grid points for y_t^N
n_d	800	Number of grid points for d_t , equally spaced
$\left[\ln \frac{y_t^T}{y_t^N}, y_t^T \right]$	$[-0.1093, 0.1093]$	Range for traded output
$\left[\ln \frac{y_t^N}{y_t^T}, y_t^N \right]$	$[-0.1328, 0.1328]$	Range for nontraded output
$\left[\frac{d}{R_t}, \frac{\bar{d}}{R_t} \right]$	$[0.4, 1.02]$	Range for debt

Source: [Bianchi \[2011\]](#)

Other parameters are calibrated following the DSGE-SOE literature; the inverse of intertemporal elasticity of substitution σ is set at 2, a standard value in the existing related literature. The elasticity of substitution ζ is set at 0.83 as in Bianchi [2011]. We set ψ at 1 as a baseline calibration.

2.5.1 The long run macroeconomic dynamics

We solve equilibrium conditions for the unregulated, Ramsey and regulated economies with τ_t^{MP} and τ_t^{IM} . We use the optimal set of processes derived from Ramsey economy's solutions to solve the regulated economies with $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SU} . In what follows, we analyze foreign debt accumulation rules in the private economy vs. the regulated economy. Figure 2.2 displays the average of next period bond holdings in the unregulated and regulated economies, as a function of the average of current debt holdings across all 16 economic states of nature. Since the mean value of tradable output is 1, we can interpret all results as ratios with respect to the average output of tradables.

Figure 2.2 shows that when the endogenous collateral constraint is not binding, next period bond holdings as a function of current debt is monotonically increasing with a slope value above 1, except for the regulated economy with τ_t^{IM} . This means that private agents accumulate a higher amount of foreign debt in next periods when compared to today debt levels.

In addition, under τ_t^{MP} and τ_t^{IM} households' decision rules are affected in two distinct ways:

- Implementing τ_t^{MP} rises the intercept and reduces the slope of the policy function curve. As long as the debt-to-GDP ratio is under its equilibrium level, the simple macroprudential debt-tax is remaining negative to incite households to carry a high amount of debt during such periods. As a result, tomorrow debt levels are higher than that of current levels. When debt-to-GDP ratio exceeds its equilibrium level, τ_t^{MP} becomes positive leading to a tightening of households' financial conditions. In such states, the slope of accumulating debt in next periods goes below 1 so that next period foreign debt level declines.

- Implementing τ_t^{IM} moves private debt decision rule curves down, by reducing its intercept and increasing its slope. Indeed, τ_t^{IM} is constant and positive across all states of nature, so that private agents are avoided to accumulate a large amount of debt even when the collateral constraint is not binding. Therefore, the intercept of policy function under τ_t^{IM} is shifted down. Furthermore, comparing τ_t^{IM} policy function curve against the 45-degree line shows that its slope is close to 1. Which means that next period debt amount increases one by one to the increase of current bond holdings.

Otherwise, during periods in which the credit limit is not reached, resource allocations in both the Ramsey and unregulated economy are the same, leading to a null optimal capital tax. As a result, the policy function of Ramsey planner and that of the unregulated economy are very close.

When the collateral constraint is binding (constrained region) in the unregulated economy, the sign of the slope of all policy functions becomes negative in the first point at which the collateral constraint is satisfied with equality but it is not binding. To the left of this point, the optimal capital tax (either $\tau_t^{\mu_t=\mu_t^{SP}}$ or τ_t^{SU}) increases to reach its maximum value at this point. The aim of Ramsey planner in such times is to correct the externality by inhibiting households from accumulating a large amount of foreign debt. Consequently, the accumulated debt during next period in the Ramsey economy is relatively lower than that of the unregulated economy. Once the endogenous collateral constraint becomes binding, Ramsey planner lowers the optimal capital tax $\tau_t^{\mu_t=\mu_t^{SP}}$ that reaches negative value while τ_t^{SU} is undetermined during such periods.

To investigate the long run economic dynamic of foreign debt accumulation in the unregulated and regulated economies, we simulate the set of processes for one million years. Figure (2.3) displays the ergodic distribution of the simulated bond holdings data in each economy. It shows:

- that the economies regulated with τ_t^{MP} and τ_t^{IM} display a limited foreign debt accumulation when compared to the unregulated and the Ramsey economy. The chances of carrying a debt of about 80.6% and 83.1% of traded output are only

12.8% and 5.4% respectively,

- the Ramsey economy³ has a probability of about 19.2% to accumulate the highest amount of debt equivalent to 93.4% of traded endowment,
- the unregulated economy has a probability of 13% to accumulate an amount of foreign debt above 95% of traded output, while the probability for the regulated economies with τ_t^{MP} and τ_t^{IM} to accumulate such a debt level is null,
- the large differences in debt distributions are translated into a large difference in average debt levels. In fact, the average of debt to aggregate output ratios in regulated economies with τ_t^{MP} and τ_t^{IM} are 24.8% and 24.5% respectively, against 29.2% in the private economy and 28.9% in the Ramsey economy (Table 2.3).

2.5.2 Crises frequency and severity

In what follows, we examine the frequency and the severity of crises in the unregulated and regulated economies. As in Bianchi [2011], a crisis corresponds to a period in which the collateral constraint is binding. Implementing τ_t^{MP} and τ_t^{IM} shifts the economy away from the binding collateral constraint region, while Ramsey economy experiences a crisis every 16 years against once every 12 years in the unregulated economy. As a result, the

Table 2.3: Debt-to-output ratios, Frequency of Crises and Welfare

	Debt-to-Output Ratio	Frequency of Crises	Welfare gain ^a
Unregulated economy	29.17%	12 years	-
Ramsey economy	28.89%	16 years	0.046
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	28.89%	16 years	0.046
Regulated economy with τ_t^{SU}	28.89%	16 years	0.046
Regulated economy with τ_t^{MP}	24.78%	No crisis	0.333
Regulated economy with τ_t^{IM}	24.54%	No crisis	0.196

Source: Authors' calculations

^aIn percent of permanent consumption

absence of crises in the regulated economies with τ_t^{MP} and τ_t^{IM} is translated into a higher

³Regulated economies with both $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SU} displays the same ergodic debt distributions

welfare gain of about 0.3 and 0.2 percent of permanent consumption respectively. However, the welfare gain of implementing optimal capital tax is only around 0.05 percent. To understand the above welfare effect of macroprudential and capital control policies, we estimate the long run decline in private consumption during all crisis periods occurring in the unregulated economy. Figure 2.4 highlights the extent of consumption drops for the unregulated economy in which non-trivial probabilities are associated to a fall in private consumption above 20%. The Ramsey economy displays relatively a moderate drop in consumption in comparison with the laissez-faire economy, and significantly higher than that of the regulated economies with macroprudential and capital control policies.

On average, the laissez-faire economy experiences a drop of private consumption of about 16.6 percent (Table 2.4), against 14.4 percent in the Ramsey economy, 4.4 in the regulated economy with τ_t^{IM} and 5.5 percent in the regulated economy with τ_t^{MP} . The drop of private consumption is accompanied by a limited output loss of about 2.5 percent of the long term average of aggregate output in the economy regulated with τ_t^{IM} and to 6.7 percent in the economy regulated with τ_t^{MP} . Nevertheless, output declines by 18.5 percent in Ramsey economy against 25.9 percent in the private economy. As a result, the decline of aggregate consumption and production leads to a positive trade balance-to-GDP, except for the regulated economy with the pegged debt-tax that experiences a negative trade balance-to-GDP.

In addition to that, during crisis periods the average of the appreciation of the real exchange rate⁴ is 28.3 percent in the unregulated economy against 12.6 in Ramsey economy. Instead of an appreciation, the regulated economies with τ_t^{IM} and τ_t^{MP} display a depreciation of about 6.3 and 1 percent respectively.

2.5.3 Macroeconomic volatility

In terms of the macroeconomic volatility, our main finding shows that the regulated economy with τ_t^{IM} reduces significantly the volatility the economy. Indeed, implementing

⁴The real exchange rate is given by $\left[a^\zeta + (1-a)^\zeta p_t^{N^{1-\zeta}} \right]^{\frac{-1}{1-\zeta}}$ which implies a one-to-one negative relationship between the price of non-tradables and the real exchange rate.

Table 2.4: The Severity of Financial Crises

^a	Output	Consumption	Relative price	Trade balance-to-GDP
Unregulated economy	-25.9	-16.6	-28.3	7.2
Ramsey economy	-18.5	-14.4	-12.6	4.0
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	-18.5	-14.4	-12.6	4.0
Regulated economy with τ_t^{SU}	-18.5	-14.4	-12.6	4.0
Regulated economy with τ_t^{IM}	-2.5	-4.4	6.3	-0.9
Regulated economy with τ_t^{MP}	-6.7	-5.5	1.0	0.2

Source: Authors' calculations

^aAll variables are responses on impact expressed as percentage deviations from averages in the corresponding ergodic distribution, except for trade balance-to-GDP which is the average of this ratio during crisis periods.

τ_t^{IM} shifts households' consumption preferences toward nontraded goods and thus leading to a negative correlation between consumption of tradables c_t^T and nontraded endowment y_t^N of about 19.57%. The resulting opposite co-movement of nontraded endowments and households' consumption of tradables stabilizes the aggregate consumption that is characterized by a volatility of about 3.74% versus 5.8% in the unregulated economy, 5.8% in the Ramsey economy and 5.06% in the regulated economy with simple macroprudential policy. In addition, the correlation between c_t^T and traded endowment y_t^T is only about 31.69% instead of 67.99% in the unregulated economy, 78.63% and 89.91% in the Ramsey economy and the regulated economy with τ_t^{MP} respectively. Consequently, a significant change in traded and nontraded endowments is not translated into a large variation of tradable good consumption and then a foreign debt accumulation. This fact reduces the amplification effect of the borrowing collateral constraint and leads to a moderate aggregate output volatility (Table 2.5).

It follows also that macroprudential policy implemented via a simple macroprudential policy rule helps to stabilize the external accounts. In fact, the trade balance-to-GDP ratio displays a standard deviation of only 0.8% while it is 2.8% in the unregulated economy, 1.7% in both Ramsey economy and the regulated economy with fixed debt tax. The results point out, in addition, a positive correlation between the balance-to-GDP ratio and the aggregate output in the regulated economies with τ_t^{MP} and τ_t^{IM} , while this correlation is negative in the unregulated and Ramsey economies.

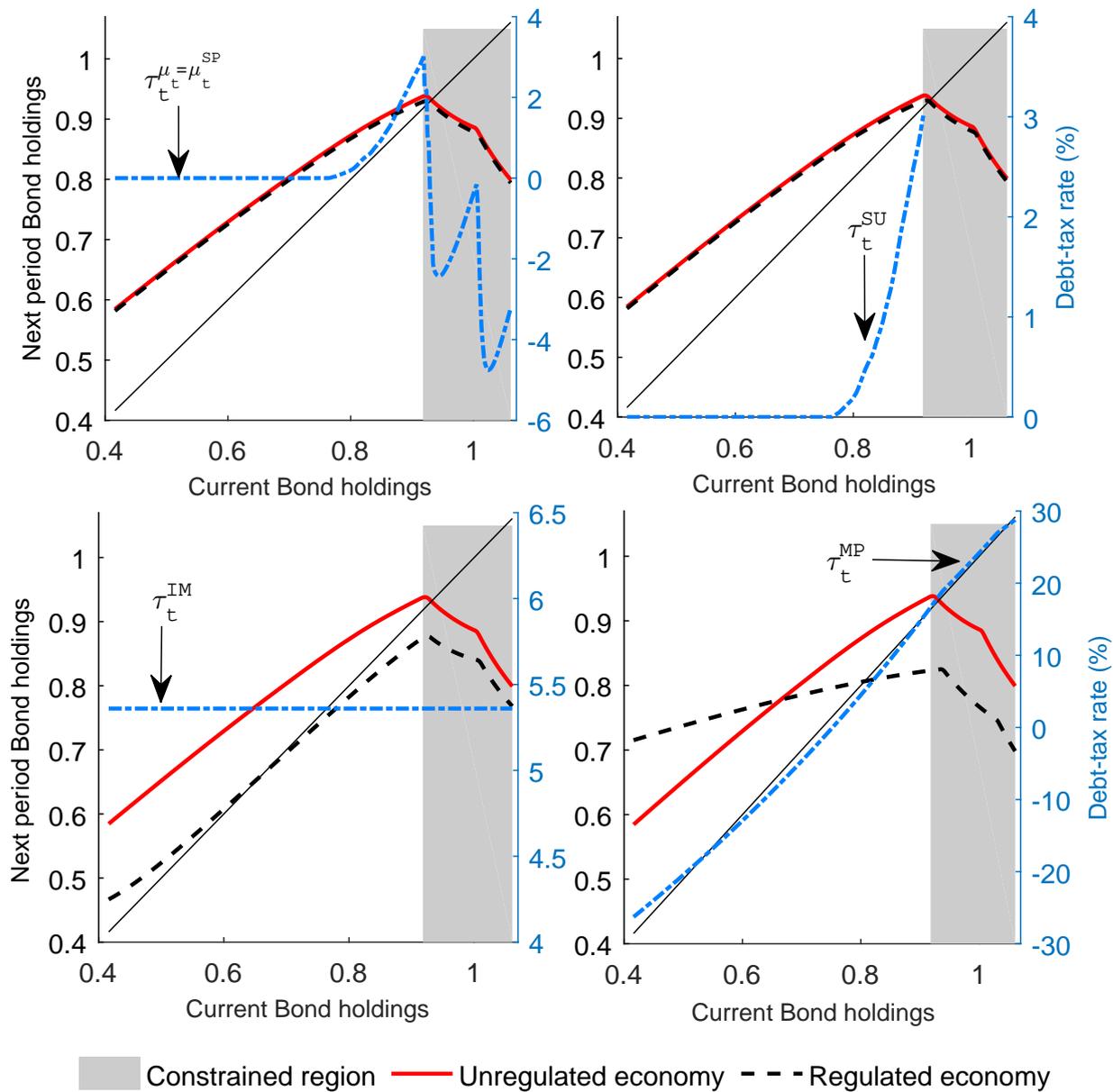


Figure 2.2: Bond decision rules (the average over all economic state of nature)

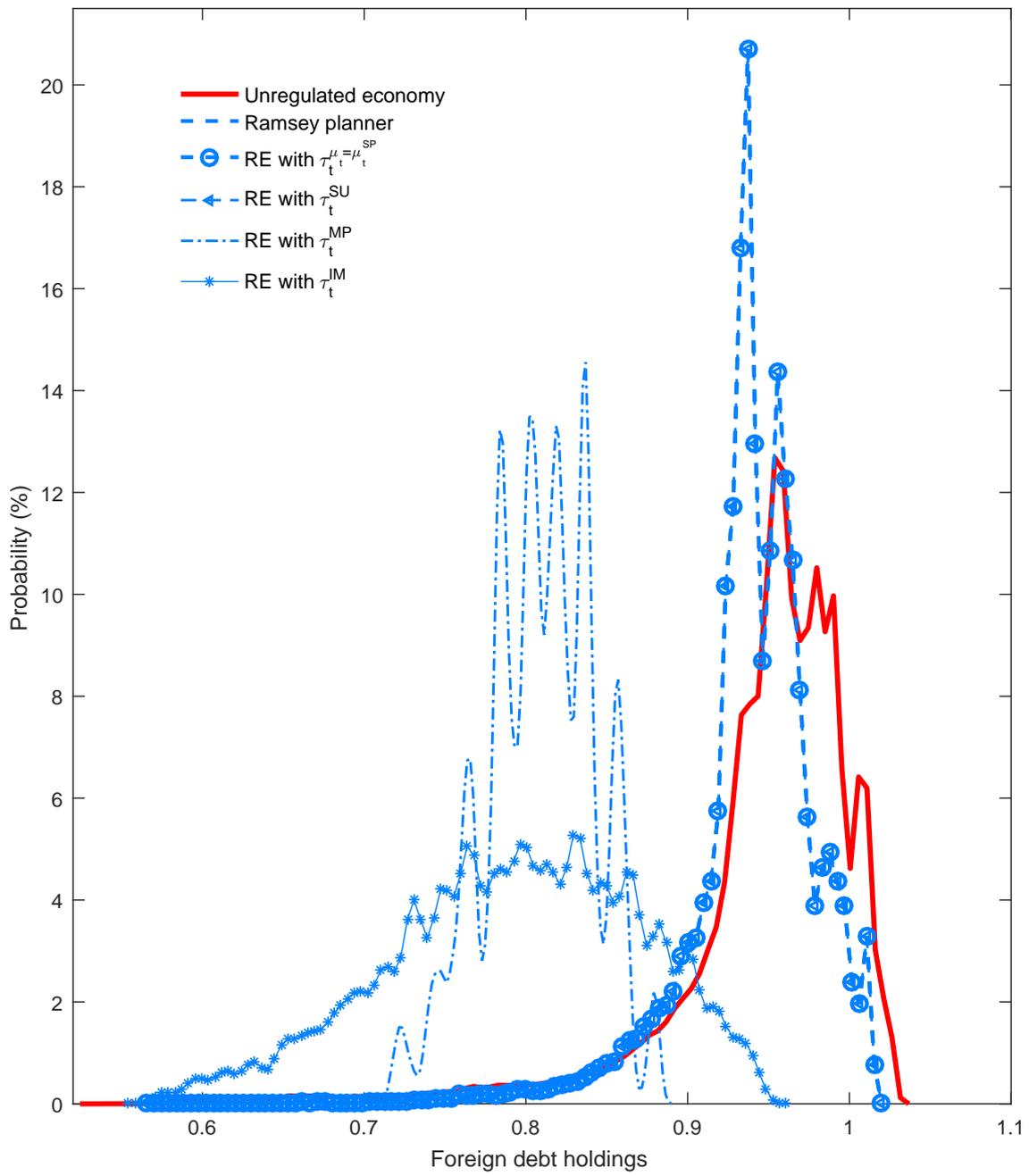


Figure 2.3: The ergodic distribution of foreign debt holdings

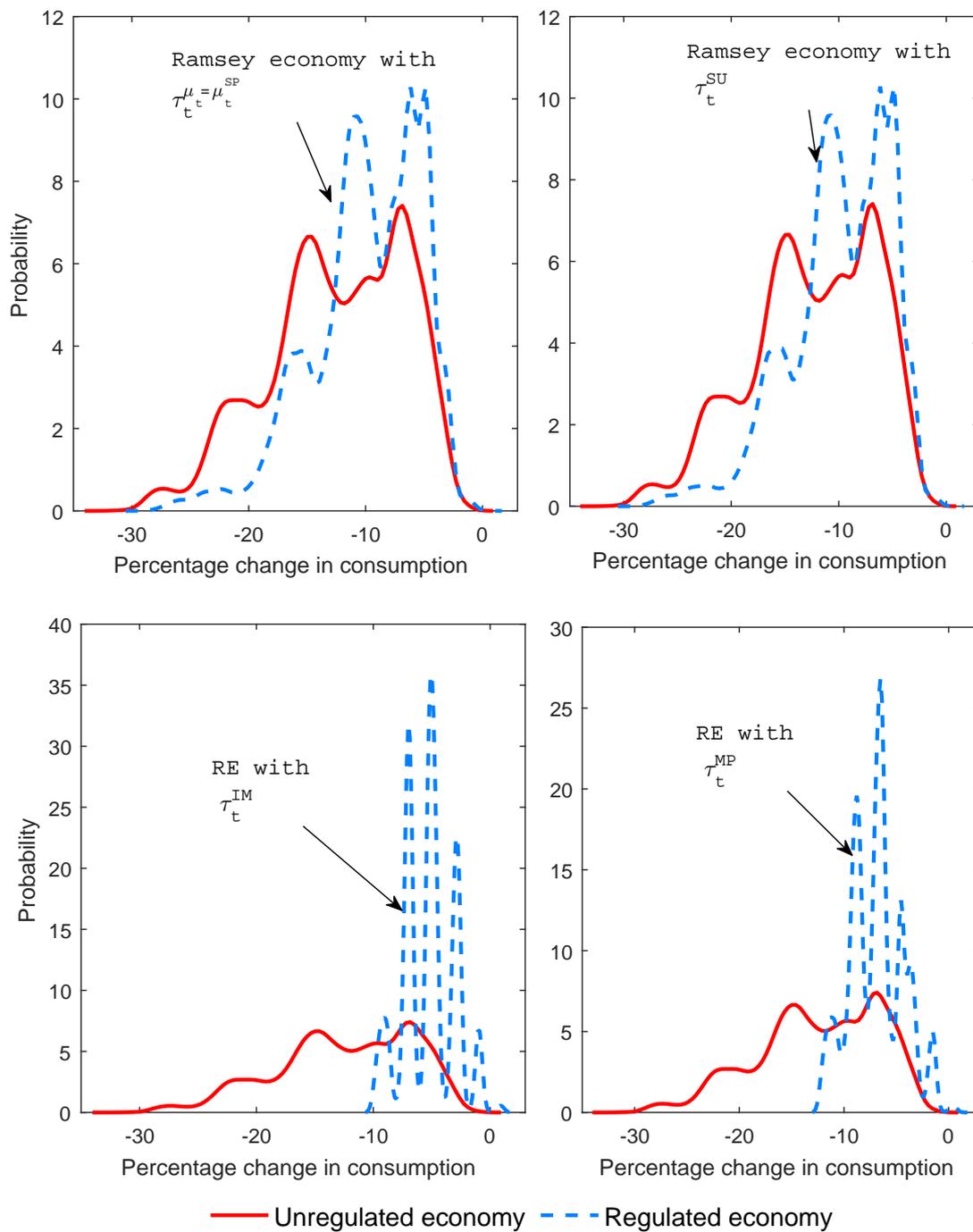


Figure 2.4: The ergodic distribution consumption drops during crisis periods

Table 2.5: The macroeconomic volatility

	The Unregu- lated economy	The Ramsey economy	With $\tau_t^{\mu_t = \mu_t^{SP}}$	The Regulated economy With τ_t^{SU}	With τ_t^{MP}	With τ_t^{JM}
Aggregate output	8.0	6.7	6.7	6.7	4.9	2.2
Aggregate consumption	5.8	5.4	5.4	5.4	5.1	3.7
Consumption of tradables	8.8	7.0	7.0	7.0	4.6	1.5
Relative price	10.0	7.5	7.5	7.5	3.9	7.2
Trade balance-to-GDP	2.7	1.7	1.7	1.7	0.8	1.7

Source: Authors' calculations

Table 2.6: The aggregate output correlation with other variables ($corr(y_t, \cdot)$)

	The Unregu- lated economy	The Ramsey economy	With $\tau_t^{\mu_t = \mu_t^{SP}}$	The Regulated economy With τ_t^{SU}	With τ_t^{MP}	With τ_t^{JM}
Aggregate consumption	0.833	0.828	0.828	0.828	0.875	0.353
Consumption of tradables	0.99	0.99	0.99	0.99	0.99	0.88
Relative price	0.76	0.63	0.63	0.63	0.08	-0.01
Trade balance-to-GDP	-0.74	-0.56	-0.56	-0.56	0.30	0.52

Source: Authors' calculations

2.5.4 Boom-bust cycles under endogenous endowments shocks

Following [Schmitt-Grohé and Uribe \[2017\]](#), we define a boom-bust episode as a situation in which tradable output starts above its trend and is below the trend three years later. To characterize the typical boom-bust cycle, we extract all windows containing a boom-bust cycle from the simulated data. This yields 12 non-overlapping boom-bust episodes every century equivalent to 254,127 windows. We refer to the average dynamics of an economy over all boom-bust episodes as the typical boom-bust cycle. We take the median rather than the average for debt-tax rates $\tau_t^{\mu_t=\mu_t^{SP}}$, τ_t^{SU} and τ_t^{MP} as their distributions are negatively skewed.

Figure 2.5 displays with solid line the cyclical behavior of the unregulated economy and with dashed lines that of the three regulated economies. The exogenous boom-bust cycle in traded and non traded outputs produces endogenous boom-bust cycles in total output ($y_t = y_t^T + p_t y_t^N$), consumption, the relative price of nontradables, and the foreign debt holdings.

Figure 2.5 shows:

- a similar cyclical dynamic in the Ramsey economy and the regulated economy using $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SU} . The social planner restores the constrained efficient allocation by avoiding households to accumulate a relatively high foreign debt in comparison with that of the unregulated economy. However, the constrained efficient allocation achieved in the Ramsey economy is characterized by an economic contraction as much large as the contraction observed in the unregulated economy. In addition, the accumulated foreign debts in both Ramsey and unregulated economies does not respond significantly to the contraction in traded and non-traded endowments,
- different cyclical dynamics in the regulated economy with τ_t^{MP} and τ_t^{IM} . Indeed, implementing such policies affects foreign debt accumulation behavior. It decreases during the typical boom cycle and increases during the typical bust cycle. However, foreign debt levels are quite different. The pro-cyclicality of the macroprudential policy tax across the typical boom-bust cycle leads to a high level of accumulated

foreign debt in comparison with that of the regulated economy with τ_t^{IM} . In addition, during the typical bust cycle, both economies display an increase of foreign debt accumulation that helps private agents to smooth their consumption. As a result, the response of private consumption to negative exogenous shocks of endowments remains largely moderate than that of Ramsey and unregulated economies.

Figure 2.5 highlights also the pro-cyclicality of the three time-varying policy instruments during the typical boom-bust cycle. In addition, the policy instruments display a negative log term correlation with output (table 2.7) except for the policy instrument $\tau_t^{\mu_t=\mu_t^{SP}}$ which is positively correlated to output due to its negative values during crisis periods. Excluding crisis periods, $\tau_t^{\mu_t=\mu_t^{SP}}$ displays the same correlation to aggregate output as τ_t^{SP} .

Table 2.7: Cyclicity of capital control policy instruments

	unconditional median	corr(., y_t)
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	1.1%	0.27 ^a , -0.85 ^b
Regulated economy with τ_t^{SU}	1.2%	-0.85
Regulated economy with τ_t^{MP}	5.1%	-0.6
Regulated economy with τ_t^{IM}	5.4%	-

Source: Authors' calculations

^aincluding all simulated data

^bexcluding crisis periods

2.5.5 Typical crisis under exogenous endowments shocks

In this section, we explore the crisis dynamic of the unregulated and regulated economies. To this end, we extract all eleven-year windows centered around a period in which the collateral constraint binds in the unregulated economy. This yields 84,221 windows.

Figure 2.6 displays with solid line the dynamics of the unregulated economy during crisis period. In the figure, the time of the crisis is normalized to period 0. The crisis occurs after a string of increasingly negative endowment shocks. In the period of the crisis, both endowments are 8.8% and 7.3% below the trend of traded and non-traded endowment respectively. In the unregulated economy, the decline of endowments triggers a Fisherian debt deflation, first, by lowering the collateral value and deteriorating financial conditions

of households, whom respond by cutting back consumption of tradable. As a result, c_t^T decline by 23.7% more than the contraction in traded output, leading to a large improvement in the trade balance of about 16% of tradable output. Second, the decline of c_t^T combined with the fall of nontraded output leads to a depreciation of the real exchange rate of about 22.7% and then a decline of aggregate output of about 20.1%. Consequently, the Fisherian debt-deflation aggravates the decline of the collateral value, which is already quite depressed by the fall in both endowments. At the time of the crisis, as the economy is forced to deleverage, foreign debt drops by about 14.7%.

Figure 2.6 displays with broken lines the typical crisis in Ramsey and regulated economies. The implementation of the optimal capital taxes, $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SP} , generates an output contraction of about 13%, that is driven mainly by a depreciation of the relative price of 11.7% due to a decline of consumption of tradables of about 14.6%. As a result, foreign debt decreases by 7%. The fall of aggregate absorption lead to a surplus of trade balance of about 9.8% in terms of traded output. However, under τ_t^{MP} and τ_t^{IM} , the regulated economies display stable dynamic behavior during the typical crisis period. As households are enforced to accumulate a moderate debt levels, their borrowing abilities are unaffected by the decline of both traded and non-traded endowments. As a result, households smooth their consumption by increasing their debt holding during the crisis by about 3% in the regulated economy under τ_t^{MP} and about 6.7% in the regulated economy under τ_t^{IM} .

During the crisis, all policy instruments are pro-cyclical except $\tau_t^{\mu_t=\mu_t^{SP}}$ that displays negative values during the typical crisis period as explained in previous section.

2.6 Conclusion

In the present chapter, we provide an explanation for the pro-cyclicality of the optimal capital control policy tax stressed by [Schmitt-Grohé and Uribe \[2017\]](#), in an open economy model with pecuniary externalities due to flow collateral constraints. We show that the optimal tax is set according to the difference between the cost to benefit ratios of

accumulating an extra unit of debt in the unregulated economy and the Ramsey economy. As this difference is pro-cyclical, the optimal tax is lowered during boom cycle and set to zero when the borrowing constraint is not binding in current and all immediate future states. It is increased during bust cycle when the probability of hitting the collateral constraint in future immediate successor states becomes positive. During such periods, households fails to internalize the effect of accumulating a large amount of debt today on their ability to freely smooth their consumption tomorrow. Then, setting a positive tax on external borrowing incites private agents to reduce their bonds holdings. However, by contrast to [Schmitt-Grohé and Uribe \[2017\]](#), the optimal capital control tax according to our solution is counter-cyclical during financial crisis and displays negatives values.

Furthermore, we investigate the effectiveness of two additional capital control policies. First, a simple macroprudential policy with foreign debt-to-GDP ratio targeting. The main advantage of such a policy is its uncomplicated implementation based on a simple policy rule that links debt-tax rate variation to changes in debt-to-GDP gap. The resulting debt-tax cyclical behavior is pro-cyclical as output contraction during a boom-bust cycle lead to a pro-cyclical debt-to-GDP gap. Our results highlight that the implementation of such a policy reduces drastically the volatility of the economy and leads to a welfare gain seven times higher than that of the Ramsey economy. Second, a capital control policy that aims to affect households impatience and consumption preferences, e.i a fixed debt-tax that makes households as much patient as the rest of world. The main result shows that implementing this policy shifts the economy far away from binding collateral constraint region, reduces the economic volatility and delivers a high welfare gain when compared with both the unregulated and Ramsey economy. Nevertheless, the effectiveness of this policy is conditional on the model parameter calibration and initial values. For instance, when the elasticity of substitution between tradable and nontradable goods equals the inverse the households' risk aversion, adopting such a policy could involve the economy into a permanent financial crisis mainly when the collateral constraint is binding in the initial period.

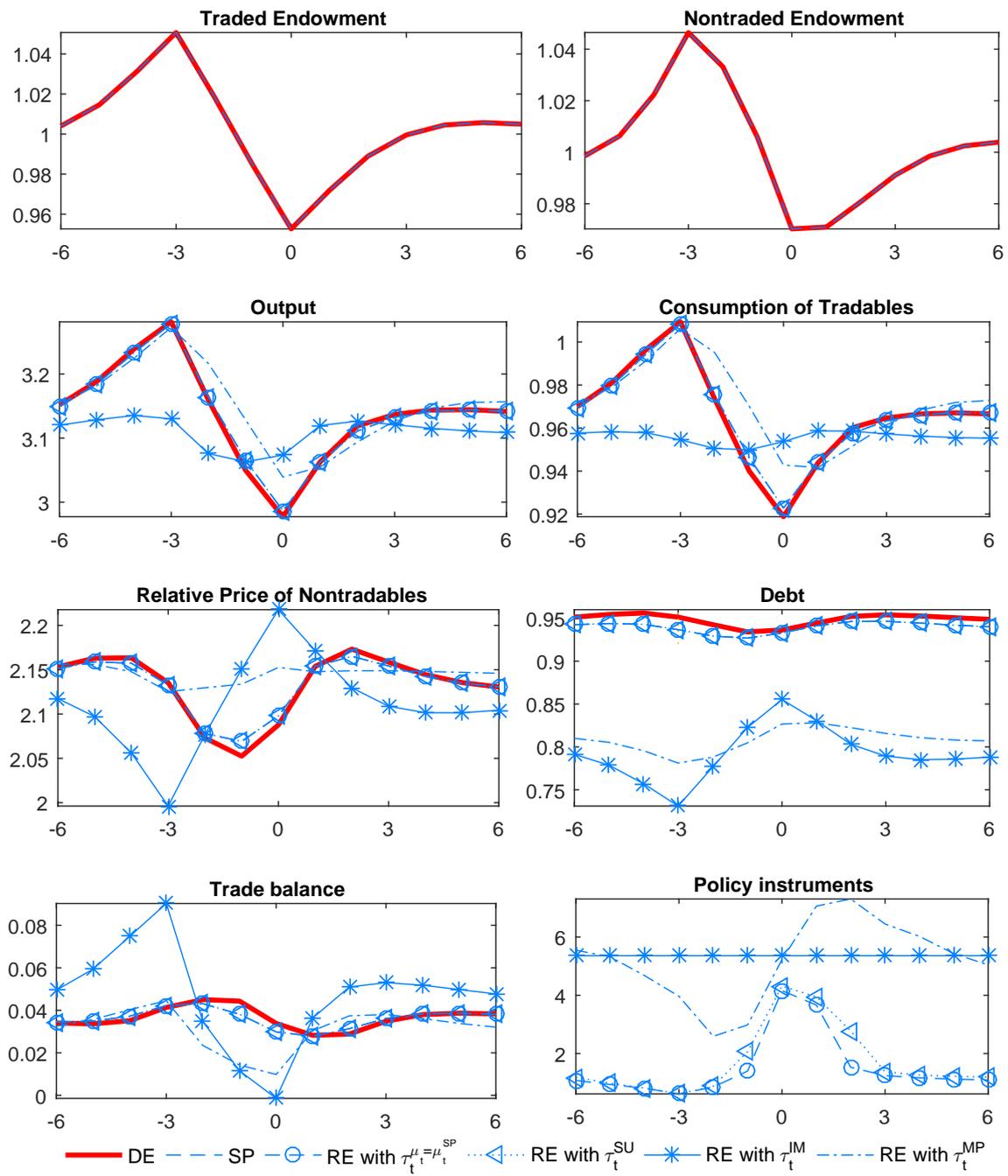


Figure 2.5: The Typical Boom-Bust Cycle in the Endowment-Shock Economy

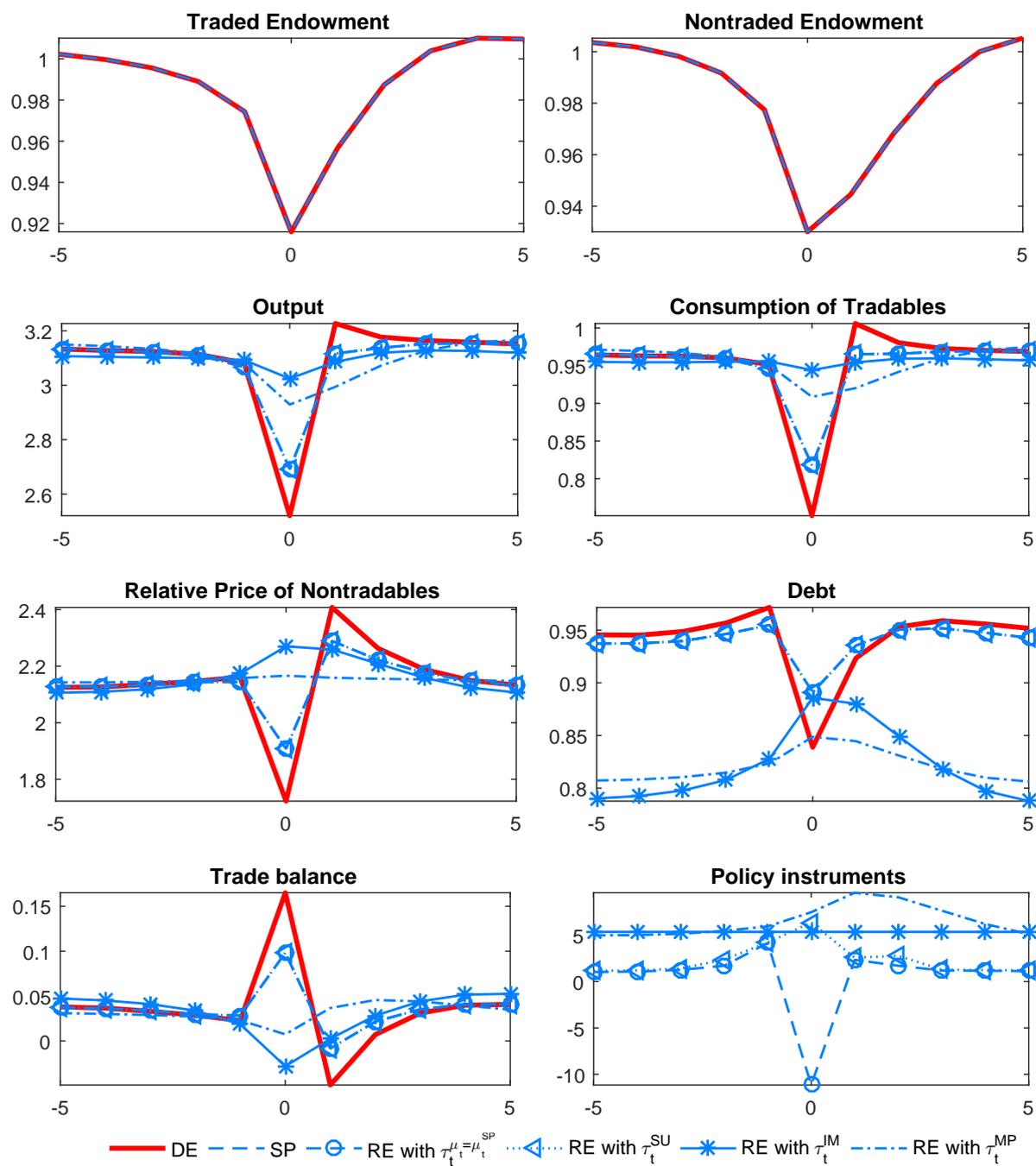


Figure 2.6: The Typical crisis in the Endowment-Shock Economy

Chapter 3

Sterilization and capital control policies for managing debt-creating capital inflows

3.1 Introduction

As underlined by [Stiglitz \[2000\]](#), capital market liberalization without an adaptive regulatory framework might be systematically associated with a higher economic instability and volatility, and a higher probability of a recession. It brings an additional trade-off for monetary authority between stabilizing the economy and stabilizing capital flows. Recent works highlight a promising role of alternative policies that may exacerbate this trade-off, such as prudential capital control policies ([Rey \[2015\]](#), [Farhi and Werning \[2014\]](#), [Korinek and Sandri \[2016\]](#)).

The effectiveness of prudential capital control policies is justified by their associated welfare enhancing effects as argued in a recent growing literature. Indeed, [Korinek \[2010\]](#) stresses the effectiveness of capital control policies at mitigating the negative effect of pecuniary externalities associated with capital flows and foreign currency indebtedness. [Jeanne and Korinek \[2010b\]](#) show the role of a time-varying Pigouvian tax on foreign borrowing in inducing borrowers to internalize the externalities resulting in their external

borrowing behavior. In his seminal paper, [Bianchi \[2011\]](#) demonstrates that a constrained-efficient allocation can be recovered through appropriate state-contingent capital controls, reserve requirements, or margin requirements on external borrowing. [Farhi and Werning \[2012\]](#) argue that capital controls can mitigate the effects of excess international capital movements caused by risk premium shocks. In a more recent paper, [Korinek and Sandri \[2016\]](#) emphasizes that capital controls on pro-cyclical payoff flows to EMEs, such as foreign currency debt, are Pareto improving.

Similarly, the renewed interest on capital account restriction policies reconsiders also the potential role of sterilized interventions. [Guzman et al. \[2018\]](#) indicate that capital account regulations and sterilized interventions may act as the best complementary policies to usual counter-cyclical macroeconomic policies in economies experiencing boom-bust cycles of capital flows and discuss some circumstances under which the cost associated with sterilizations could be compensated. [Adler et al. \[2016\]](#) highlight that the benefits of using foreign exchange rate intervention as an additional stabilizer tool are greater in regimes where monetary policy is credibly focusing on output and inflation stabilization. [Blanchard et al. \[2013\]](#) argues that sterilized interventions aiming at stabilizing inflation may be desirable in economies with greater financial frictions and more highly segmented markets. [Liu and Spiegel \[2015\]](#) find that capital controls and sterilized interventions are efficiently complementary with monetary policy and are welfare enhancing. [Blanchard et al. \[2017\]](#) show that sterilized intervention fully counteract the effects of bond inflows, leaving both the exchange rate and interest rates unchanged. When, however, sterilized foreign exchange intervention is used in response to non-bond inflows, it can avoid the exchange rate appreciation, but this comes with a larger decrease in the rate of return on non-bonds.

In the present chapter we assess the complementarity of monetary policy with capital controls and sterilized interventions in a non linear Dynamic Stochastic General Equilibrium (DSGE) Small Open Economy (SOE) model, characterized by two regimes, i.e. a normal time regime and a crisis regime. The model is based on the linear version presented in [Liu and Spiegel \[2015\]](#). We assume that:

- the economy is subject to boom-bust cycles in capital flows,
- capital inflows are channeled to domestic private agents in a perfectly competitive domestic banking sector,
- households are subject to liquidity constraint of the type of [Mendoza \[2002\]](#), i.e. in the aggregate term, the economy can not accumulate an amount of debt that exceeds a share of domestic output.

Domestic firms use only labor to produce a single traded consumption good and set prices according to *Rotemberg* price setting scheme ([Rotemberg \[1982\]](#)). In such an environment, the borrowing constraint amplifies both exogenous and endogenous shocks in the economy. Indeed, when the rest of the world is in crisis, the decline of national output resulting in the weakness of external demand, could lead to a binding credit constraint. As a result, households may respond by cutting back the aggregate spending leading to a further contraction of private consumption, and plunging the economy into a recession. Accordingly, policy makers may face a trade-off between stabilizing the economy and stabilizing capital inflows. In fact, easing monetary policy could increase capital outflows leading to a more tightening of households financial conditions. Otherwise and following a negative domestic productivity shock, the decline of output would lead to a binding credit constraint avoiding households to smooth their consumption by increasing their debt holdings. As a result, the decline of private consumption would result in a further important output reduction.

To study sterilization policies we assume imperfect financial asset substitutability and we introduce a time-varying tax on capital flows as a measure of capital controls. We solve the model using OccBin toolkit, a Dynare¹ compatible toolkit introduced in [Guerrieri and Iacoviello \[2015\]](#). The toolkit adapts a first-order perturbation approach and applies it in a piecewise fashion to solve dynamic models with occasionally binding constraints. We generate a boom-bust cycles in capital flows by considering a sequence of foreign interest and domestic technology shocks. Our main results emphasize the pro-cyclicality of

¹([Juillard et al. \[1996\]](#))

sterilized interventions and capital controls, i.e. restrictions on capital account are tightened during boom cycles in capital inflows and relaxed during bust cycles. In addition, implementing such policies with a monetary policy focusing on price and output stability outperform the outcome of only monetary policy. They reduce significantly the volatility of the economy associated with fluctuations in foreign interest rate and domestic productivity shocks. However, sterilized interventions lead to a higher volatile capital flows.

The remainder of the chapter is organized as follows: 3.2 presents the model. Section 3.3 characterizes the solution strategy. Section 3.4 analyzes the outcomes of monetary and alternatives policies and Section 3.5 concludes.

3.2 The Model

We adopt a standard small open economy model with a flexible exchange rate regime and a single traded final consumption good as in [Liu and Spiegel \[2015\]](#). We consider an economy in which the domestic financial market channels foreign capital flows to private agents. We assume that private agents are subject to liquidity constraint of the type of [Mendoza \[2002\]](#), thus their debt holdings do not exceed a share of their current income. As in [Liu and Spiegel \[2015\]](#), by implementing sterilized interventions, the government could affect domestic liquidity by varying government bonds supply. To explore capital control policies, we introduce a time-varying tax on capital flows.

Formally, the economy is populated by a continuum of infinitely-lived households whose preferences are given by a representative household utility function. The representative household consumes a final consumption good and provides labor hours to domestic firms. In the production side, we consider tradable sector as the only sector in the economy producing the final consumption good which can be either consumed by domestic households or exported to the rest of the world. The final good is a composite of differentiated intermediate products that are produced using labor as the only input. The market for the final consumption good is perfectly competitive while that of differentiated intermediate goods is monopolistically competitive and prices are sticky according to [Rotemberg](#)

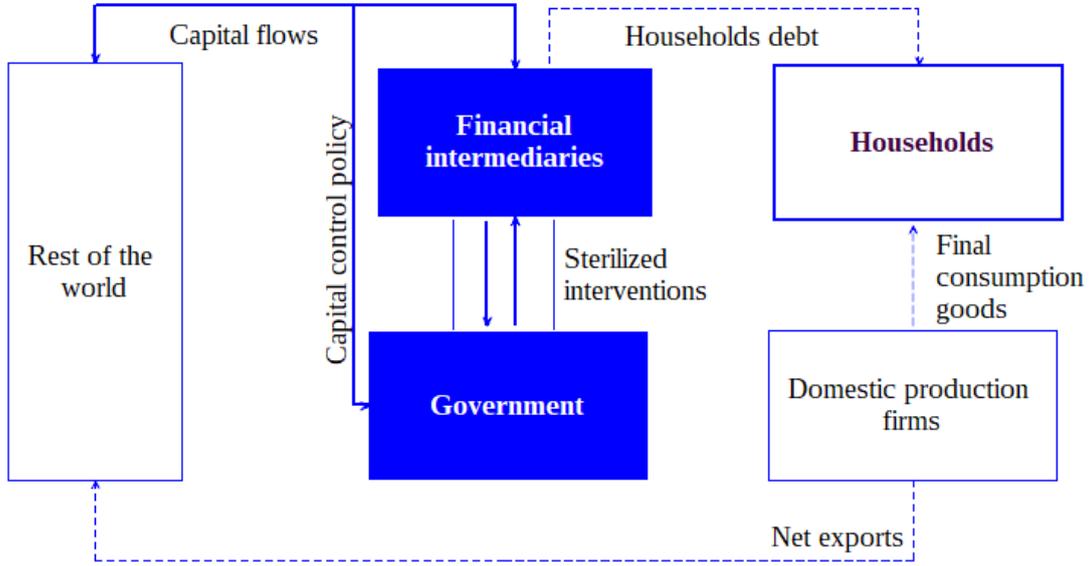


Figure 3.1: The structure of the economy

[1982].

3.2.1 Households

The representative household i , $i \in [0, 1]$, has preferences over consumption and labor effort described by the following utility function:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln(c_t(i)) - \phi_l \frac{l_t(i)^{1+\eta}}{1+\eta} \right\} \quad (3.1)$$

Where $E(\cdot)$ is the expectation operator, $c_t(i)$ denotes consumption of final goods, and $l_t(i)$ is labor hours. The parameter β is the subjective discount factor; the non-negative term ϕ_l is utility weight on labor, while η is a curvature parameter that represents the disutility of labor.

Households are the owners of domestic firms and thus are recipients of profits d_t and earn a real wage w_t for labor supply in the domestic economy. The representative household

has access to one type of non-contingent one-period debt $b_{h,t+1}$ (in real terms) assumed in period t and maturing in period $t+1$ with gross nominal interest rate of R_t . The parameter φ_{b_h} measures the size of the portfolio adjustment costs for households' bonds and \bar{b}_h denotes the steady-state of debt holdings. We assume that the government consumes no goods and thus all taxes profits are rebated to households in the form of sum-lump transfers T_t .

Omitting households specific indices for notational simplicity, the budget constraints faced by the representative household in period t can be written as follows:

$$c_t + R_{t-1} \frac{b_{h,t}}{\pi_t} = w_t l_t + b_{h,t+1} - \frac{\varphi_{b_h}}{2} (b_{h,t+1} - \bar{b}_h)^2 + d_t + T_t \quad (3.2)$$

As in [Liu and Spiegel \[2015\]](#), we assume that households take as given the foreign inflation rate, which is normalized to zero. It is also assumed that the law of one price holds for the final consumption goods, so that the real exchange rate is one. It follows that the nominal exchange rate corresponds to the domestic price level and that changes in the nominal exchange rate corresponds to domestic inflation.

We assume that the domestic credit market is imperfect as households must satisfy a liquidity requirement of the type of [Mendoza \[2002\]](#) under which a fraction ϕ of current expenditures must be paid out of current income:

$$w_t l_t + d_t \geq \phi \left(c_t + R_{t-1} \frac{b_{h,t}}{\pi_t} - T_t \right)$$

Combining this equation with equation (3.2) we obtain the following collateral constraint:

$$b_{h,t+1} \leq \frac{1-\phi}{\phi} (w_t l_t + d_t) + \frac{\varphi_{b_h}}{2} (b_{h,t+1} - \bar{b}_h)^2 \quad (3.3)$$

Then, households face a borrowing constraint limiting their ability to borrow more than a fraction $\frac{1-\phi}{\phi}$ of their income. The collateral constraint has an important insight in how the economy is affected by the binding borrowing constraint; an increase of labor supply and more domestic production would relax the collateral constraint. This fact could be

a result of either an increase of domestic consumption or a positive trade balance.

3.2.2 Domestic Firms

The economy is populated by a continuum of firms producing final goods by incorporating differentiated products $y_t(j)$ which follows constant returns technology:

$$y_t(j) = a_t l_t(j) \quad (3.4)$$

With $l_t(j)$ denotes labor input for firm j and a_t denotes an aggregate technology shock that follows the stationary stochastic process given by:

$$\ln(a_t) = \rho_a \ln(a_{t-1}) + \epsilon_{at}$$

ρ_a is a persistence parameter and ϵ_{at} is an innovation to the technology shock and follows a normal process with a mean of zero and a standard deviation of σ_a . Firms face a competitive input market and a monopolistically competitive product market. We assume that the final good is a Dixit-Stiglitz aggregator of differentiated products with the aggregation technology.

$$y_t = \left[\int_0^1 y_t(j)^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}}$$

With θ denotes the elasticity of substitution between differentiated products. Accordingly, the optimal demand schedule is given by:

$$y_t^d(j) = \left[\frac{P_t(j)}{P_t} \right]^{-\theta} y_t$$

P_t denotes the price level that is related to the individual prices $P_t(j)$ by $P_t = \left[\int_0^1 P_t(j)^{1-\theta} dj \right]^{\frac{1}{1-\theta}}$.

Firm j takes as given the the real wage rate w_t , the price level P_t , and the demand schedule for differentiated goods, and sets a price $P_t(j)$ to maximize expected discounted dividend flows. Firms are assumed to face a quadratic price adjustment cost á la Rotemberg with

a size of ψ :

$$\frac{\psi}{2} \left(\frac{P_t(j)}{\bar{\pi} P_{t-1}(j)} - 1 \right)^2 c_t$$

With $\bar{\pi}$ is the steady-state inflation rate. We normalize the adjustment cost in aggregate consumption units c_t . The firm j maximization problem is given by:

$$\text{Max}_{p_t(j)} E_0 \sum_{k=0}^{\infty} \beta^k \frac{\Lambda_{t+k}}{\Lambda_t} d_{t+k}(j)$$

$d_{t+k}(j)$ denotes the dividend flow from firm j in period $t+k$ given by:

$$d_{t+k}(j) = \left(\frac{P_{t+k}(j)}{P_{t+k}} - \frac{w_{t+k}}{a_{t+k}} \right) y_{t+k}^d(j) - \psi \left(\frac{P_t(j)}{\bar{\pi} P_{t-1}(j)} - 1 \right)^2 c_t$$

The optimal price-setting decision implies that in a symmetric equilibrium with $P_t(j) = P_t$ for all j , we have:

$$\frac{w_t}{a_t} = \frac{\theta - 1}{\theta} + \frac{\psi}{\theta} \frac{c_t}{y_t} \left[\left(\frac{\pi_t}{\bar{\pi}} - 1 \right) \frac{\pi_t}{\bar{\pi}} - \beta E_t \left(\frac{\pi_{t+1}}{\bar{\pi}} - 1 \right) \frac{\pi_{t+1}}{\bar{\pi}} \right] \quad (3.5)$$

3.2.3 Capital flows and capital control policy

We assume that the economy experiences short term capital inflows. The demand schedule of foreign investors' for domestic assets is given by:

$$b_{ft} - \bar{b}_f = \phi_{b_f} \left[(1 - \tau_t) E_t \frac{R_t}{\pi_{t+1}} - R_t^* \right] \quad (3.6)$$

Where b_{ft} denotes the real value (in final consumption good units) of domestic bonds held by foreign investors, τ_t is a time-varying tax rate on the interest earnings for foreign investors through holding domestic bonds, and ϕ_{b_f} is a parameter that captures the sensitivity of international demand for domestic assets to changes in (after-tax) relative returns to domestic and foreign assets.

3.2.4 Monetary authority

In the benchmark model, we assume that the monetary authority sets the nominal interest rate R_t according to a simple feedback rule belonging to the following class of Taylor [1993] type rules:

$$\ln(R_t) = (1 - \rho_R) \ln(R_{t-1}) + \rho_R \left(\ln(\bar{R}) + \psi_\pi \frac{\pi_t}{\bar{\pi}} + \psi_y \ln\left(\frac{y_t}{\bar{y}}\right) \right) \quad (3.7)$$

With \bar{y} and \bar{R} are the steady state of output and interest rate respectively. $\{\rho_R, \psi_\pi, \psi_y\}$ are parameters representing, in this order, the interest rate smoothing parameter, the weights of inflation and output gap in the policy rule.

In addition to capital control tax, we assume that monetary authorities make use of an additional instrument to stabilize the economy, such as sterilized interventions. The aim of this policy is to directly control the domestic liquidity by issuing domestic bonds. The government finances interest payments for matured domestic bonds and increases in foreign bond holdings by a combination of new domestic debt issuance and interest payments on matured foreign bonds. They adjust their holdings of foreign bonds (i.e. foreign reserves) following the flow-of-funds constraints:

$$b_{gt}^* - R_{t-1}^* b_{g,t-1}^* \leq b_t - \frac{R_{t-1}}{\pi_{t-1}} b_{t-1} \quad (3.8)$$

With b_{gt}^* denotes the real value (in final consumption good units) of the government's holdings of foreign bonds, b_t denotes the real value of domestic bond supply. The monetary authority sets b_{gt}^* according the following Taylor-based rule:

$$b_{gt}^* = \rho_{b_g} b_{g,t-1}^* + (1 - \rho_{b_g}) (\psi_{b_f} (b_{ft} - \bar{b}_f) + \psi_\pi (\pi_t - \bar{\pi}) + \psi_y (y_t - \bar{y})) \quad (3.9)$$

Denoted ρ_{b_g} as a smoothing parameter, $\{\psi_{b_f}, \psi_\pi, \psi_y\}$ are weights of capital inflows, inflation and output respectively.

Therefore, the country also experiences capital outflows since the government holds foreign bonds. The balance of payments then implies that the real value of the current

account balance (denoted by ca_t) equals the net foreign capital outflows. Thus, we have:

$$ca_t = b_{gt}^* - b_{g,t-1}^* - \left(b_{ft} - \frac{b_{f,t-1}}{\pi_{t-1}} \right) \quad (3.10)$$

The government may wish to stabilize capital inflows by setting the tax rate according to the following policy rule:

$$\tau_t = \phi_{\tau_{R^*}} \ln \left(\frac{R_t^*}{\bar{R}^*} \right) + \phi_{\tau_R} \ln \left(\frac{R_t}{\bar{R}} \frac{\bar{\pi}}{\pi_{t+1}} \right) \quad (3.11)$$

With ϕ_{τ_R} and $\phi_{\tau_{R^*}}$ parameters that capture the sensitivity of capital control tax to real interest returns of domestic and foreign assets respectively. Negative values could be assigned, to ϕ_{τ_R} and $\phi_{\tau_{R^*}}$ depending on the aim of capital controls to avoid capital outflows or inflows.

We assume that all fiscal revenues from taxing foreign capital inflows are rebated to the representative household through lump-sum transfers T_t , so that:

$$T_t = \tau_{t-1} \frac{R_{t-1}}{\pi_t} b_{f,t-1} \quad (3.12)$$

3.2.5 The foreign sector

The economy takes the foreign interest rate R_t^* as given. We assume that it follows an exogenous stochastic process:

$$\ln(R_t^*) = (1 - \rho_{R^*}) \ln(\bar{R}^*) + \rho_{R^*} \ln(R_t^*) + \epsilon_{R_t^*} \quad (3.13)$$

With ρ_{R^*} denotes the persistence of the shock, R^* is the steady-state of the foreign interest rate, and ϵ_{R^*} is an innovation to the shock and follows a normal process with a mean of zero and a standard deviation of σ_{R^*} .

3.2.6 Optimal equilibrium and market clearing conditions

The representative household chooses a set of process $\Gamma = \{c_t, b_{ht}, l_t\}$ to maximize the utility function equation (3.1) subject to the budget constraint equation (3.2) and the collateral constraint equation (3.4). The optimal conditions derived from households' optimization problem are given as follows:

$$l_t^\eta c_t = w_t \left(1 + \frac{1-\phi}{\phi} \mu_t \right) \quad (3.14)$$

$$(1 - \mu_t) (1 - \varphi_{b_h} (b_{h,t+1} - \bar{b}_h)) = \beta R_t E_t \left(\frac{c_t}{\pi_{t+1} c_{t+1}} \right) \quad (3.15)$$

$$b_{h,t+1} \leq \frac{1-\phi}{\phi} (w_t l_t + d_t) + \frac{\varphi_{b_h}}{2} (b_{h,t+1} - \bar{b}_h)^2, \quad \mu_t \geq 0 \quad (3.16)$$

With μ_t is a non negative Lagrange multiplier associated with the liquidity requirement constraint. The optimal labor supply (equation (3.14)) depends not only on real wage but also on the shadow price during periods in which the collateral constraint is binding. Euler equation (3.15) represents the optimal setting of debt holding while equation (3.16) defines the complementary slackness condition related to the borrowing constraint.

Firms profit maximization problem leads to equation (3.5) implying that real wage equals inverse markup plus the inflation dynamic driving from the presence of price adjustment costs.

In equilibrium, all markets for the final good, labor, money and domestic assets clear. Goods market clearing implies that the country's trade balance (or net exports) is given by aggregate output net of domestic consumption, price and portfolio adjustment costs. Denoted by tb_t the trade balance is given by:

$$tb_t = y_t - c_t - \frac{\psi}{2} \left(\frac{P_t(j)}{\bar{\pi} P_{t-1}(j)} - 1 \right)^2 c_t \quad (3.17)$$

Combining the household budget constraint given by equation (3.2) and the government flow-of-funds constraint in equation (3.7), using the lump-sum transfer equation (3.12)

and the current account balance equation (3.10), goods market clearing condition is:

$$ca_t = tb_t - (1 - R_t^*) b_{g,t-1} - [R_{t-1} (1 - \tau_{t-1}) - 1] \frac{b_{f,t-1}}{\pi_t} \quad (3.18)$$

The market clearing conditions for labor, consumption, and domestic bonds are summarized below:

$$l_t = \lim \int_0^1 l_t(j) dj = \lim \int_0^1 l_t(i) di \quad (3.19)$$

$$c_t = \lim \int_0^1 c_t(i) di \quad (3.20)$$

$$b_{ft} = b_{ht} + b_t \quad (3.21)$$

With the labor market clearing condition 3.19, we obtain the aggregate production function:

$$y_t = a_t l_t \quad (3.22)$$

3.3 Solution Strategy

We assume that the requirement liquidity constraint is occasionally binding. Indeed, the economy is characterized by two regimes:

- A normal time regime with no binding collateral constraint and so that households accumulated debt is below the fraction of the aggregate income,
- A crisis regime with a binding collateral constraint in which households are avoided to increase their debt holding above the credit limit.

To solve the model taking account of this feature, we use the algorithm proposed in [Guerrieri and Iacoviello \[2015\]](#) using a Dynare compatible toolkit called OccBin. The toolkit simulates the responses of the economy to shocks using a first-order piecewise linear approximation around the steady state of the model. The transition path from a regime to another is based on a guess-and-verify approach. In fact, when $\mu_t > 0$, the economy is in the benchmark regime and households borrow up to the credit limit.

Otherwise, when $\mu_t = 0$, the economy switches to the alternative regime and the Euler equation (3.17) holds.

In what follows, we describe the model parameters' calibration and the optimization procedure to estimate optimal parameters of alternative policy rules.

3.3.1 Model calibration

We calibrate most of the parameters from the literature (Table 3.1). The elasticity of substitution between differentiated goods is set to 10 so that the markup steady state is 11 percent in line with the estimated range given by Basu and Fernald [1997]. We set $\eta = 2$, so that the Frisch elasticity of labor supply is 0.5, which is consistent with empirical studies of Keane and Rogerson [2012]. We assume that households are relatively impatient with respect to the rest of the world, which is a common feature in the related literature and thus the discount factor β is set at 0.985. The gross annualized interest rate steady-state is set at 1.01 (corresponding to foreign discount factor of about 0.99). In all our numerical experiments below, we focus on a steady state equilibrium with zero inflation (i.e. $\pi = 1$), no capital control taxes (i.e. $\tau = 0$) and no sterilization policies (i.e. $b_{gt}^* = 0$). In the steady state, we assume that the domestic interest rate equals the world interest rate, and households' debt is fully financed by capital inflows. The difference between domestic interest rate and discount factor creates a wedge that brings the economy into two switching regimes. In the reference regime corresponding to low income, the borrowing constraint binds. Private debt is then given by the credit limit proportional to aggregate production. In the alternative regime when the income is relatively high the collateral constraint is slack and current consumption can be high relative to future consumption even if debt is below the maximum amount allowed. We calibrate ϕ as in Mendoza [2002] at 0.7143 which avoids household to carry an amount of debt that exceeds 40 percent of current income valued at final goods prices so that the steady-state of trade balance is about 0.4 percent of GDP. The utility weight on leisure is set to 34.01 that implies a labor hours steady state of 30 percent of the time endowment. Empirical studies on price rigidities in emerging markets show that the frequency of price

change is higher with respect to advanced economies. [Gouvea et al. \[2007\]](#) estimates a price consumer duration contract between 2.7 and 3.8 months in the case of Brazil, while [Medina et al. \[2007\]](#) shows an average of 1.6-2.5 months in Chile and [Gabriel and Reiff \[2010\]](#) finds 4.2 months for Hungary. As the slope of Philips curve in our model is given by $\frac{(\theta-1)}{\psi} \frac{c_t}{y_t}$, we set ψ to be consistent with an average duration of price contracts of about six months. With [Calvo \[1983\]](#) price contracts, the slope of the Philips curve is given by $\frac{(1-\alpha)(1-\beta\alpha)}{\alpha}$, with α is the probability that a firm cannot re-optimize prices. For $\alpha = 0.45$ and a steady state of consumption-to-GDP ratio of about 99.6 percent, the associated adjustment cost coefficient ψ is 13.2 (taking $\beta = 0.985$ as given). Following [Liu and Spiegel \[2015\]](#), we set the portfolio adjustment costs at 0.01. We assume a one-to-one correlation between domestic and foreign real return and capital inflows so that $\phi_{b_f} = 1$. For shock parameters, we set persistence parameters at 0.9 and standard-deviations at 0.05 for both aggregate productivity and foreign interest rate shocks. We calibrate the interest rate smoothing parameter at $\rho_R = 0.5$, and the weights of inflation and output gap in policy rules $\psi_\pi = 1.5$ $\psi_y = 0.5$ respectively, in accordance with the range estimated in [Hofmann and Bogdanova \[2012\]](#).

Table 3.1: Parameters' calibration

Parameter	Value	Description	Source
ϕ	0.7143	Parameter of the collateral constraint	Mendoza [2002]
β	0.985	Subjective discount factor	For example Devereux et al. [2006]
R_t^*	1.01	Steady-state of annual world interest rate	-
R_t	1.01	Steady-state of annual domestic interest rate	-
ϕ_l	34.01	Utility weight on leisure	Liu and Spiegel [2015]
η	2	Inverse Frisch elasticity	Keane and Rogerson [2012]
θ	10	Elasticity of substitution between differentiated goods	Basu and Fernald [1997]
ψ	13.2	Price adjustment costs	Gouvea et al. [2007], Medina et al. [2007], Gabriel and Reiff [2010]
φ_{b_h}	0.01	Portfolio adjustment costs	Liu and Spiegel [2015]
ϕ_{b_f}	1	Slope of foreign demand for domestic bonds	A benchmark value
ψ_π	1.5	The weights of inflation in Taylor rule	Hofmann and Bogdanova [2012]
ψ_y	0.5	The weights of output gap in Taylor rule	-
ρ_R	0.5	Taylor rule smoothing parameter	-
ρ_a	0.9	Persistence of technology shocks	A standard value
ρ_{R^*}	0.9	Persistence of foreign interest rate shocks	A standard value
σ_a	0.05	Standard deviation of technology shocks	A standard value
σ_{R^*}	0.05	Standard deviation of foreign interest rate shocks	A standard value

3.3.2 Optimal parameters for alternative policy rules

The lack of guidance in calibrating policy rules parameters creates a trade-off between setting an arbitrary values or estimating optimal coefficients. In what follows, we opt for estimating optimal values and we conduct, in addition, a sensitivity analysis to assess the stability of the resulting values. For each policy rule (equations 3.11 and 3.9), we estimate the associated coefficients that minimize a weighted sum of the variances of inflation, output and capital flows. The objective function of the optimization problem is given by:

$$\text{Min}_X \lambda_y \text{var}(y_t) + \lambda_\pi \text{var}(\pi) + \lambda_{b_f} \text{var}(b_f) \quad (3.23)$$

Where $\text{var}(\cdot)$ denotes the variance and $X = \{\rho_{b_y^*}, \psi_{b_f}, \psi_y, \psi_\pi, \phi_{\tau_R}, \phi_{\tau_{R^*}}\}$ the set of parameters to be estimated. λ is the weight of each variable. As the monetary authority prior objective is price stability, we set as a benchmark, λ_π at 1.5 while λ_y and λ_{b_f} at unity. To assess the validity of our results, we conduct a sensitivity analysis by varying the weight of each variable in the minimization problem.

3.3.3 The constrained vs. unconstrained economy

We first investigate the impact of the liquidity requirement constraint on the dynamics of the economy with and without the credit limit, setting alternative policy instruments at their steady state levels. We consider two versions, an economy with no credit constraint, that we call the unconstrained economy, and an economy with permanent binding borrowing limit; the constrained economy. We then investigate how the main macroeconomic variables respond to domestic and foreign exogenous shocks.

Figure 3.2 and 3.3 display with solid lines the impulse responses of the constrained economy and with dashed lines the dynamic behavior of the unconstrained economy to a negative aggregate productivity and foreign interest rate shocks, respectively. The decline of aggregate productivity leads relatively to a similar output decline in the constrained and unconstrained economies. As a result, inflation goes up pushing down the private consumption in both economies. However, as the collateral constraint binds, households

in the constrained economy are avoided to smooth their consumption by accumulating a large amount of debt, leading to a more pronounced contraction of private consumption. Consequently, domestic real interest rate decreases leading to a larger capital outflows. In addition, the significant decline of private consumption in the constrained economy leads to a positive trade balance, while we observe a deficit in the unconstrained economy. The decline of foreign interest rate leads to a fall in aggregate production in both economies with a significant decline of private consumption in the constrained economy due to the tightening of borrowing abilities of households. As a result, inflation decreases more significantly in the constrained economy pushing down domestic interest rate. Consequently, foreign demand for domestic bonds increases in the unconstrained economy as the decline of real return of foreign bonds is more significant than that of domestic bonds. By contrast, in the constrained economy, the decline of foreign interest rate is offset by a significant fall of real returns of domestic bonds, as a result, capital inflows remains unchanged. Thus, trade balance in the constrained economy becomes positive unlike that of the unconstrained economy which displays a deficit.

In addition, the presence of the liquidity requirement constraint leads to different macroeconomic variables' responses to aggregate productivity and foreign interest rate shocks. Table 3.2 shows the variance decompositions in percent of total variance for domestic macroeconomic variables in the constrained and unconstrained economies. The presence of the credit limit makes domestic monetary policy more dependent to international monetary conditions. Indeed, 3.2 percent of domestic interest rate variations is attributed to productivity shock in the constrained economy versus 88.5 in the unconstrained economy, while 96.8 percent is related to foreign interest rate shocks when the credit limit is all time binding, against 11.5 percent in the economy with no credit limit. This fact is a result of a high private consumption and domestic inflation sensitivity to foreign interest rate variation. Moreover, the presence of liquidity requirement constraint increases the vulnerability of the domestic economy as the responsiveness of domestic external sector (the trade balance and the current account) to variation in foreign interest rate is larger than what is observed in the unconstrained economy.

Table 3.2: Variance decomposition in percent of total variance

	ϵ_{a_t}	$\epsilon_{R_t^*}$
Constrained economy		
y_t	99.06	0.94
c_t	65.34	34.66
π_t	11.94	88.06
R_t	3.17	96.83
b_{h_t}	99.06	0.94
b_{f_t}	99.06	0.94
tb_t	1.49	98.51
ca_t	10.42	89.58
Unconstrained economy		
y_t	88.87	11.13
c_t	79.38	20.62
π_t	95.72	4.28
R_t	88.54	11.46
b_{h_t}	0.69	99.31
b_{f_t}	0.69	99.31
tb_t	4.31	95.69
ca_t	20.08	79.92

3.3.4 Occasionally vs. permanent binding collateral constraint

To figure out the difference between using linear and non linear approaches, we display in figure 3.4 and 3.5 the impulse responses of a sequence of a positive and negative shocks in the constrained economy (linear) and in economy with occasionally binding constraint (piecewise linear) in economies with only monetary policy. A negative shock in aggregate productivity pushes down domestic output leading to a binding collateral constraint ($\mu > 0$). As a result and following this shock, the macroeconomic outcomes using both the linear and non linear approaches are the same. By contrast, when the economy experiences a positive productivity shock, μ becomes negative in the linear model while it is set at 0 under the piecewise linear approach and the related model switches to the alternative regime (the unconstrained regime). Consequently, households foreign debt is not hitting the credit limit leading to a moderate increase in foreign debt accumulation when compared with the outcomes of the linear approach. Similarly, figure 3.5 displays the impulse responses of a sequence of foreign interest rate shocks. In the piecewise linear model, an increase of foreign interest rate brings the economy into the alternative regime,

as it eases households' financial conditions due to the increase of domestic production. Nevertheless, despite the increase of aggregate income and a slack borrowing constraint, the rise of private consumption in the piecewise linear model is relatively moderate due to capital outflows. In the other hand, a decline of foreign interest rate is translated into a low home production due to the decline of foreign demand for domestically produced goods. As a result, the economy shifts to the reference regime with binding liquidity requirement constraint. Following this shock, the impulse responses in both linear and piecewise linear models coincide.

3.4 Interaction between monetary policy and alternative policies

In this section, we investigate the cyclical nature of alternative policies and their macroeconomic volatility outcomes. We consider two scenarios. In the benchmark policy, we activate only monetary policy and set capital account restriction instruments at their steady state levels. We then consider two alternative policy scenarios, each being an extension of the benchmark policy. In the first scenario (MP & SP), we set sterilized interventions but not capital control policies. Thus, while government bonds' holding is adjusted following equation (3.9), capital control tax remains fixed at its steady-state value ($\tau_t = 0$). In the second scenario (MP & CCP), b_{gt}^* is held at its steady-state (i.e. $b_{gt}^* = 0$), while capital control tax is adjusted according to the equation (3.11).

3.4.1 The cyclical nature of alternative policies

Table 2.3 presents the results of the variance minimization problem. The results assign

Table 3.3: Optimal parameters' of policy rules

Parameter	MP & SP	MP & CCP
ρb_g^*	0.007	
ψb_f	0.99	
ψ_y	-0.48	
ψ_π	-0.38	
ϕ_{τ_R}		0.75
$\phi_{\tau_R^*}$		-1

the highest weight for capital flows in the sterilized policy rule, such as 0.99, and a very low smoothing parameter of about 0.007 highlighting a high sensitivity of government foreign bond holdings to variation in capital flows and domestic macroeconomic conditions. The weights of both inflation and output are negative which suggests that the government adjusts foreign reserve holdings to support the domestic economic growth. When using capital controls, the tax rate is increased to avoid a large capital inflows when the real domestic interest rate appreciates, and lowered to mitigate a large capital

outflows when foreign interest rate rises.

The impulse responses presented in figures 3.6-3.9 confirm our results. Figures show with solid and dashed lines the impulse responses to an unexpected sequence of productivity and foreign interest rate shocks of the economy in the benchmark and the alternative scenarios respectively. When the economy is driven by productivity shocks, our results emphasize a pro-cyclicality of the sterilized interventions and capital control policy tax. Both alternative policies avoid households from accumulating a large amount of debt during expansion periods when the economy is experiencing a surge in capital flows. During recessions, b_{gt}^* and τ_t are lowered to ease domestic financial conditions and mitigate capital outflows. When the economy is driven by foreign interest rate shocks, implementing either capital control policies or sterilized interventions reduce significantly the vulnerability of the domestic economy to change in the international financial conditions. In such a context, only alternative policy instruments respond to the variation of the foreign interest rate while all other domestic macroeconomic variables remain unchanged.

In other words, foreign bond holdings and capital control policy tax are pro-cyclical, i.e. they are increased during boom cycles in capital inflows and lowered during bust cycles.

3.4.2 Macroeconomic volatility

Tables 3.4 presents the outcomes of alternative policies in term of macroeconomic volatility when the economy is driven by domestic productivity shocks. It follows that the implementation of sterilized interventions reduce the volatility of the main macroeconomic variables except for capital flows. Indeed, implementing such policies lower the volatility of households' debt and domestic interest rate by 0.3 percent in comparison with the benchmark model, and by more than 0.5 percent for inflation. However, the volatility of capital flows becomes significantly higher, passing from 1.8 percent when implementing only monetary policy to more than 5.6 percent in the economy with sterilized interventions. By contrast, capital control policies reduces the volatility of capital flows and domestic inflation. Output and private consumption volatility remains relatively un-

changed. Table 3.5 provides the standard deviations of domestic macroeconomic variables

Table 3.4: Macroeconomic volatility under aggregate productivity shocks (Standard deviation in %)

	The benchmark model	MP & SP	MP & CCP
c_t	1.89	1.88	2.00
$b_{h,t+1}$	1.77	1.50	1.36
y_t	2.03	2.09	2.02
π_t	1.37	0.84	0.88
b_{f_t}	1.77	5.59	1.36
τ_t	0.00	0.00	0.48
b_{gt}^*	0.00	0.59	0.00
R_t	0.89	0.58	0.62
ca_t	0.15	0.16	0.13

Source: Authors' calculations

when the economy is driven by foreign interest rate shocks. Accordingly, the domestic economic volatility is significantly reduced mainly when using sterilized interventions. Under this scenario, capital flows become highly volatile with a standard deviation of about 19.4 percent versus 9.1 in the benchmark model while the volatility of all domestic macroeconomic variables becomes significantly irrelevant. However, when using capital control policies, capital flows volatility decreases to 0.3 percent with a higher macroeconomic volatility when compared to what is observed when using sterilized interventions. In summary, implementing serialized intervention with a standard monetary policy re-

Table 3.5: Macroeconomic volatility under foreign interest rate shocks (Standard deviation in %)

	The benchmark model	MP & SP	MP & CCP
c_t	1.16	0.01	0.59
$b_{h,t+1}$	9.06	0.00	0.29
y_t	0.53	0.00	0.28
π_t	2.59	0.02	0.04
b_{f_t}	9.06	19.39	0.29
τ_t	0.00	0.00	2.08
b_{gt}^*	0.00	2.17	0.00
R_t	3.17	0.02	0.11
ca_t	0.44	0.00	0.03

duces significantly the volatility of the economy at the expense of a higher volatile capital flows, while the adoption of capital control policies mitigate the volatility of capital flows and the macroeconomic volatility associated with fluctuation of foreign interest rate and

domestic productivity shocks.

3.4.3 Sensitivity analysis

In what follows we assess the sensitivity of the estimated optimal parameter values of policy rules to alternative calibration. To this end, we discuss the effect of varying each λ_i in the weighted sum of the variance of inflation, output and capital flows with $i = \{\pi, y, b_f\}$. As a benchmark case, we set $\{\lambda_\pi = 1.5, \lambda_y = 1, \lambda_{b_f} = 1\}$ and we explore the result of two alternative cases. The quantitative results of all experiments are shown in Table 3.6. The results show that the parameters' values of the capital control policy rule are not

Table 3.6: Sensitivity Analysis: optimal parameters' values for policy rules

Parameter	The benchmark case	$\lambda_{b_f} = 0$	$\lambda_{b_f} = 1.5$
Sterilized interventions			
$\rho_{b_g^*}$	0.007	0.005	0.105
ψ_{b_f}	0.99	1.01	0.80
ψ_y	-0.48	-0.48	-0.50
ψ_π	-0.38	-0.38	-0.38
Capital control policy			
ϕ_{τ_R}	0.75	0.76	0.76
$\phi_{\tau_R^*}$	-1	-1	-1

affected by the weight assigned to inflation, output and capital flows in the weighted sum of variance. For sterilized interventions, optimal parameters' values are very close when varying λ_{b_f} from 1 to 0. However, when $\lambda_{b_f} = 1.5$ the resulting optimal values assign a higher value for the smoothing parameter and a relatively lower value for capital flows deviation from steady state. This indicates that when the government reducing volatility objective accords the same weight to capital flows and inflation, sterilized interventions should react less to variation in capital flows. In this case, the volatility of the economy (Tables 3.7 and 3.8) becomes higher than that when $\lambda_{b_f} = 1$. To conclude, the parameters' values estimated under $\{\lambda_\pi = 1.5, \lambda_y = 1, \lambda_{b_f} = 1\}$ could be considered as optimal.

Table 3.7: Sensitivity Analysis: The macroeconomic volatility under foreign interest rate shocks

Parameter	The benchmark case	$\lambda_{b_f} = 0$	$\lambda_{b_f} = 1.5$
Sterilized interventions			
c_t	0.01	0.01	0.26
$b_{h,t+1}$	0.00	0.01	0.91
y_t	0.00	0.01	0.11
π_t	0.02	0.06	0.81
b_{f_t}	19.39	19.68	15.64
τ_t	0.00	0.00	0.00
b_{gt}^*	2.17	2.21	1.67
R_t	0.02	0.09	1.07
ca_t	0.00	0.01	0.11

Table 3.8: Sensitivity Analysis: The macroeconomic volatility under productivity shocks

Parameter	The benchmark case	$\lambda_{b_f} = 0$	$\lambda_{b_f} = 1.5$
Sterilized interventions			
c_t	1.88	1.88	1.88
$b_{h,t+1}$	1.50	1.52	1.40
y_t	2.09	2.09	2.07
π_t	0.84	0.83	0.96
b_{f_t}	5.59	5.69	4.43
τ_t	0.00	0.00	0.00
b_{gt}^*	0.59	0.61	0.42
R_t	0.58	0.60	0.48
ca_t	0.16	0.16	0.14

3.5 Conclusion

In this chapter, we have examined the effectiveness of sterilization and capital control policies in stabilizing macroeconomic fluctuations in a small open economy with debt-creating capital inflows and liquidity requirement constraint of the type of [Mendoza \[2002\]](#). Our results show that the presence of the credit constraint creates a pecuniary externality that amplifies domestic and foreign exogenous shocks in the economy, and an additional trade-off for monetary authorities that should stabilize both the domestic economy and capital flows. When implementing sterilized interventions and capital control policies as complement to a monetary policy focusing on domestic inflation and output stability, our main finding highlights a reduction in the macroeconomic volatility. Especially, when the economy is driven by domestic productivity shocks, implementing sterilized interventions

helps to reduce the volatility of inflation and private debt at the expense of output and capital flows volatility. On the other hand, combining capital control and monetary policy leads to a low volatility in inflation, capital flows and private debt while consumption and output volatility remain relatively unchanged.

When the economy is driven by foreign interest rate shocks, adopting either capital control or sterilization policies reduces drastically the volatility of most of macroeconomic variables. However, sterilized intervention increases significantly the volatility of capital flows.

Our results suggest also that both serialized interventions and capital controls are procyclical and thus lean against the wind. In fact, when the economy experiences a surge of capital flows, the optimal response of capital control and sterilization policies is to avoid households from accumulating a large amount of debt by either increasing government bond supply to absorb the increase of domestic liquidity or by raising capital control tax.

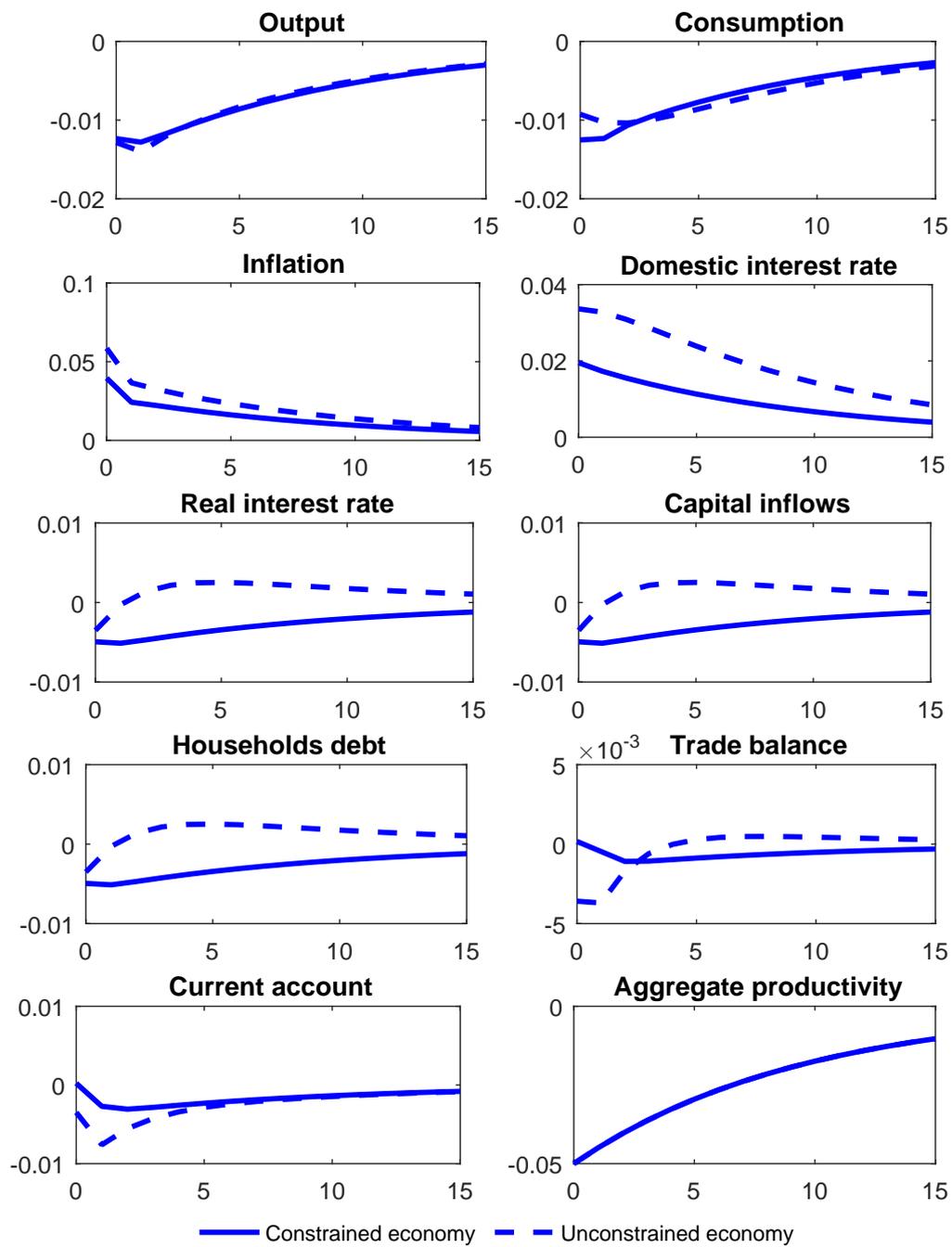


Figure 3.2: Aggregate productivity shock sequence

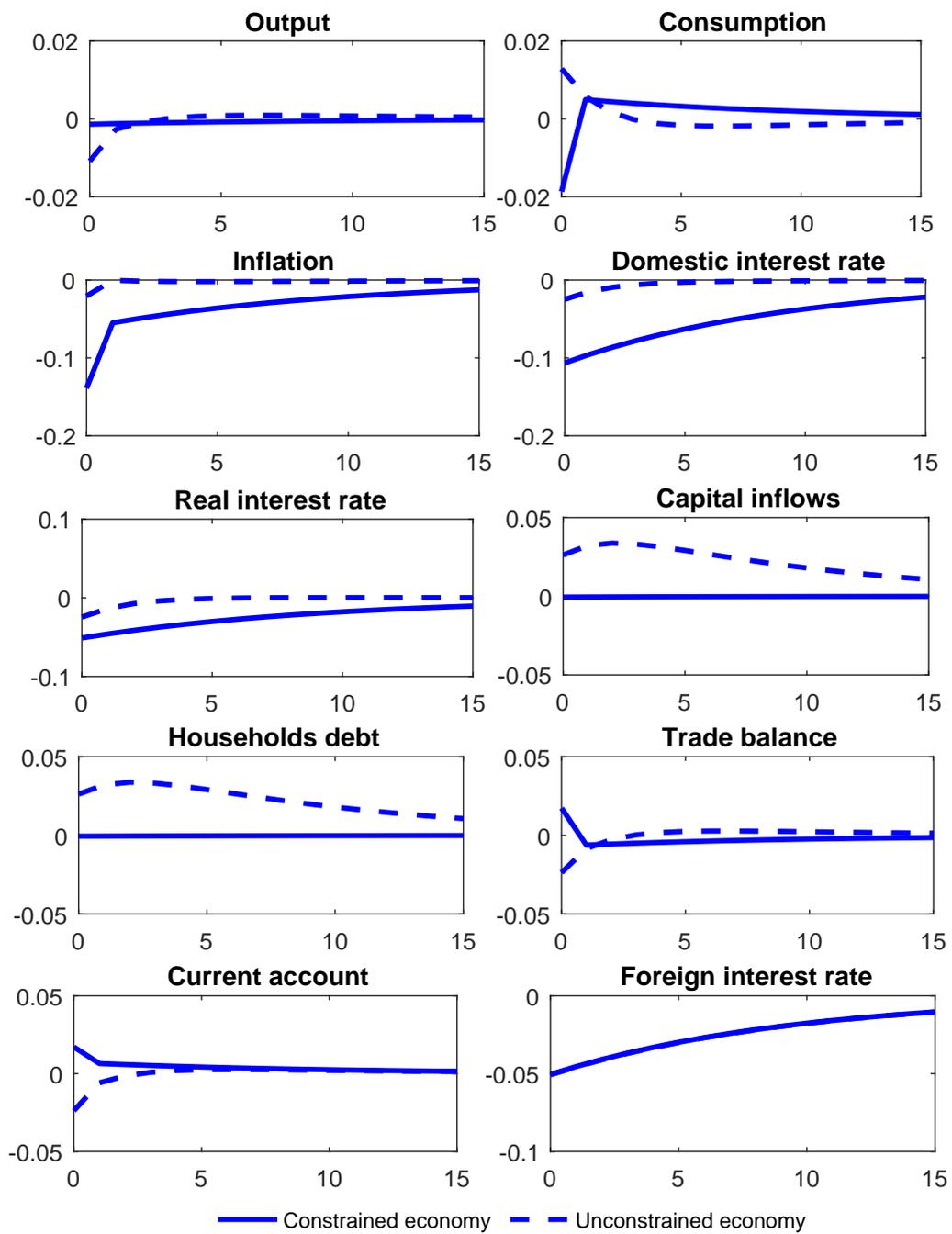


Figure 3.3: Foreign interest rate shock sequence

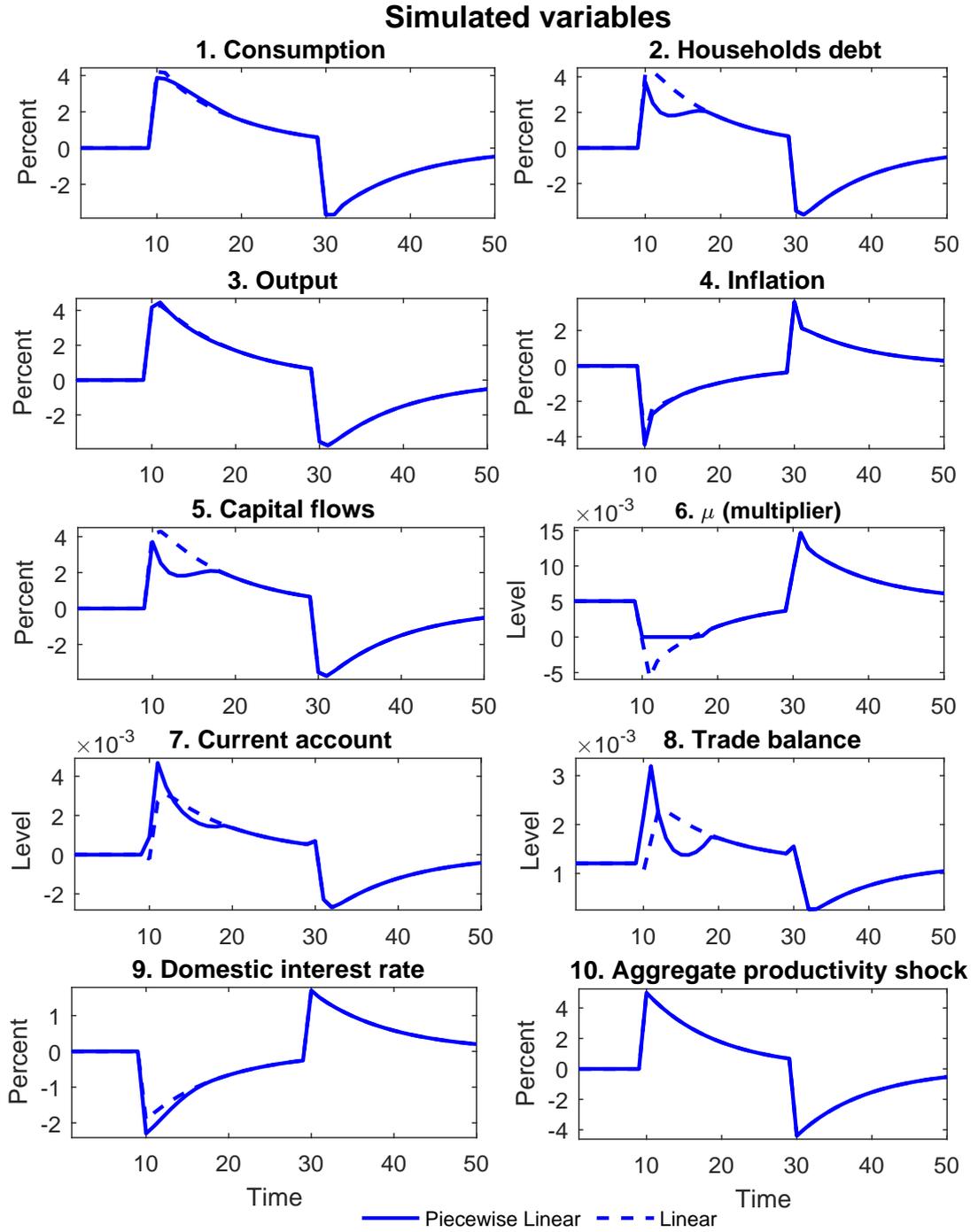


Figure 3.4: Aggregate productivity shock sequence

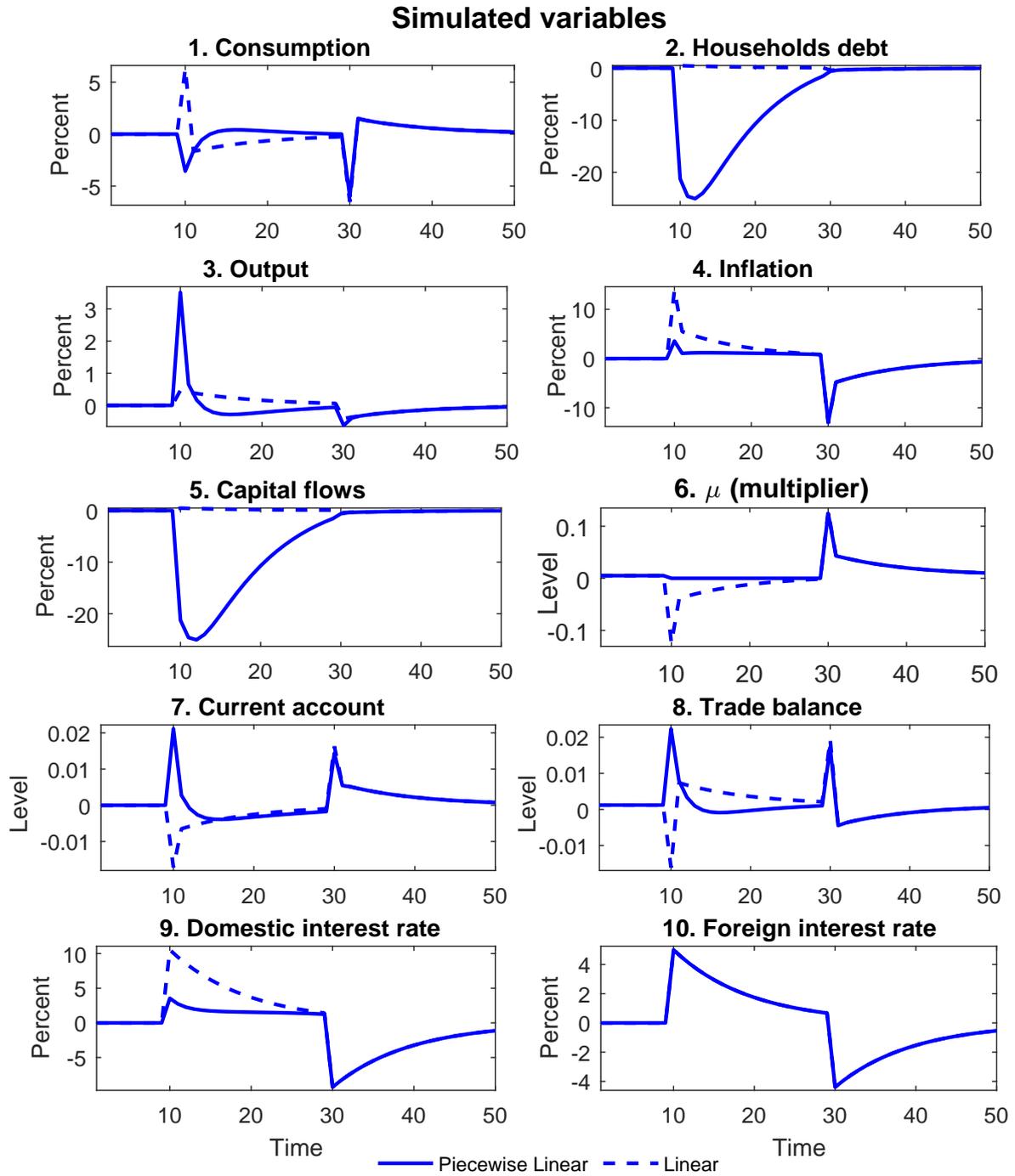


Figure 3.5: Foreign interest rate shock sequence

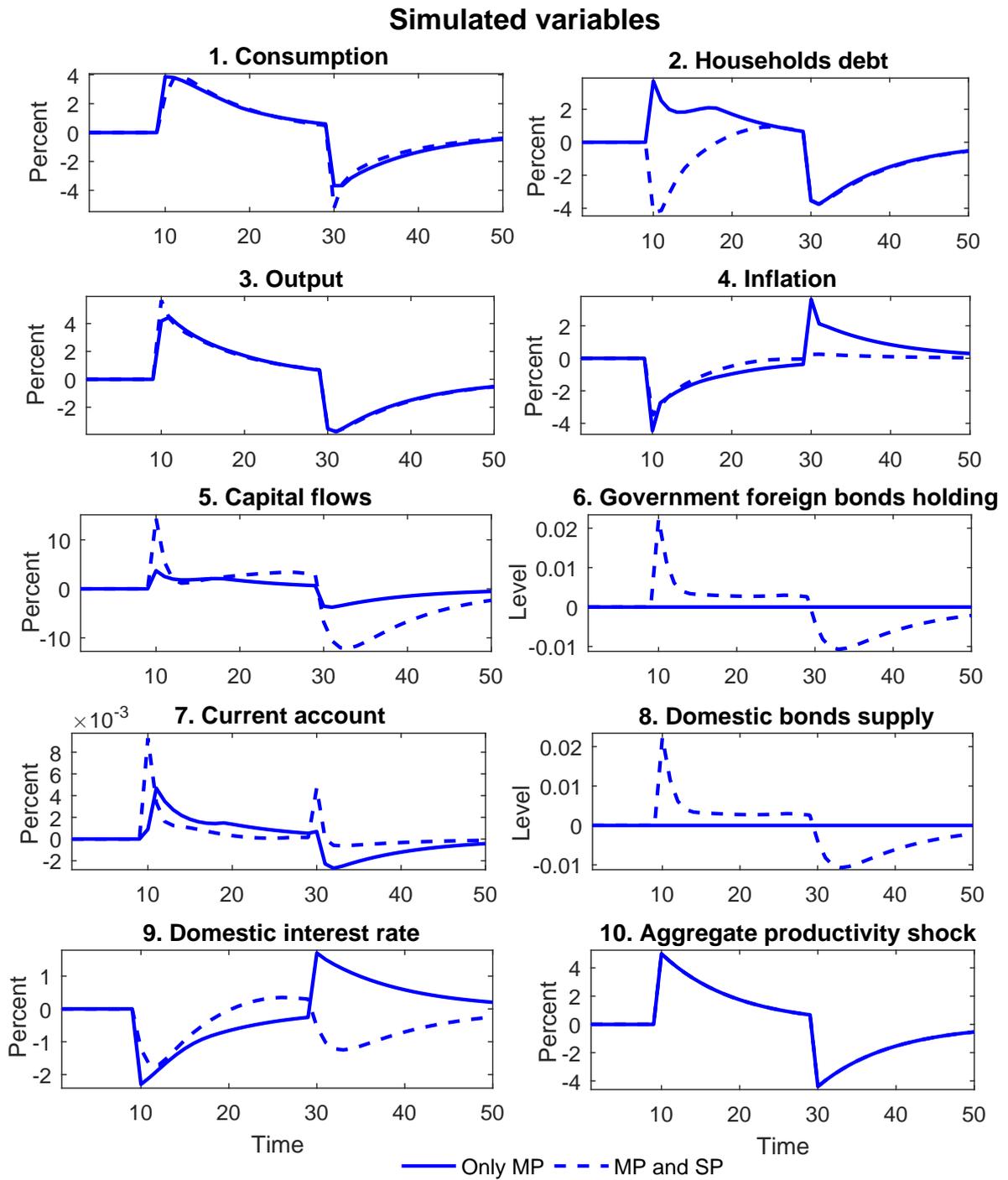


Figure 3.6: Aggregate productivity shock sequence

Simulated variables

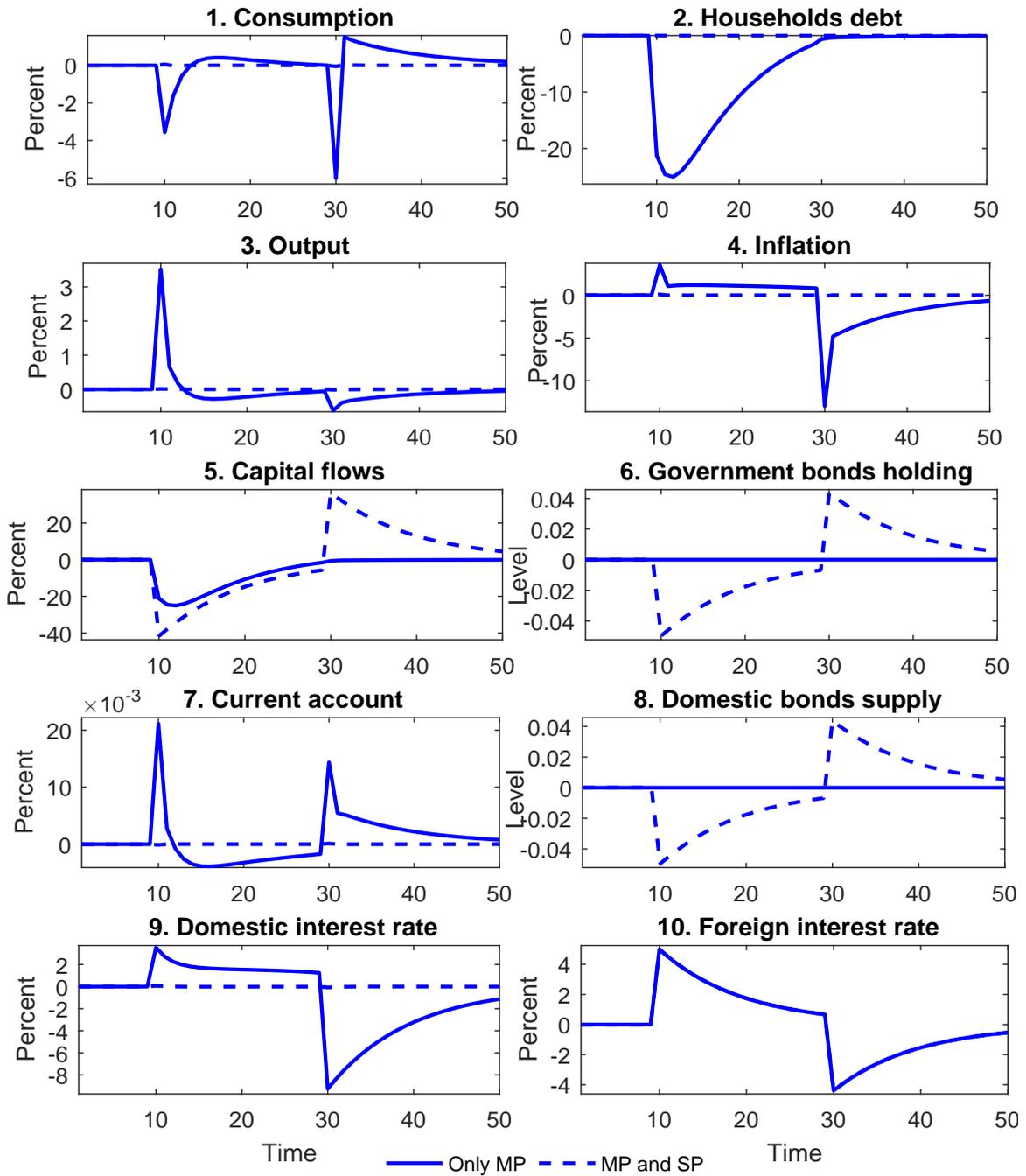


Figure 3.7: Foreign interest rate shock sequence

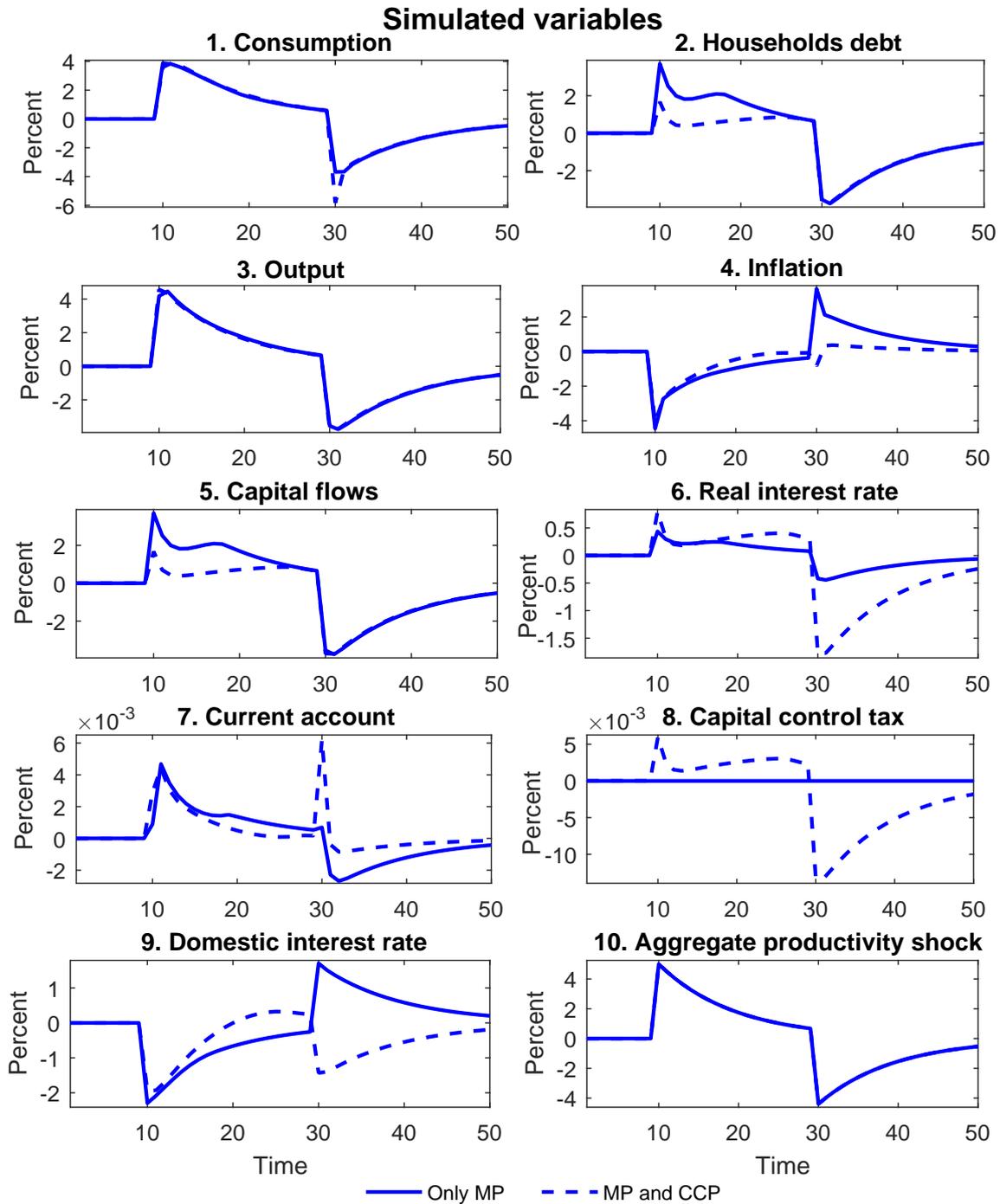


Figure 3.8: Aggregate productivity shock sequence

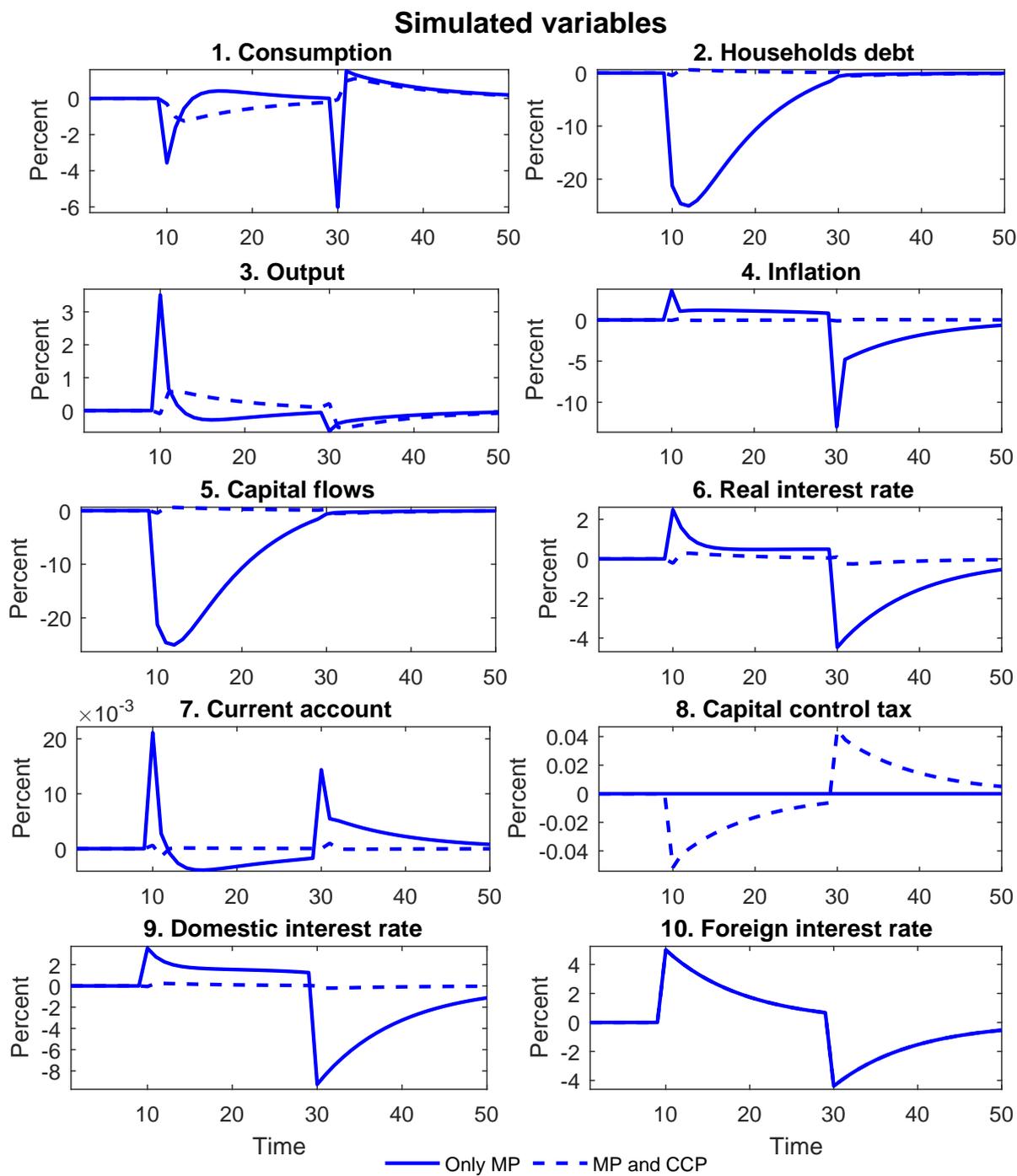


Figure 3.9: Foreign interest rate shock sequence

Chapter 4

Financial acceleration and optimal prudential capital controls in a SOE subject to floods and sudden stops

4.1 Introduction

In theory capital account liberalization leads to a more efficient allocation of capital across countries. It provides rich countries with a higher return on private savings while recipient countries with a cheaper financing options allowing them to enhance their economic growth, employment opportunities, and living standards. However, recurrent financial crises over the last decades question whether free international mobility of capital contributes, as predicted, to a higher local economic growth and development. According to [Stiglitz \[2000\]](#), capital market liberalization is likely to be a source of instability rather than economic development, as empirical evidences have been stressing a significant likelihood of having a recession in periods following capital market liberalization with no notable positive impact on growth ([Rodrik et al. \[1998\]](#), [Easterly et al. \[2001\]](#)). Indeed, the pro-cyclicality of international capital flows that '*(..) are exacerbating economic fluctuations, when they do not actually cause them*'([Stiglitz \[2000\]](#)) undermines financial stability in recipient countries. In other words, during good times, emerging market

economies experience a surge of capital flows that amplifies their economic and credit growth, while during downturn periods, capital outflows tend to deepen the economic recession.

Recently, [Rey \[2015\]](#) points out new empirical evidence on the pro-cyclicality of the global financial market highlighted by a co-movement in capital flows, asset prices, credit growth and leverage, and concludes that the global financial cycle transforms the *trilemma* into a *dilemma*, i.e. to ensure the independence of monetary policy capital flows should be managed directly by using capital control policies, or indirectly by implementing macroprudential measures, regardless the exchange rate regime. In fact, as global financial cycle is determined by exogenous global factors that are beyond the control of governments, domestic economic policies become constrained by the evolution of those factors. Thus, implementing capital account management policies aims at enhancing the effectiveness of domestic public policies ([Angeloni and Faia \[2009\]](#), [Kannan et al. \[2012\]](#)) and reducing the frequency of crisis.

The aim of this chapter is to contribute to this new literature on the dilemma by examining the trade-offs and complementarities between monetary, macroprudential and capital control policies in an emerging market economy with an open capital account and a flexible exchange rate. To this end, we adopt an open economy New Keynesian dynamic stochastic general equilibrium (DSGE) model, featuring financial frictions *a la* Bernanke ([Bernanke et al. \[1999\]](#)) and nominal rigidities ([Gali and Monacelli \[2005\]](#), [Devereux et al. \[2006\]](#), [Gertler et al. \[2007\]](#), [Farhi and Werning \[2012\]](#)). However, our framework differs from the existing studies in one important way, as we assume that domestic private debt is mostly fueled by capital inflows channeled throughout a perfectly competitive domestic banking sector to local private agents. This assumption aims at highlighting the mechanism by which exogenously generated boom-bust cycles in capital flows are transmitted to the domestic economy and the vulnerabilities they induce. In fact, in such an environment financial conditions are procyclical, i.e. during expansions domestic agents benefit from both a decline of the external finance premium related to their external financing and a surge of capital inflows that further ease domestic financial conditions. However,

during recessions the increase in the external finance premium combined with capital outflows creates an amplification effect resulting in a more pronounced economic downturn. In this chapter, we examine the aggregate macroeconomic responses to domestic and exogenous shocks using optimal monetary, capital control and macroprudential policies. Our main finding shows that when the economy is hit by a domestic exogenous shock on productivity, implementing monetary policy delivers the higher welfare gain. Nevertheless, when the economy is driven by a foreign exogenous shock, alternative policies, including an augmented Taylor rule targeting credit growth, enhance significantly the aggregate welfare. In addition, a sudden stop in foreign capital inflows, induced by either a negative exogenous shock on capital flows or an unexpected increase in the foreign interest rate brings the economy into a crisis. In this case, the use of capital control tax helps to stabilize capital flows and thus to mitigate their impact on the economic growth leading to a higher welfare gain in comparison with other alternative policies.

The remainder of the chapter is organized as follows. Section 4.2 describes the model. The equilibrium is characterized in Section 4.3 and an illustrative calibration is presented in Section 4.4. Section 4.5 describes the welfare assessment and results. We discuss the outcomes of using alternative policies in Section 4.5.1 and Section provides some concluding remarks.

4.2 The model

Our framework is a DSGE model of an emerging market economy that features a financial accelerator mechanism developed in [Bernanke et al. \[1999\]](#) and nominal rigidities, belonging to the strand of literature described in [Gali and Monacelli \[2005\]](#), [Devereux et al. \[2006\]](#), [Gertler et al. \[2007\]](#), [Farhi and Werning \[2012\]](#). The economy is described in Figure 4.1. It is populated by a unit mass of identical infinitely-lived households, who consume domestic and imported goods, supply labor to home production firms and hold interest-bearing assets dominated in local and foreign currencies. To improve the tractability of the model, we assume three types of firms in the economy:

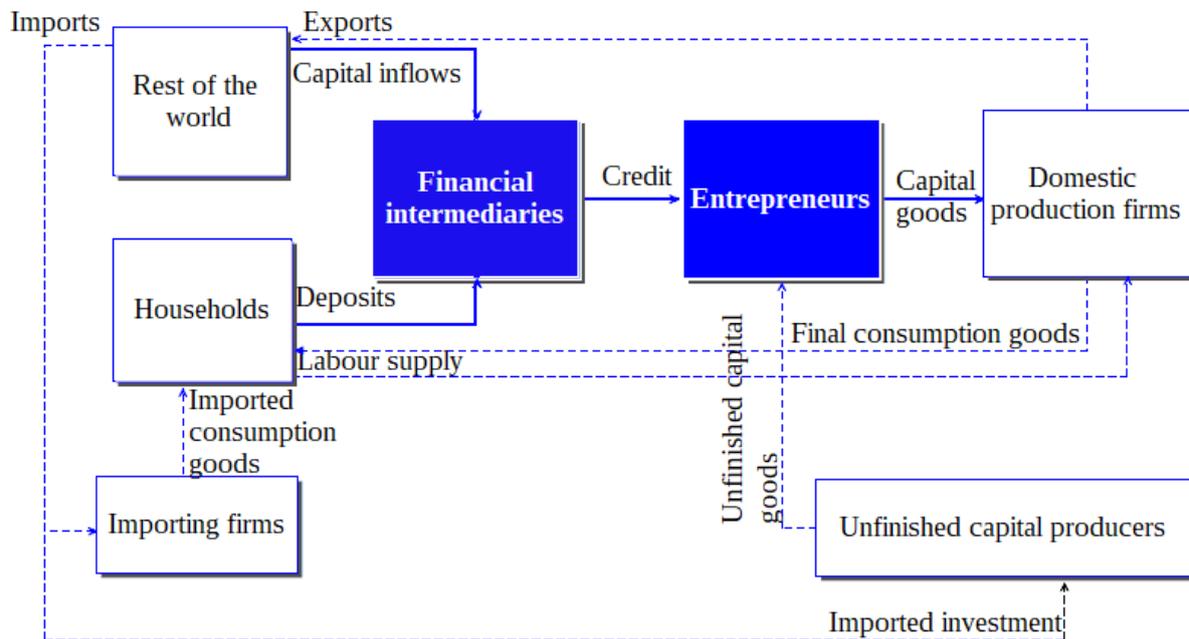


Figure 4.1: The structure of the economy

- Production firms produce a differentiated final consumption goods, that are sold in domestic and foreign markets, using both capital and labor as inputs. These firms engage in local currency pricing a la Calvo [1983]. As a result, final consumption good prices are sticky,
- Importing firms also have some market power and price their goods following Calvo [1983] mechanism. Price stickiness in export and import sectors causes the law of one price to fail such that exchange rate pass through is incomplete in the short term,
- Competitive firms that combine investment with rented capital to produce unfinished capital goods that are then sold to entrepreneurs.

As in this class of models, entrepreneurs play a key role. They transform the unfinished capital goods and rent them to production firms. To acquire capital, each entrepreneur uses its accumulated profits from previous capital investment (net worth) and income from

supplying labor to domestic production firms. Because of the absence of a self-financing possibility, each entrepreneur needs to borrow in the domestic financial sector and faces an external finance premium on borrowing that depends inversely on his net worth. The presence of the external finance premium creates an amplification effect of financial system in propagating shocks, the so-called financial accelerator mechanism, and implies a procyclicality of financial conditions. Otherwise, domestic financial intermediaries collect, in a perfectly competitive market, households' deposits and capital inflows and provide funds to entrepreneurs.

4.2.1 Households

Our small open economy is inhabited by a representative household who seeks to maximize the following utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{H_t^{1+\phi}}{1+\phi} \right) \quad (4.1)$$

Where E_0 is the mathematical expectation conditional upon information available at period 0, β is the representative consumer's subjective discount factor with $0 < \beta < 1$, σ is a strictly positive parameter denoting the inverse of the inter-temporal elasticity of substitution, $\phi > 0$ is the inverse elasticity of labour supply H_t and C_t denotes a composite consumption index given by:

$$C_t = \left[\alpha^{\frac{1}{\gamma}} C_{H,t}^{\frac{\gamma-1}{\gamma}} + (1-\alpha)^{\frac{1}{\gamma}} C_{M,t}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

With $C_{H,t}$ and $C_{M,t}$ being indices of home and imported consumption goods. Such indices are in turn given by the following CES aggregators of the quantities consumed of each type of good:

$$C_{H,t} = \left(\int_0^1 C_{H,t}(i)^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} ; \quad C_{M,t} = \left(\int_0^1 C_{M,t}(i)^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

$\gamma > 0$ denotes the elasticity of substitution between home and foreign goods, $\epsilon > 1$ is the elasticity of substitution among goods within each category, and $(1 - \alpha)$ is the weight of imported consumption goods in the domestic consumption basket.

The consumer price index (CPI), P_t is given by:

$$P_t = [\alpha P_{H,t}^{1-\gamma} + (1 - \alpha) P_{M,t}^{1-\gamma}]^{\frac{1}{1-\gamma}}$$

With $P_{H,t}$ and $P_{M,t}$ denote home and foreign price respectively.

Households receive a nominal wage $W_{h,t}$ for providing labour to home production firms and hold domestic and foreign bonds, $B_{h,t+1}$ and $B_{h,t+1}^*$, in nominal terms, issued in date t and maturing in date $t + 1$. They then earn gross nominal interest rates of about R_t and R_t^* in domestic and foreign financial markets. Following [Schmitt-Grohé and Uribe \[2003\]](#), we introduce portfolio adjustment costs to induce stationary. Households own all home production and importing firms and thus are recipients of profits, Π_t . Households' budget constraint is, then, given by:

$$P_t C_t + B_{h,t+1} + S_t B_{h,t+1}^* = W_{h,t} H_t + R_{t-1} B_{h,t} + S_t R_{t-1}^* B_{h,t}^* + \Pi_t + T_t \quad (4.2)$$

$$- \frac{\varphi_B}{2} (B_{h,t+1} - B_h)^2 - \frac{\varphi_B^*}{2} (S_t B_{h,t+1}^* - S B_h^*)^2$$

With T_t is lump sum tax transfers from the government. The parameters φ_B and φ_B^* measure the size of the portfolio adjustment costs for domestic and foreign bonds, respectively. B_h^* and B_h denote the steady state of foreign and domestic bonds.

The representative household chooses a set of process $\Gamma = \{C_t, H_t, B_{h,t+1}, B_{h,t+1}^*\}$ that maximizes its expected lifetime utility (4.1) subject to the budget constraint (4.2).

The optimality conditions for households' consumption allocation, labour supply, and

saving decisions are as follows:

$$\lambda_t = \frac{C_t^{-\sigma}}{P_t} \quad (4.3)$$

$$\frac{W_{h,t}}{P_t} = H_t^\phi C_t^\sigma \quad (4.4)$$

$$\beta R_t E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \right] = 1 + \varphi_B (B_{h,t+1} - B_h) \quad (4.5)$$

$$\beta R_t^* E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{S_{t+1}}{S_t} \right] = 1 + \varphi_B^* (S_t B_{h,t+1}^* - S B_h^*) \quad (4.6)$$

$$\frac{C_{H,t}}{C_{M,t}} = \frac{\alpha}{1-\alpha} \left(\frac{P_{H,t}}{P_{M,t}} \right)^{-\gamma} \quad (4.7)$$

The marginal utility of the consumption index is given by equation (4.3). Euler equation (4.5) equates the optimal consumption/saving decision while equation (4.4) denotes the optimal labour supply. The optimality condition governing the choice of foreign bonds yields the equation (4.6). Because of the presence of portfolio costs, the uncovered interest parity condition fails to hold. Equation (4.7) describes the optimal choice of home and imported consumption goods.

4.2.2 Firms

There are three types of firms in the economy. Production firms produce a final consumption goods using both capital and labor as inputs to satisfy domestic and foreign demand. These firms price their goods in local currency a la Calvo [1983]. As a result, final good prices are sticky in terms of the local currency of the markets in which they are sold. Importing firms that sell goods produced in the foreign economy also have some market power and price imported goods following Calvo mechanism. Price stickiness in export and import prices causes the law of one price to fail such that exchange rate pass through is incomplete in the short run. Finally, there are competitive firms that combine investment with rented capital to produce unfinished capital goods that are then sold to entrepreneurs.

4.2.2.1 Production firms

The economy is populated by a large number of monopolistically competitive firms each producing a differentiated good indexed by $j \in [0, 1]$ using a Cobb-Douglas production function:

$$Y_t(j) = A_t L_t(j)^{1-\alpha_p} K_t(j)^{\alpha_p} \quad (4.8)$$

With A_t is total factor productivity common to all firms and assumed to follow a first order auto-regressive process $AR(1)$:

$$\ln A_t = \rho_A \ln A_{t-1} + \epsilon_{A,t} \quad (4.9)$$

Denoting ρ as the persistence of the technological shock, and $\epsilon_{A,t}$ is an innovation to the shock and follows a normal process with a mean of zero and a standard deviation of $\sigma_{A,t}$. Labor input $L_t(j)$ is provided by household, $H_t(j)$, and entrepreneurs, $H_{E,t}(j)$, and defined as $L_t(j) = H_t(j)^{1-\Omega} H_{e,t}(j)^\Omega$. Capital goods $K_t(j)$ are provided by entrepreneurs to be described below.

Assuming that the price of each input is taken as given, production firms minimize their costs subject to the constraint given in (4.8). The Cost minimizing problem implies the following first-order conditions:

$$W_{h,t} = (1 - \alpha_p) (1 - \Omega) MC_t \frac{Y_t(j)}{H_t(j)} \quad (4.10)$$

$$W_{e,t} = (1 - \alpha_p) (1 - \Omega) MC_t \frac{Y_t(j)}{H_{e,t}(j)} \quad (4.11)$$

$$R_t^k = \alpha_p MC_t \frac{Y_t(j)}{K_t(j)} \quad (4.12)$$

Where MC_t denotes the nominal marginal cost, $W_{e,t}$ is nominal wage of entrepreneurs' labour while R_t^k denotes the nominal gross return on capital. Notice that since we have an homogenous type of labor and capital, nominal wages, capital's gross return and the marginal cost are common across firms.

Firms exploit their market power and set prices in order to maximize their profits in domestic and foreign markets. They segment the local and foreign markets with local

currency pricing, where $P_{H,t}$ and $P_{X,t}$ denote aggregate price induces of goods domestically consumed and exported respectively. Firms face nominal rigidities a la Calvo [1983], in each period a fraction θ_i of a randomly selected firms is not allowed to change the price of goods it produces. The remaining fraction of firms $1 - \theta_i$ can re-optimize its nominal price, denoted $P_{i,t}^*(j)$ with $i = H, X$, by maximizing the expected discounted value of profits. Therefore, the optimization problem of home production firms is given by:

$$\max_{\{P_{i,t}^*(j)\}_{t=0}^{\infty}} E_t \sum_{k=0}^{\infty} (\beta\theta_i)^k \frac{\lambda_{t+k}}{\lambda_t} \{P_{i,t}^*(j) - MC_{t+k}\} Y_{i,t+k}(j) \quad (4.13)$$

We assume that different varieties have the same elasticities in both markets, so that the demand for good j can be written as:

$$Y_{i,t+k}(j) = \left[\frac{P_{i,t}^*(j)}{P_{i,t+k}} \right]^{-\lambda} Y_{i,t+k}, i = H, X \quad (4.14)$$

Where $Y_{H,t}$ and $Y_{X,t}$ is domestic and foreign aggregate demand for domestic goods.

The first order condition of profit maximization, (4.13), under the constraint (4.14) yields the following optimality condition on $P_{i,t}^*(j)$:

$$P_{i,t}^*(j) = \frac{\lambda}{\lambda - 1} \frac{E_t \left\{ \sum_{k=0}^{\infty} (\beta\theta_i)^k \lambda_{t+k} P_{i,t+k}^{\lambda} MC_{t+k} Y_{i,t+k} \right\}}{E_t \left\{ \sum_{k=0}^{\infty} (\beta\theta_i)^k \lambda_{t+k} P_{i,t+k}^{\lambda} Y_{i,t+k} \right\}}$$

Given the Calvo-type setup, the price index evolves according to the following law of motion:

$$P_{i,t} = \left[\theta_i P_{i,t-1}^{1-\lambda} + (1 - \theta_i) (P_{i,t}^*(j))^{1-\lambda} \right]^{\frac{1}{1-\lambda}}$$

Accordingly the New Keynesian Phillips curve for both exported and domestic good prices is given by:

$$\hat{\pi}_{i,t} = \frac{(1 - \beta\theta_i)(1 - \theta_i)}{\theta_i} m\hat{c}_{i,t} + \beta E_t (\hat{\pi}_{i,t+1}), i = H, X \quad (4.15)$$

$m\hat{c}_{i,t}$ denotes the real marginal cost in term of the aggregate price index i , $\frac{MC_t}{P_{i,t}}$, log linearized around its steady state.

4.2.2.2 Importing firms

There is a set of monopolistically competitive importing firms, owned by domestic households. They buy foreign goods at prices P_t^* (in foreign currency) and then sell them to the domestic market at $P_{M,t}$. They face also price rigidities a la Calvo. Only a fraction $1 - \theta_M$ can re-optimize its nominal price each period. This implies that there is some delay between exchange rate changes and the import price adjustments so that the short-run exchange rate pass-through to import prices is also incomplete. Importing firms price their goods in the same way as described previously for home production firms. The Calvo-pricing mechanism yields the following imported inflation dynamics:

$$\hat{\pi}_{M,t} = \frac{(1 - \beta\theta_M)(1 - \theta_M)}{\theta_M} \left(\hat{s}_t + \hat{p}_t^* - \hat{p}_{M,t} \right) + \beta E_t(\hat{\pi}_{M,t+1}) \quad (4.16)$$

With \hat{x}_t log-linearized of the variable x around their steady state, with $x = \{S_t, P_t^*, P_{M,t}\}$.

4.2.2.3 Unfinished capital producers

We assume that competitive firms combine investment I_t and rented capital K_t to produce unfinished capital good K_{t+1} that will be sold at price Q_t . As in [Bernanke et al. \[1999\]](#), K_t is provided by entrepreneurs who rent their capital at the end of period t to the investment sector at price \overline{Q}_t . I_t denotes aggregate investment in period t , which is composed of domestic and final goods:

$$I_t = \left[\alpha^{\frac{1}{\gamma}} I_{H,t}^{\frac{\gamma-1}{\gamma}} + (1 - \alpha)^{\frac{1}{\gamma}} I_{M,t}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}} \quad (4.17)$$

With domestic and imported investment good prices are assumed to be the same as the domestic and imported consumer good price indices, $P_{H,t}$ and $P_{M,t}$. The new capital stock requires the same combination of domestic and foreign goods so that the nominal price of a unit of investment equals the price level, P_t .

Following [Kiyotaki and Moore \[1997\]](#), we assume that the marginal return to investment in terms of capital goods is decreasing in the amount of investment undertaken (relative to the current capital stock) due to the existence of adjustment costs, represented

by $\frac{\psi_t}{2} \left(\frac{I_t}{K_t} - \delta \right)^2$ where δ is the depreciation rate. Then, the production technology of unfinished capital producers is given by:

$$E_t \left(\frac{I_t}{K_t} - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 \right)$$

This production technology is characterized by constant returns to scale so that the unfinished capital producing firms earn zero profit in equilibrium. The stock of capital used by firms in the economy evolves according to:

$$K_{t+1} = \left[\frac{I_t}{K_t} - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 \right] K_t + (1 - \delta) K_t$$

The optimality conditions for the unfinished capital producing firms with respect to the choice of I_t and K_t yield the following expressions for Q_t and \bar{Q}_t :

$$\frac{Q_t}{P_t} = \left[1 - \psi \left(\frac{I_t}{K_t} - \delta \right) \right]^{-1} \quad (4.18)$$

$$\bar{Q}_t = Q_t \left\{ \psi \left(\frac{I_t}{K_t} - \delta \right) - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 + (1 - \delta) \right\} \quad (4.19)$$

Then, capital producers choose the optimal mix of imported and domestic inputs according to the following intra-temporal first-order-condition:

$$\frac{I_{H,t}}{I_{M,t}} = \frac{\alpha}{1 - \alpha} \left(\frac{P_{H,t}}{P_{M,t}} \right)^{-\gamma} \quad (4.20)$$

4.2.3 Entrepreneurs

As it is the case in this class of models, entrepreneurs are key players. They transform unfinished capital goods that are then rent to the production firms. There is a continuum of entrepreneurs indexed by $j \in [0, 1]$. Each entrepreneur has access to a stochastic technology in transforming $K_{t+1}(j)$ units of unfinished capital into $\omega_{t+1}(j)K_{t+1}(j)$ units of finished capital goods. Following [Bernanke et al. \[1999\]](#), the idiosyncratic productivity $\omega_{t+1}(j)$ is assumed to be i.i.d across time and across firms, drawn from a log-normal

distribution $F(\cdot)$, with p.d.f of $f(\cdot)$ and $E(\cdot) = 1$.

Entrepreneurs finance the purchase of unfinished capital goods by using both internal and external funds. They borrow from a perfectly competitive financial intermediaries to be presented in next section.

The probability that an entrepreneur will survive until next period is ν , so his expected lifetime is $\frac{1}{1-\nu}$. This assumption ensures that entrepreneurial self-financing never occurs. Entrepreneurs issue debt contracts to finance their desired capital stock in excess of net worth. At the end of each period, entrepreneurs purchase capital, $K_{t+1}(j)$, that will be used in the beginning of the following period at the nominal price Q_t . The budget constraint and the cost of borrowing faced by a typical entrepreneur are given by:

$$P_t N_{t+1}(j) = Q_t K_{t+1}(j) - D_{t+1}^E(j) \quad (4.21)$$

Where $N_{t+1}(j)$ is entrepreneur j net worth at the end of time t , and $D_{t+1}^E(j)$ denotes debt dominated on domestic currency held in period t and maturing in period $t + 1$.

The entrepreneurs' demand for capital depends on the expected marginal return R_{t+1}^E and the expected marginal external financing cost, R_t , which equals the expected interest rate on external borrowed funds. The entrepreneurial return on capital is the sum of the rental rate on capital paid by production firms and the price (equation (4.19)) of rented capital to the firms that produce unfinished capital goods. We then obtain this relationship:

$$E_t [R_{t+1}^E] = E_t \left[\frac{R_{t+1}^K}{Q_t} + \frac{Q_{t+1}}{Q_t} \left\{ (1-\delta) + \psi \left(\frac{I_{t+1}}{K_{t+1}} - \delta \right) \frac{I_{t+1}}{K_{t+1}} - \frac{\psi}{2} \left(\frac{I_{t+1}}{K_{t+1}} - \delta \right)^2 \right\} \right] \quad (4.22)$$

The optimal contract identifies the capital demand of entrepreneurs, $K_{t+1}(j)$ and a cut off value, $\varpi_{t+1}(j)$ such that the entrepreneur maximizes their expected return subject to the participation constraints of the lender. Given that $\varpi_{t+1}(j)$ is independent of all other shocks and identical across time and across entrepreneurs, all entrepreneurs are identical ex-ante. Then, each entrepreneur faces the same financial contract specified by the cut off value and the external finance premium. This allows us to specify the rest of the model in aggregate terms. The resulting first order condition from the optimal debt

contract is:

$$E_t \left[\frac{R_{t+1}^E}{R_t} \right] = [1 + \phi_{t+1}] \quad (4.23)$$

Where $1 + \phi_{t+1}$ denotes default premium associated with idiosyncratic project's realized return of the entrepreneur and corresponding to:

$$[1 + \phi_{t+1}] = E_t \left[\frac{1}{[\Gamma(\varpi_{t+1}(j)) - \mu G(\varpi_{t+1}(j))] + \frac{(1-\Gamma(\varpi_{t+1}(j)))[\Gamma'(\varpi_{t+1}(j)) - \mu G'(\varpi_{t+1}(j))]}{\Gamma'(\varpi_{t+1}(j))}}] \right] \quad (4.24)$$

Where $\Gamma(\varpi_{t+1}(j))$ denotes the fraction of net capital output received by the lender and $\mu G(\varpi_{t+1}(j))$ represents monitoring cost payed by lender in default case which implies that the net share received by the lender is thus $\Gamma(\varpi_{t+1}(j)) - \mu G(\varpi_{t+1}(j))$. Following [Bernanke et al. \[1999\]](#), we can rewrite the net worth of the entrepreneur as:

$$P_t N_{t+1}(j) = \nu [(1 - \Gamma(\varpi_t(j))) R_t^E Q_{t-1} K_t(j)] + W_t^E(j) \quad (4.25)$$

The entrepreneur leaving the scene at time t consume their return on capital. The consumption of the entrepreneurs, $C_t^E(j)$, can then be written as:

$$P_t C_t^E(j) = (1 - \nu) [(1 - \Gamma(\varpi_t(j))) R_t^E Q_{t-1} K_t(j)] \quad (4.26)$$

4.2.4 Financial sector

4.2.4.1 Capital inflows

Denoting $B_{f,t+1}$ as domestic bonds held by foreign investors in period t and maturing in period $t + 1$, expressed in local currency. We assume that foreign investors' demand for domestic bonds varies according to the following demand schedule¹:

$$\varphi_{B_f} \left[\frac{B_{f,t+1}}{S_t} - \frac{B_f}{S} \right] = \beta^* \left[(1 - \tau_t) R_t \frac{S_t}{S_{t+1}} - R_t^* \right] + \epsilon_{cf,t} \quad (4.27)$$

¹Which it is derived from the first order condition of households decision rule for bonds holding in the rest of the world, see [C](#) for further details

With ψ_{B_f} is a parameter that captures the size of the portfolio adjustment costs. B_f denotes the steady state of capital inflows. S_t is the nominal exchange rate and S its steady state. τ_t is a time varying tax on capital inflows. $\epsilon_{cf,t}$ is an exogenous preference shock for domestic assets described by a first-order autoregressive process of the form:

$$\epsilon_{cf,t} = \rho_{cf}\epsilon_{cf,t-1} + e_t$$

With $e_t \sim N(0, \sigma_{cf}^2)$ and is iid. We aim by introducing $\epsilon_{cf,t}$ at accounting for other sources of exogenous shocks leading to an unexpected decline in capital inflows². In what follows, we define the real exchange rate as:

$$q_t = S_t \frac{P_t^*}{P_t} \quad (4.28)$$

P_t^* refers to foreign price index and R_t^* denotes world interest rate and are assumed to be exogenous to the national economy.

4.2.4.2 Financial intermediaries

Banks raise funds using households' deposits and capital inflows. We assume that bank sector is perfectly competitive which means that banks intermediate funds with zero profit. The balance sheet of the financial sector is given by:

$$B_{f,t+1} + B_{h,t+1} = D_{t+1}^E \quad (4.29)$$

4.2.5 Public policies

The assumption that domestic financial sector channels capital inflows to feed into private debt creates additional challenges for monetary authority to stabilize the economy. In fact, even if monetary policy can achieve on domestic stability, capital inflows volatility could lead to an inefficient resources allocation, leaving room for other policy instruments to improve social welfare. As alternative policies, we analyze macroprudential policies

²Non-fundamental shocks such as social or political instability

and capital account restrictions.

4.2.5.1 Macroprudential policy

In order to explore the effect of macroprudential measure on macroeconomic and financial stability, we follow [Scott et al. \[2009\]](#), [Unsal \[2011\]](#), [Agénor et al. \[2014\]](#) by considering a generic case where macroprudential measures lead to an additional costs on domestic borrowing. These costs takes the form of a *regulation premium* RP_t , that follows a policy rule calling for tightening financial conditions when private debt exceeds its steady state:

$$RP_t = \psi_{rp} \ln \left[\frac{D_{t+1}^E}{D_t^E} \right] \quad (4.30)$$

$\psi_{rp} > 0$ is a parameter that measures the sensitivity of the regulation premium to the cyclical component of private credit. Accordingly, the spread between the lending rate and the policy rate is affected by both the external finance and the regulation premium. Hence, the lending cost becomes:

$$E_t \left[\frac{R_{t+1}^E}{R_t} \right] = [1 + \phi_{t+1}] [1 + RP_t] \quad (4.31)$$

4.2.5.2 Capital control policy

Public authority may wish to stabilize capital inflows by implementing a time-varying capital tax, τ_t . As in [Kitano and Takaku \[2017\]](#), we consider a simple rule for capital controls as follows:

$$\tau_t = \psi_\tau \ln \left[\frac{D_{t+1}^E}{B_{f,t+1}} \right] \quad (4.32)$$

We interpret the time-varying tax rate τ_t as an instrument for capital controls. We assume that revenues from taxing foreign capital inflows are rebated to the representative household through lump-sum transfers, so that:

$$T_t = \tau_{t-1} R_{t-1} B_{f,t} \quad (4.33)$$

4.2.5.3 Monetary policy

As in [Schmitt-Grohé and Uribe \[2007\]](#), we assume in the benchmark model that the monetary authority sets the nominal interest rate R_t according to a simple feedback rule belonging to the following class of [Taylor \[1993\]](#) type rules:

$$\ln(R_t) = (1 - \varpi) \ln(R_{t-1}) + \varpi \left(\ln(R) + \alpha_\pi \pi_t + \alpha_y \ln\left(\frac{Y_t}{Y}\right) \right) \quad (4.34)$$

With Y and R are the steady state of output and interest rate respectively. π_t is the CPI inflation. $\{\varpi, \alpha_\pi, \alpha_y\}$ are parameters representing the interest rate smoothing parameter, the weights of inflation and output gap in the policy rule.

In addition to macroprudential and capital control policies, we consider an alternative policy regime in which monetary policy also reacts to the credit gap, $\frac{D_{t+1}^E}{D^E}$, in addition to CPI inflation and the output gap. Hence, the resulting augmented Taylor rule has the form:

$$\ln(R_t) = (1 - \varpi) \ln(R_{t-1}) + \varpi \left(\ln(R) + \alpha_\pi \pi_t + \alpha_y \ln\left(\frac{Y_t}{Y}\right) + \alpha_{DE} \ln\left(\frac{D_{t+1}^E}{D^E}\right) \right) \quad (4.35)$$

4.2.6 The rest of the world

We assume that the economy takes as given foreign demand for domestically produced foods $Y_{X,t}$, foreign price index dynamics P_t^* , and foreign interest rate R_t^* . All of them evolve according to the following autoregressive processes:

$$\ln \left[\frac{Y_{X,t}}{Y_X} \right] = \rho_x \ln \left[\frac{Y_{X,t-1}}{Y_X} \right] + \epsilon_{x,t} \quad (4.36)$$

$$\ln \left[\frac{P_t^*}{P^*} \right] = \rho_{p^*} \ln \left[\frac{P_{t-1}^*}{P^*} \right] + \epsilon_{p^*,t} \quad (4.37)$$

$$\ln \left[\frac{R_t^*}{R^*} \right] = \rho_{r^*} \ln \left[\frac{R_{t-1}^*}{R^*} \right] + \epsilon_{r^*,t} \quad (4.38)$$

With the set of shocks $\{\epsilon_{x,t}, \epsilon_{p^*,t}, \epsilon_{r^*,t}\}$ are assumed to be i.i.d and distributed normally with zero mean and $\{\sigma_{x,t}, \sigma_{p^*,t}, \sigma_{r^*,t}\}$ respective standard deviations.

4.3 General Equilibrium and Balance-of-Payments Dynamics

Market clearing in the production sector requires that total domestic output be equal to domestic consumption, domestic investment, and exports to the rest of the world. Frictions such as portfolio adjustment and monitoring costs are included in the output, given that they are expressed in terms of the final composite good. Thus the overall resource constraint faced by the domestic economy can be written as:

$$P_t Y_t = P_{H,t} Y_{H,t} + P_{X,t} Y_{X,t} \quad (4.39)$$

Where:

$$Y_{H,t} = C_{H,t} + C_{H,t}^E + I_{H,t} + \alpha \left[\frac{P_{H,t}}{P_t} \right]^{-\gamma} \left\{ \mu G(\varpi_t) R_t^E Q_{t-1} K_t + \frac{\varphi_B}{2} (B_{h,t+1} - B_h)^2 + \frac{\varphi_B^*}{2} (S_t B_{h,t+1}^* - S B_h^*)^2 \right\} \quad (4.40)$$

$$Y_{M,t} = C_{M,t} + C_{M,t}^E + I_{M,t} + (1 - \alpha) \left[\frac{P_{M,t}}{P_t} \right]^{-\gamma} \left\{ \mu G(\varpi_t) R_t^E Q_{t-1} K_t + \frac{\varphi_B}{2} (B_{h,t+1} - B_h)^2 + \frac{\varphi_B^*}{2} (S_t B_{h,t+1}^* - S B_h^*)^2 \right\} \quad (4.41)$$

$\mu G(\varpi_{t+1})$ is the expected monitoring cost. $C_{H,t}^E$ and $C_{M,t}^E$ are entrepreneurs demand for domestic and imported goods respectively.

The country's trade balance (or net exports) is given by the following equation:

$$TB_t = P_{X,t} Y_{X,t} - S_t P_t^* Y_{M,t} \quad (4.42)$$

The balance of payments then implies that the nominal value of the current account balance (denoted by CA_t) equals the net foreign capital outflows:

$$CA_t = S_t (B_{h,t+1}^* - S_t B_{h,t}^*) - (B_{f,t+1} - B_{f,t}) \quad (4.43)$$

The trade balance is related to the current account through:

$$CA_t = TB_t + S_t B_{h,t}^* (R_{t-1}^* - 1) - B_{f,t} [R_{t-1} (1 - \tau_{t-1}) - 1] \quad (4.44)$$

This relation can be derived by combining the household budget constraint, equation (4.2), the market equilibrium conditions described by equations (4.39)-(4.41), the lump-sum transfer given by equation (4.33), the financial sector balance sheet described in equation (4.29), the budget constraint of entrepreneurs given in equation (4.21) and the current account balance expression described in equation (4.43). This condition corresponds to the goods market clearing condition.

4.4 Model Parametrization and solution

4.4.1 Calibration

We calibrate the model for a typical emerging market economy by dwelling extensively on [Devereux et al. \[2006\]](#). Table 1 summarizes the parametrization adopted for different sectors of the economy. The discount factor β and β^* are set at 0.985 and thus the world steady state of nominal interest rate is 6 percent. The utility weight on leisure is set at unity. The inverse of intertemporal substitution, is set at 0.5 and so that σ is equivalent to 2. The elasticity of substitution between home and foreign goods is set at 11 implying a 10 percent mark-up. We follow [Schmitt-Grohé and Uribe \[2003\]](#) by setting portfolio adjustment costs at $\varphi_i = .00075$ for domestic ($i = B$) and foreign bonds ($i = B^*$) as well as for domestic bonds $i = B_f$ held by foreign agents.

Concerning the production sector, we assume a 35 percent as the share of capital in production and 0.01 the share of entrepreneurial labour in the effective labour, implying that 1 percent of the total wage bill goes to entrepreneurs. The degree of openness is set at 0.28 a value included in the range used the existing literature, i.e. between 0.25 ([Elekdağ and Tchakarov \[2007\]](#)) and 0.5 ([Gertler et al. \[2007\]](#)). The elasticity of substitution between differentiated goods of the same origin is set at 1. To determine the degree of

nominal price rigidities in the model, we assume that the probability that a firm in the production and importing sectors can re-optimize its nominal price is $(1 - 0.75)$ so that $\theta_i = 0.75$ for $i = \{H, X, M\}$. Thus, all prices would adjust on average after four quarters. This follows the standard estimate used in the literature, e.g. [Chari et al. \[2000\]](#). Price stickiness in exporting and importing goods sectors implies an incomplete pass-through of exchange rate and impedes the law of one price to hold.

Parameters governing the capital accumulation function are set at their conventional values used in the literature, thus, the quarterly depreciation rate and investment adjustment cost are set at 0.025 and 12 respectively. As in [Bernanke et al. \[1999\]](#), [Devereux et al. \[2006\]](#), we set the monitoring cost parameter at 0.2, a steady-state risk spread at 200 basis points, and the leverage ratio at 3. Thus, the implied survival rate of entrepreneurs is 0.93.

To solve the model we transform it to reach a stationary representation³. We then solve the model numerically up to a second-order approximation around the non-stochastic steady state⁴.

4.5 Optimal policy responses and welfare evaluation

As stressed in [Bernanke et al. \[1999\]](#), [Faia and Monacelli \[2007\]](#), the fraction of entrepreneurial consumption over aggregate consumption can be reasonably assumed to be negligible. Thus, the overall social welfare of the economy can be approximated by households' welfare given by:

$$Max_X W_t = U(C_t, H_t) + \beta E_t W_{t+1} \quad (4.45)$$

Where $W_t \equiv E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, H_t)$, $U(\cdot)$ denotes the utility function and $X = \{\varpi, \alpha_\pi, \alpha_y, \alpha_{DE}, \psi_\tau, \psi_{rp}\}$ is the set of policy rules' parameters to be estimated. Following [Rotemberg and Wood-](#)

³We consider the model in real terms

⁴The non-stochastic steady state of the model is solved numerically in MATLAB, and then the second-order approximation of the model and the stochastic simulations are performed using Dynare ([Juillard et al. \[1996\]](#))

Table 4.1: Parameters' calibration

Parameter	Value	Description
β	0.985	Subjective discount factor
β^*	0.985	Subjective discount factor in the rest of the world
σ	2	Inverse of intertemporal elasticity of substitution
ϕ	1	The inverse elasticity of labour supply
$\theta_i, i=X,H,M$	0.75	Probability that prices are unchanged
δ	0.025	Capital depreciation
η	0.35	Capital share in production
$(1 - \alpha)$	0.28	The degree of openness
ψ	12	Investment adjustment cost
ψ_i	0.00075	Portfolio adjustment costs, $i = \{B, B^*, B_f\}$
Ω	0.01	Entrepreneur labour share
λ	11	Elasticity of substitution between differentiated goods of the same origin
γ	1	Elasticity of substitution between home and foreign goods
$\frac{Q}{N} \frac{K}{N}$	3	Leverage ratio steady state
ϕ	0.02	Financial risk premium
ν	0.93	Entrepreneurial survival rate
μ	0.2	Monitoring cost
ρ_A	0.73	Persistence of productivity shock
$\sigma_{A,t}$	0.045	Standard deviation of productivity shock
ρ_x	0.43	Persistence of export shock
$\sigma_{x,t}$	0.055	Standard deviation of export shock
ρ_{p^*}	0.45	Persistence of foreign demand shock
$\sigma_{p^*,t}$	0.065	Standard deviation of foreign demand shock
ρ_{r^*}	0.77	Persistence of foreign interest rate shock
$\sigma_{r^*,t}$	0.15	Standard deviation of foreign interest rate shock
ρ_{cf}	0.93	Persistence of foreign demand for domestic bonds shock
$\sigma_{cf,t}$	0.001	Standard deviation of foreign demand for domestic bonds shock

ford [1998], we determine X that maximizes the welfare W_t . To this end, we adopt a loop over X and we take values that correspond to a local welfare maximum using a MATLAB maximization routine.

To assess the welfare implication of alternative policies, we follow Unsal [2011] by taking a second order approximation of W_t around deterministic steady state. Using a second order solution of the model, we then calculate W_t in each of the separate cases of monetary and alternative policies. We present a comparative analysis of alternative policies in terms of a consumption equivalent, ζ , given by the fraction of consumption required to equate welfare under any given alternative policies, W_t^* , to the one under the optimal

Taylor rule, W_t . In our specification of the utility function, and under $\sigma = 2$:

$$\zeta = \frac{(1 - \beta)(W_t^* - W_t) \left(C - \frac{H_t^{1+\phi}}{1+\phi}\right)^2}{C \left(1 - (1 - \beta)(W_t^* - W_t) \left(C - \frac{H_t^{1+\phi}}{1+\phi}\right)\right)} \quad (4.46)$$

Where the variables without subscripts are the steady-state values of the corresponding variables. ζ is a measure of welfare gain in units of steady state consumption if its sign is positive, and a welfare loss otherwise.

The present economy is characterized by five sources of exogenous shocks, i.e. domestic productivity shock $\epsilon_{A,t}$, a demand shock for domestically produced goods $\epsilon_{x,t}$, a supply shock in the rest of the world $\epsilon_{p^*,t}$, foreign interest rate shock $\epsilon_{r^*,t}$ and foreign demand for domestic bonds $\epsilon_{cf,t}$. To find the optimal policy rules' parameters, we then search numerically in the grid of parameters X that optimize W_t in response to all shocks. However, in what follows we present results for the three main shocks, i.e. the domestic and two foreign shocks $\{\epsilon_{r^*,t}, \epsilon_{cf,t}\}$ ⁵.

The welfare maximization implies a set of parameters presented in Table 4.2. The welfare gains/losses corresponding to monetary and alternative policies are reported in Table 4.3. The results highlight non null values for alternative policies' parameters, i.e. there is a

Table 4.2: Optimized parameters of the policy rules

	Taylor rule	Augmented Taylor rule	Capital Control policy	Macroprudential policy
ϖ	0.54	0.44	0.40	0.67
α_π	1.99	1.98	1.71	3.68
α_y	0.48	0.13	0.96	4.11
α_{DE}	-	1.50	-	-
ψ_τ	-	-	3.49	-
ψ_{rp}	-	-	-	1.39

room for capital control policies and macroprudential measures to play. Specially, adopting an augmented Taylor rule for monetary policy leads to a more aggressive response of R_t to deviations of credit and inflation from their steady states. The optimized coefficients for macroprudential instrument assign high values for the smoothing parameter and the weight of inflation and output, while optimized parameters of capital control tax

⁵Other foreign shocks such as $\epsilon_{p^*,t}$ and $\epsilon_{x,t}$ deliver the same macroeconomic responses as $\epsilon_{r^*,t}$

rule are quite similar to that of a standard monetary policy rule, mainly for inflation. The analysis yields another important result, i.e. we observe a positive welfare effect of using alternative policies only when the economy is hit by foreign exogenous shock. However, under domestic productivity shock no alternative policy measure outperforms Taylor rule based monetary policy. When the economy is hit by a non fundamental shock leading to a sudden decline in capital inflows, capital control tax provides the higher welfare gain, and thus outperforms the optimal monetary and macroprudential policies.

Table 4.3: Welfare gain results, in Percent of Steady-State Consumption

	Augmented Taylor rule	Capital Control policy	Macroprudential policy
$\epsilon_{A,t}$	-0.0188	-0.0088	-0.058
$\epsilon_{r^*,t}$	0.0026	0.0036	0.0041
$\epsilon_{cf,t}$	0.0039	0.0057	0.0009

4.5.1 Do Alternative Policies Perform?

Figures 4.2-4.4 present the impact of the three exogenous shocks under four different policy options: (i) the standard Taylor rule; (ii) the augmented Taylor rule; (iii) the capital control policy and (iv) the macroprudential policy.

Following a positive productivity shock (Figure 4.2), policy rates are lowered in response to a positive output gap and a low inflation. However, our results point out that dynamic responses under alternative policies are characterized by a low financial accelerator effect. Indeed, implementing such policies dampen private credit growth by increasing the cost of borrowing (i.e. regulation premium and capital control tax), which leads to a low investment and output growth in comparison with the scenario of using only a standard monetary policy. In addition, this counter-cyclicality of capital control and macroprudential instruments lead to a more moderate domestic asset prices expansion. Nevertheless, reducing financial amplification does not improve the welfare. In fact, the higher welfare loss of about 0.058 percent of permanent consumption, is observed when broad macroprudential policy is activated, while the welfare loss of using capital control policies is 0.008 percent. Similarly, monetary policy targeting both inflation and credit growth leads under domestic exogenous shock to a welfare loss of about 0.0188 percent.

When the economy is hit by an anticipated increase in foreign interest rate (Figure 4.3), domestic economy is affected via two main channels. In one hand, imported inflation increases, pushing up domestic prices and policy rate. In the other hand, capital inflows suddenly stop reducing the amount of domestic liquidity and tightening financial conditions of entrepreneurs. In sum, private debt falls leading to a decline in private investment and aggregate output. In this context, all alternative policy instruments are counter-cyclical since capital control tax and the regulation premium are lowered to mitigate the sudden stop of capital inflows, while monetary policy is focusing on the domestic macroeconomic stability. As a result, capital outflows response to the unexpected increase of R_t^* is limited using either alternative policies. Nevertheless, the use of macroprudential policy measure provides the higher welfare gain of about 0.0041 percent of permanent consumption, against 0.0036 and 0.0026 percent using capital control tax and the augmented Taylor-rule policy respectively.

The same dynamic responses are observed following a sudden stop in capital inflows, i.e. an increase in domestic inflation with a decline in capital flows leading to a significant decline in private debt and private investment. However, lowering capital control tax mitigates the negative exogenous shock on capital flows, which instead of failing, as it is the case under other policy regimes, are stabilized. As a result, the use of capital control policy prevents a financial crisis and enhances the aggregate welfare by 0.0057 percent of permanent consumption. Similarly, implementing the augmented Taylor rule based monetary policy is welfare enhancing. The welfare gain of using macroprudential policy, by contrast, is negligible.

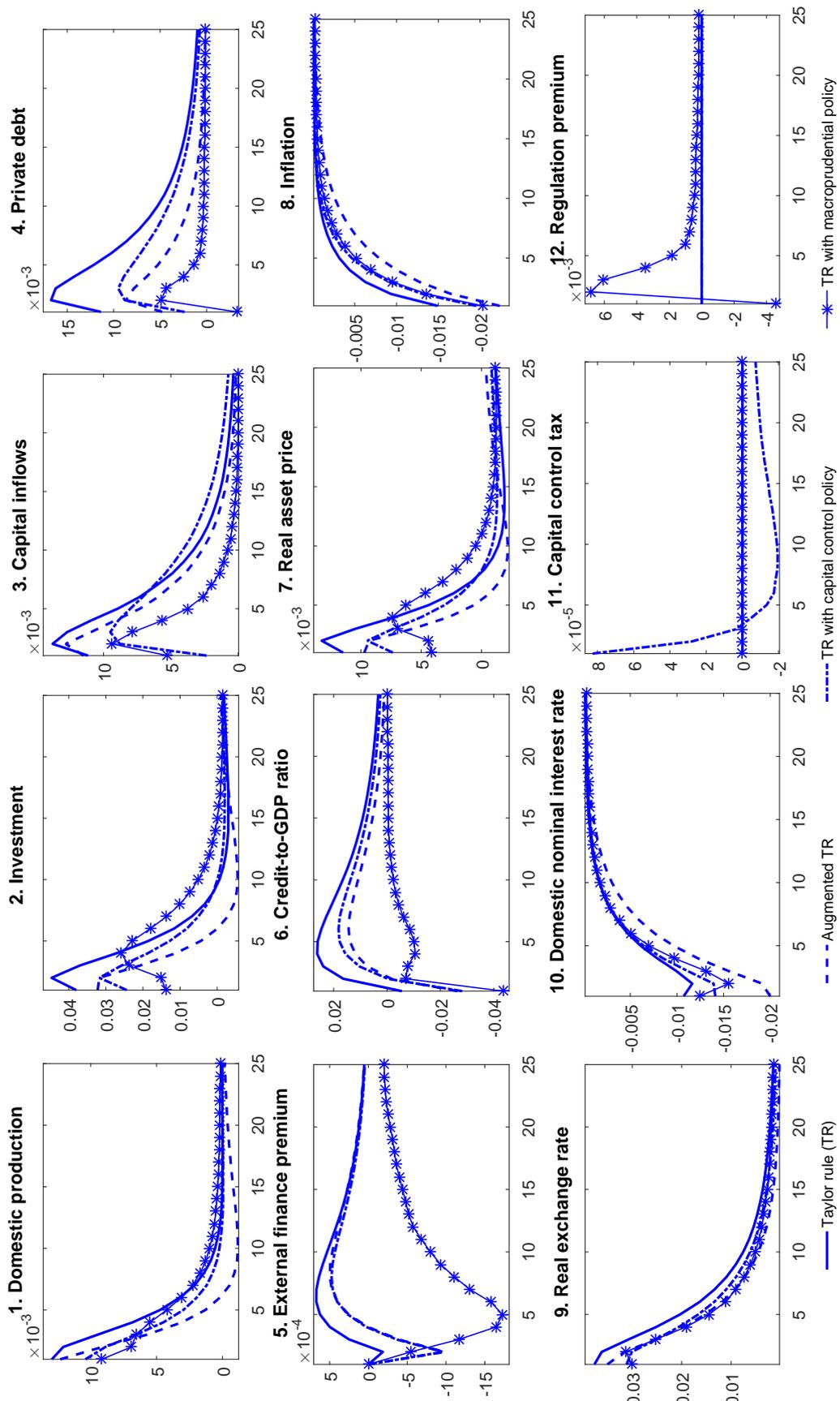


Figure 4.2: Macroeconomic dynamics under a positive domestic productivity shock

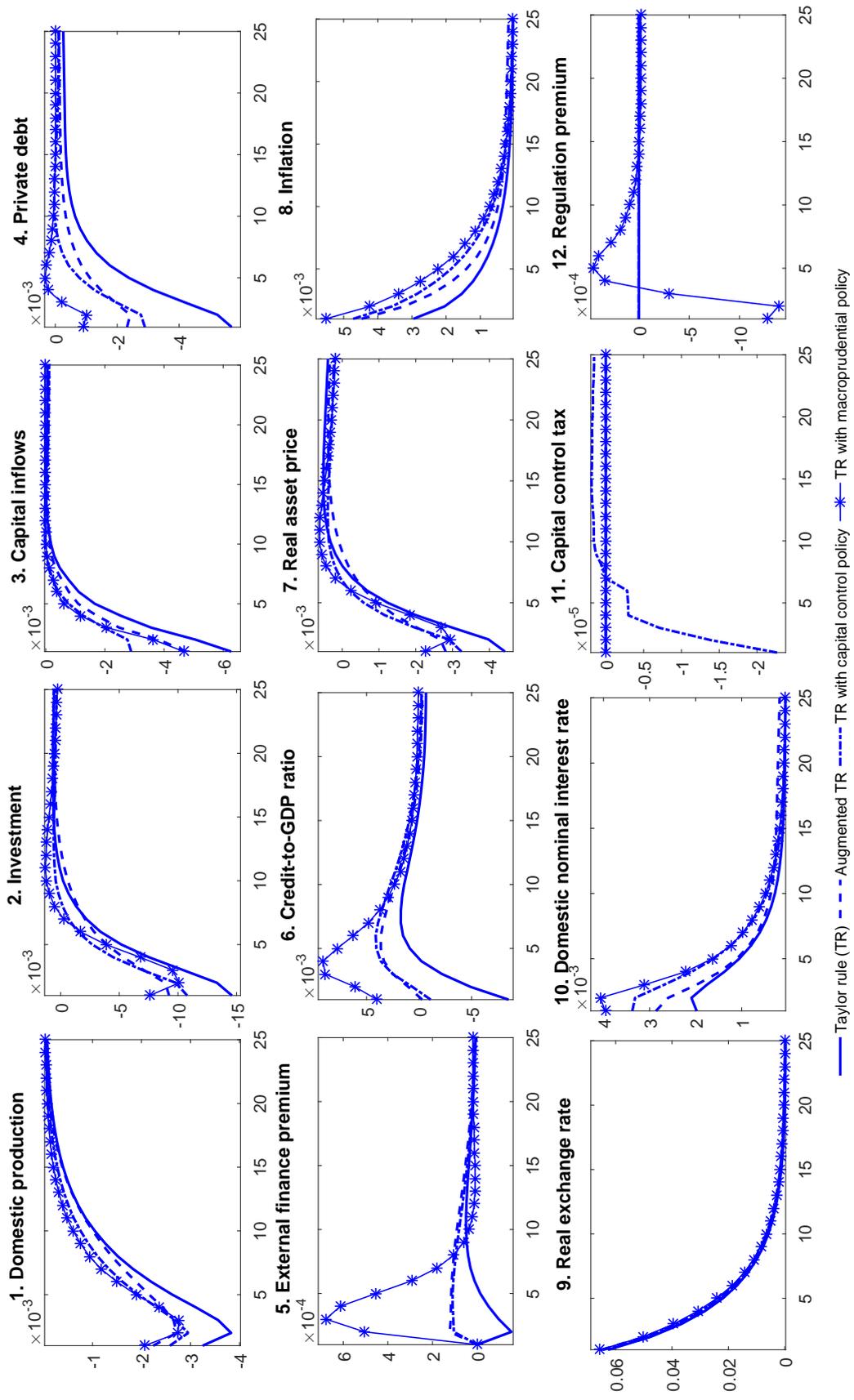


Figure 4-3: Macroeconomic dynamics under a positive foreign interest rate shock

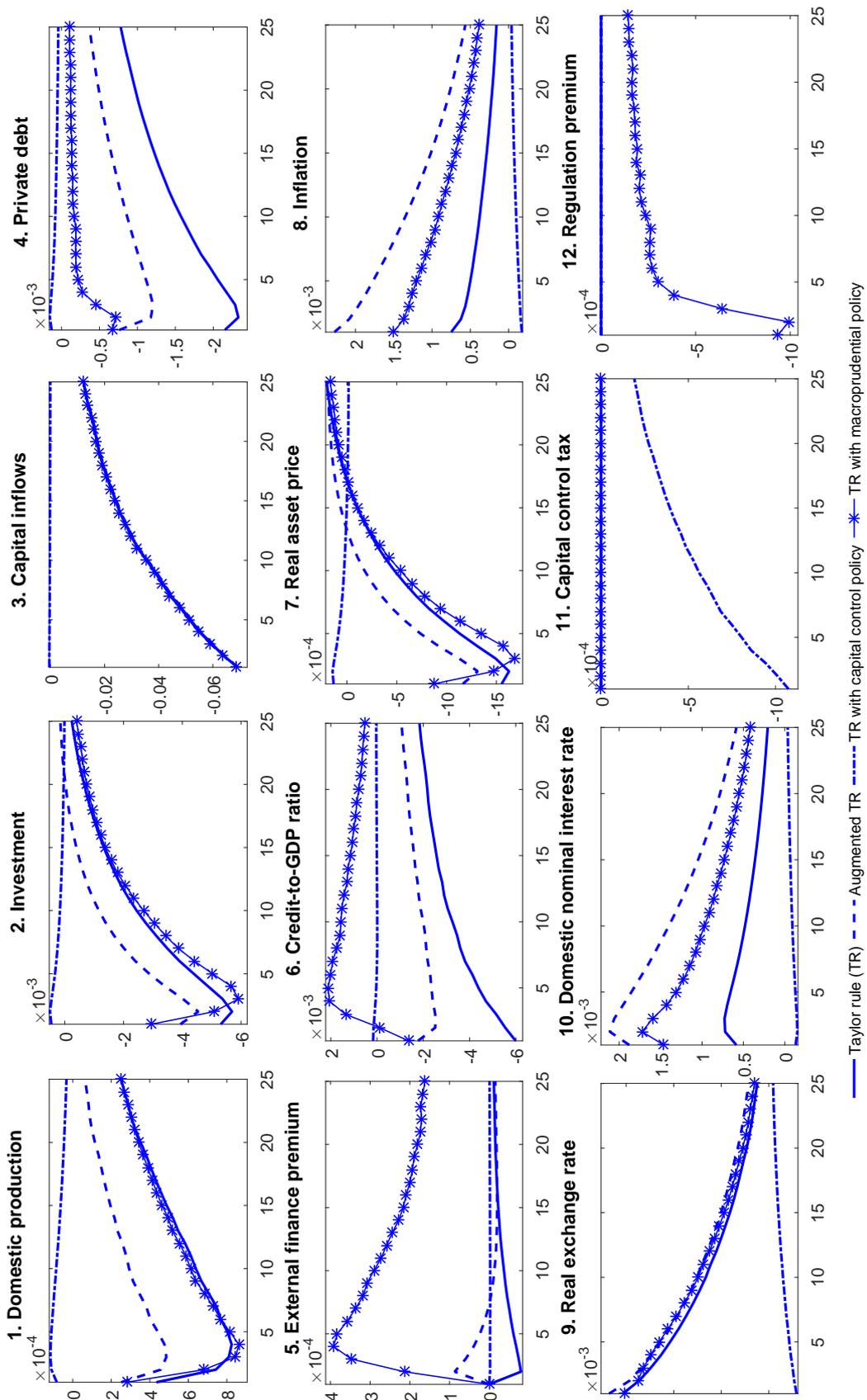


Figure 4.4: Macroeconomic dynamics under a negative exogenous shock in capital inflows

4.5.2 Macroeconomic and financial stability

Table 4.4 provides the estimates of the volatility measured by the standard deviation of each variable. Comparing the volatility of the economy under different scenarios, we note that adopting only monetary policy delivers the lowest volatility for inflation, policy rate and the current account. However, the volatility of other variables is higher than that observed using alternative policies. Indeed, domestic output and private debt volatility is significantly low when implementing Taylor rule based monetary policy and a broad macroprudential measure, while capital control policies have a significant smoothing effect on capital flows. The augmented Taylor rule based monetary policy reduces the volatility of private investment and the current account.

Our findings The monetary authorities should

Table 4.4: The macroeconomic volatility (Approximated theoretical standard deviation, in percent)

	Taylor rule	Augmented Taylor rule	Capital policy	Control	Macroprudential policy
Output	2.72	2.46	2.06		1.95
Private investment	8.69	5.74	6.57		8.60
Private credit	4.19	1.81	3.05		1.66
Domestic Inflation	2.04	3.63	2.80		3.02
Domestic interest rate	1.22	1.18	1.21		1.74
External finance premium	0.22	0.19	0.24		0.63
Real exchange rate	14.36	14.07	14.04		14.31
Current account	15.04	25.20	20.45		21.85
Capital flows	18.17	18.18	3.06		17.82

4.6 Conclusion

The purpose of this chapter was to develop a dynamic stochastic model of a small open emerging market economy with imperfect capital mobility and a significantly high dependence to external financing (capital inflows) to study the role of capital control and macroprudential policy measures in response to a sudden stop in capital inflows. In the model, domestic banks channel households savings and capital inflows to provide credit to entrepreneurs, who transform unfinished capital goods and rent them to production

firms. The presence of nominal rigidities a la Calvo (Calvo [1983]) and volatile capital flows, constrain the conduct of domestic monetary policy (Rey [2015]) which has a trade-off, i.e. targeting macroeconomic or financial stability. In this context, alternative policies such as capital control and macroprudential policy measures are investigated to assess their effectiveness and their ability to complement monetary policy.

Our main finding emphasizes different dynamic responses of the economy to exogenous shocks depending on their source. When the economy is hit by a domestic exogenous shock on productivity, implementing monetary policy delivers the higher welfare gain. Nevertheless, when the economy is subject to an unexpected exogenous shock, alternative policies including an augmented Taylor rule, targeting credit growth, enhance significantly the aggregate welfare.

In addition, a sudden stop in foreign capital inflows, induced by either a negative exogenous shock on capital flows or an unexpected increase in foreign interest rate, brings the economy into a crisis. Indeed, an unexpected decline in capital inflows leads to a drop in domestic credit supply. As a result, entrepreneurs reduce their debt accumulation by lowering their aggregate expenditure on investment. Consequently, aggregate output shrinks significantly. Following this shock, lowering capital control tax helps to stabilize capital flows and thus to mitigate their impact on the economic growth leading to a higher welfare gain in comparison with other alternative policies. The adoption of broad measure of macroprudential policy, by contrast, delivers a similar welfare as a scenario where only Taylor-rule based monetary policy is implemented. It calls also for leaning against the wind by lowering the regulation premium on entrepreneurial external financing.

General Conclusion

The aim of this thesis was to contribute to the empirical and the theoretical literature on prudential capital control policies in emerging market economies. Since the last Global Financial crisis, a debate on free capital movement is calling into question the benefit of liberalizing capital account, e.g providing a lever for growth and improving the social welfare. Indeed, according to a recent literature, the unobserved welfare enhancement following the integration of the international financial market is due to financial frictions arising from the presence of pecuniary externalities ([Calvo et al. \[1994\]](#), [Stiglitz \[2000\]](#), [Mendoza \[2002\]](#), [Bianchi \[2011\]](#), [Korinek \[2018\]](#)). In general, pecuniary externalities are a result of a constrained domestic economy, in which private agents are subject to a credit limit constraint or a government constrained to trade-off between the risk and benefit associated with a volatile capital flows.

Following this new literature, we have examined the role of pecuniary externalities in explaining the dynamics of Currency Crises in emerging market economies, and we assess the interest of conducting optimal prudential capital control policies to mitigate such crises. We focus our attention on crises driven by Sudden Stop in capital flows. Sudden stops are commonly defined as episodes when the economy experiences an abrupt and significant reduction in capital inflows followed by a decline in most macroeconomic aggregates, a depreciation of the real exchange rate, an increase of external financing costs, nonperforming bank loans and a banking and financial crises. We have investigated some main empirical regularities of such periods using a dataset including 75 developed and emerging market economies over the time period 1960Q1 – 2017Q4. We have explored, in addition, the relationship between the probability of such episodes and a number of

domestic and international factors. Our main result highlights that the probability of a sudden stop depends significantly on domestic real economic growth, global real GDP growth, and the domestic credit-to-GDP gap.

Subsequently, we have analyzed the conduct of optimal prudential capital control policies in a Sudden Stop environment using a Small Open Economy Dynamic Stochastic General Equilibrium (SOE-DSGE) model with pecuniary externalities due to flow collateral constraints ([Mendoza \[2002\]](#)). In this model, we consider a social planner that seeks to maximize the private welfare taking account of the effect of the externality. The social planner sets an optimal capital control tax on external borrowing to induce households to internalize the impact of their aggregate decision on their financial conditions. Furthermore, we assess the outcomes of two alternative policies, a simple macroprudential policy and a fixed debt-tax. Our main finding points out a prominent role of macroprudential policy in improving the social welfare and reducing the severity and the frequency of financial crises in the economy. Implementing a fixed tax on foreign borrowing helps also to stabilize the economic volatility and provides a higher welfare than that of the Ramsey economy. In an extended SOE-DSGE model, we introduce a government that may wish to use sterilized interventions, capital controls and monetary policy to manage an economy subject to volatile capital flows. Our result suggest that the optimal policy response of both sterilization and capital control policies combined with a monetary policy focusing on stabilizing domestic inflation and output lean against the wind. Consequently, restrictions on capital account are tightened during boom cycles in capital inflows and relaxed during bust cycles.

Finally in the last chapter and using an open economy New Keynesian-DSGE model featuring financial frictions a la Bernanke ([Bernanke et al. \[1999\]](#)), we have explored the outcomes of prudential capital controls when capital inflows finance the domestic private investment. In such an environment, financial conditions are procyclical, i.e. during expansion periods the decline of external finance premium and the surge of capital flows ease financial conditions of the private investors leading to an amplification of the real economic growth and private debt. However, during recession the increase of ex-

ternal finance premium and capital outflows tighten access to credit leading to a more pronounced decline in private investment and thus in aggregate output. Implementing prudential capital controls, such as macroprudential and capital control policies to complement monetary policy improve the social welfare when the economy is driven by a foreign exogenous shock, while monetary policy delivers the higher welfare gain when the economy is subject to domestic productivity shocks.

Looking forward, our analysis outlines several areas for future research. In particular, our empirical study could include a classification of countries in terms of the exchange rate regime to figure out how this latter affects the probability of experiencing a sudden stop in capital flows and how countries with different regimes respond to such shocks. Regarding our theoretical experiments, our models mainly those presented in the third and the last chapters could be extended to account for the impact of optimal prudential policies on a labor market with frictions and sticky wages. Indeed, high unemployment rate observed in emerging market economies is among the major problems and challenges that face public authorities. Capital account liberalization is encouraged in this context to reduce the number of unemployed people by giving financial support to the creation of new jobs and opportunities. However, the presence of frictions in the labor market could inhibit countries from gaining all the benefits of capital inflows and could amplify the associated risks as it is the case with pecuniary externalities in the credit market.

Appendix A

Data and sensitivity analysis

A.1 Countries of interest

Table A.1: Countries included in the event analysis

Emerging market economies (1)	Emerging market economies (2)	Developed economies
Argentina	Philippines	Australia
Brazil	Poland	Austria
Bulgaria	Romania	Belgium
Chile	Russia	Canada
China	Rwanda	Cyprus
Colombia	South Africa	Denmark
Croatia	Tanzania	Finland
Czech Republic	Thailand	France
Dominican Republic	Tunisia	Germany
Ecuador	Turkey	Greece
Egypt	Ukraine	Iceland
El Salvador	Uruguay	Ireland
Hungary	Venezuela	Israel
India	Vietnam	Italy
Indonesia	Zambia	Japan
Jordan		Lithuania
Kenya		Luxembourg
South Korea		Netherlands
Lebanon		New Zealand
Macedonia		Norway
Malaysia		Portugal
Mexico		Singapore
Morocco		Slovak Republic
Nigeria		Spain
Pakistan		Sweden
Panama		Switzerland
Paraguay		United Kingdom
Peru		United States

A.2 Sudden stops episodes by country

Table A.2: Sudden stop episodes

country	peak	start	end	country	peak	start	end
Argentina	1976Q4	1976Q4	1977Q1	Morocco	1992Q4	1992Q4	1993Q1
Argentina	1982Q1	1981Q2	1982Q2	Nepal	1972Q2	1972Q1	1972Q2
Argentina	1985Q4	1985Q3	1985Q4	Netherlands	1981Q4	1981Q1	1982Q1
Argentina	1990Q1	1990Q1	1990Q1	Netherlands	2003Q2	2003Q2	2003Q2
Argentina	1995Q2	1994Q3	1995Q3	Netherlands	2009Q4	2009Q2	2010Q1
Argentina	1999Q1	1999Q1	1999Q4	New Zealand	1998Q1	1997Q4	1998Q2
Argentina	2002Q2	2001Q3	2002Q4	New Zealand	2009Q3	2009Q1	2009Q3
Argentina	2009Q2	2009Q2	2009Q2	Nigeria	1984Q1	1983Q2	1984Q1
Argentina	2014Q4	2014Q4	2014Q4	Nigeria	1992Q2	1992Q2	1992Q2
Belgium	1981Q2	1981Q2	1981Q3	Nigeria	1995Q4	1995Q2	1995Q4
Belgium	2009Q3	2009Q3	2009Q4	Nigeria	2014Q4	2014Q4	2014Q4
Brazil	1983Q3	1980Q4	1983Q3	Macedonia	2014Q4	2014Q4	2014Q4
Brazil	1987Q4	1987Q3	1987Q4	Norway	2008Q2	2008Q1	2008Q2

Brazil	1999Q3	1999Q3	1999Q3	1999Q3	Panama	1982Q3	1982Q3	1982Q3
Brazil	2009Q1	2009Q1	2009Q1	2009Q2	Paraguay	1981Q3	1981Q3	1981Q3
Brazil	2014Q4	2013Q4	2014Q4	2014Q4	Paraguay	1995Q2	1995Q1	1995Q4
Bulgaria	2009Q4	2008Q3	2009Q4	2009Q4	Paraguay	1999Q1	1999Q1	1999Q2
Canada	1982Q3	1982Q1	1982Q3	1982Q3	Peru	1978Q4	1978Q4	1978Q4
Canada	1990Q2	1990Q2	1990Q3	1990Q3	Peru	1985Q1	1984Q4	1985Q2
Chile	1982Q3	1981Q4	1982Q3	1982Q3	Peru	1989Q3	1989Q2	1989Q3
Chile	1998Q4	1998Q4	1999Q3	1999Q3	Philippines	1984Q4	1984Q1	1985Q1
Colombia	1999Q2	1998Q4	1999Q3	1999Q3	Philippines	1991Q4	1991Q2	1992Q1
Colombia	2008Q1	2008Q1	2008Q2	2008Q2	Philippines	1998Q3	1998Q2	1998Q4
Croatia	2009Q2	2008Q4	2009Q2	2009Q2	Portugal	1975Q4	1975Q3	1975Q4
Czech Republic	1998Q2	1997Q3	1998Q2	1998Q2	Portugal	1982Q4	1982Q3	1982Q4
Czech Republic	2008Q3	2008Q3	2008Q4	2008Q4	Portugal	2012Q2	2011Q3	2012Q2
Czech Republic	2011Q3	2011Q3	2012Q2	2012Q2	Romania	2008Q4	2008Q3	2009Q3
Denmark	1980Q3	1980Q3	1981Q1	1981Q1	Russian Federation	1999Q2	1998Q3	1999Q4
Denmark	1987Q2	1986Q4	1987Q3	1987Q3	Russian Federation	2014Q4	2014Q4	2014Q4
Dominican Republic	1965Q3	1964Q4	1965Q3	1965Q3	Rwanda	1984Q4	1984Q4	1984Q4
Dominican Republic	1990Q4	1990Q4	1991Q1	1991Q1	Rwanda	1990Q4	1990Q4	1990Q4
Dominican Republic	2002Q3	2002Q3	2002Q3	2002Q3	Singapore	2003Q1	2003Q1	2003Q3

Dominican Republic	2009Q1	2008Q4	2009Q3	South Africa	1977Q2	1976Q2	1977Q2
Ecuador	1999Q3	1999Q2	2000Q1	South Africa	1983Q1	1982Q3	1983Q2
Egypt	2011Q4	2011Q1	2011Q4	South Africa	1992Q1	1991Q4	1992Q1
El Salvador	2009Q3	2009Q1	2009Q3	South Africa	2009Q3	2008Q4	2009Q3
Ethiopia	1985Q2	1985Q2	1985Q2	South Africa	2014Q4	2014Q4	2014Q4
Ethiopia	1991Q3	1991Q2	1991Q4	Spain	1993Q2	1992Q4	1993Q3
Finland	1994Q1	1993Q1	1994Q1	Spain	2009Q2	2008Q3	2009Q3
Finland	2009Q4	2009Q4	2009Q4	Spain	2012Q4	2012Q3	2013Q1
France	1968Q3	1968Q2	1968Q3	Sudan	1989Q3	1989Q3	1989Q4
Germany	1981Q4	1981Q3	1982Q2	Sweden	1978Q1	1977Q4	1978Q3
Germany	2002Q3	2001Q2	2002Q3	Sweden	1991Q4	1991Q1	1991Q4
Greece	1973Q4	1973Q2	1973Q4	Switzerland	2010Q1	2009Q2	2010Q1
Greece	1982Q2	1982Q1	1982Q2	Thailand	1998Q1	1996Q4	1998Q3
Greece	1986Q3	1986Q1	1986Q4	Thailand	2014Q1	2013Q4	2014Q2
Greece	1993Q3	1993Q3	1993Q3	Tunisia	1982Q3	1982Q3	1982Q3
Greece	2009Q2	2008Q4	2009Q3	Turkey	1978Q2	1978Q2	1978Q4
Greece	2012Q3	2012Q2	2012Q4	Turkey	1988Q4	1988Q4	1988Q4
Hungary	2009Q3	2009Q1	2009Q4	Turkey	1994Q3	1994Q2	1994Q3
Iceland	1983Q2	1983Q1	1983Q3	Turkey	2001Q2	1998Q4	2001Q4

Iceland	1992Q2	1992Q2	1992Q2	Turkey	2009Q1	2008Q4	2009Q2
Iceland	2009Q2	2009Q2	2009Q2	Ukraine	1999Q2	1998Q4	1999Q3
Indonesia	1998Q3	1997Q2	1998Q3	Ukraine	2009Q2	2008Q4	2009Q4
Ireland	1982Q4	1982Q3	1983Q1	Ukraine	2014Q3	2013Q2	2014Q4
Ireland	2009Q1	2008Q2	2009Q3	United Kingdom	1975Q4	1975Q1	1976Q1
Israel	1976Q3	1976Q1	1976Q3	United Kingdom	1981Q1	1980Q4	1981Q2
Israel	1985Q3	1983Q4	1985Q3	United Kingdom	1991Q2	1989Q4	1991Q2
Israel	2001Q4	2001Q4	2001Q4	United Kingdom	2010Q2	2009Q2	2010Q2
Italy	1975Q2	1975Q1	1975Q3	United States	1970Q2	1969Q3	1970Q2
Italy	1993Q4	1993Q1	1993Q4	United States	1973Q4	1973Q1	1973Q4
Italy	2001Q4	2001Q4	2001Q4	United States	1991Q1	1991Q1	1991Q2
Italy	2012Q2	2009Q3	2012Q4	United States	2009Q2	2009Q1	2009Q3
Japan	1979Q1	1979Q1	1979Q1	Uruguay	1971Q1	1971Q1	1971Q1
Japan	2014Q4	2014Q3	2014Q4	Uruguay	1999Q4	1998Q3	2000Q1
Jordan	1989Q3	1989Q2	1989Q3	Uruguay	2014Q4	2014Q4	2014Q4
Kenya	1992Q4	1992Q4	1992Q4	Venezuela	1980Q4	1980Q4	1980Q4
South Korea	1998Q1	1997Q2	1998Q3	Venezuela	1990Q1	1989Q2	1990Q1
South Korea	2009Q2	2008Q4	2009Q3	Venezuela	1996Q4	1996Q3	1996Q4
Lithuania	1999Q3	1999Q3	1999Q3	Zambia	1971Q2	1970Q3	1971Q2

Lithuania	2009Q1	2008Q3	2009Q4	Zambia	1976Q4	1976Q4	1976Q4
Luxembourg	2012Q1	2011Q4	2012Q1	Zambia	1983Q3	1982Q4	1983Q3
Mexico	1983Q1	1982Q2	1983Q2	Zambia	1997Q4	1997Q4	1997Q4
Mexico	1987Q2	1987Q1	1987Q3				
Mexico	1995Q2	1995Q1	1995Q4				
Mexico	2009Q4	2009Q4	2009Q4				

Source: Authors' calculations

A.3 Data source and definition

Table A.3: Data definition and source

	Source	Definition
Nominal GDP	World Bank's World Development Indicators (WDI)	Annual GDP (USD) interpolated at quarterly frequency over the period of 1960 to 2017. Used to normalize our measurement of capital inflows, current account balance and foreign reserves flows
Current account balance to GDP	IMF's International Financial Statistics (IFS)	Current account balance in USD as fraction of the interpolated nominal GDP
Trade balance to GDP	IMF's International Financial Statistics (IFS)	External trade export and import balance in USD as fraction of the interpolated nominal GDP
Trade openness	IMF's International Financial Statistics (IFS)	The sum of external trade export and import in USD as fraction of the interpolated nominal GDP
Foreign reserves flows (to GDP)	IMF's International Financial Statistics (IFS)	The annual difference of foreign reserves stock in USD as fraction of the interpolated nominal GDP

Real economic growth	IMF's International Financial Statistics (IFS) and World Bank's World Development Indicators (WDI)	Year-over-year change. Quarterly data comes from the IFS and for countries with no available data we use annual data from WDI interpolated at quarterly frequency.
Real private consumption growth	OECD Main Economic Indicators and World Bank's World Development Indicators (WDI)	Year-over-year change. Quarterly data comes from the OECD database and for countries with no available data we use annual data from WDI interpolated at quarterly frequency.
Real investment growth	OECD Main Economic Indicators and World Bank's World Development Indicators (WDI)	Year-over-year change. Quarterly data comes from the OECD database and for countries with no available data we use annual data from WDI interpolated at quarterly frequency.
Real exchange rate growth	IMF's International Financial Statistics (IFS), Bank of International Settlement statistics, OECD Main Economic Indicators	Year-over-year change
Consumer price index	IMF's International Financial Statistics (IFS)	

Inflation rate	IMF's International Financial Statistics (IFS)	Year-over-year change of CPI
Real Stock market index	IMF's International Financial Statistics (IFS)	Countries' Equity prices deflated by the corresponding CPI
Terms of trade growth	The United Nations (UN) Statistics Division and World Bank's World Development Indicators (WDI)	Quarterly data comes from UN and for countries with no available data we use annual data from from WDI interpolated at quarterly frequency. Year-over-year change
Credit to GDP gap	Bank of International Settlement statistics	The difference between the credit-to-GDP ratio and its long-term trend
Credit to private sector growth	Bank of International Settlement statistics	Year-over-year change of total credit to the private non-financial sector
Households' debt growth	Bank of International Settlement statistics	Year-over-year change of total credit to households
Exchange rate stability index	Aizenman et al. [2008]	
Monetary independence index	Aizenman et al. [2008]	

Chinn-Ito index of financial openness	Chinn and Ito [2008]	
Global real output gap	OECD Main Economic Indicators	Year-over-year change of the composite leading indicator of G7 ¹
VIX index growth	Bloomberg and Cboe	Year-over-year change of VIX index

¹Canada, France, Germany, Italy, Japan, united kingdom and United state

A.4 Sensitivity analysis

A.5 Sensitivity analysis

Table A.4: Sensitivity analysis: Baseline

	Baseline	(1)	(2)	(3)	(4)
Control variables					
Current account	-7.24** (2.96)	-10.49*** (1.81)	-8.14*** (2.56)	-9.93*** (1.65)	-7.62*** (1.76)
Real economic growth	-16.77*** (3.19)	-20.67*** (1.99)	-21.43*** (2.56)	-21.98*** (1.74)	-18.43*** (1.73)
Country-specific macroeconomic indicators					
Real Exchange rate growth	0.78 (1.33)	-3.46*** (0.81)			
Terms of trade growth	0.55 (1.41)	-1.11 (0.91)			
Trade openness	-1.05 (1.12)	-1.88*** (0.72)			
Country-specific financial indicators					
Foreign reserve flow	-4.23*** (1.30)		-5.24*** (1.21)		
Credit to GDP gap	0.06*** (0.01)		0.04*** (0.01)		
Trilemma indicators					
Exchange rate Stability index	-1.51** (0.61)			-1.32*** (0.38)	
Monetary Independence index	-0.76 (0.74)			-0.35 (0.50)	
Chinn-Ito index of financial openness	-0.34*** (0.13)			-0.04 (0.08)	
Economic uncertainty					
Economic Uncertainty Index	1.60 (2.07)				-1.46 (1.54)
Global real GDP index growth	-29.70*** (6.16)				-31.78*** (4.46)
Observations	3684	5228	4224	6003	6567

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors (clustered by country) in parenthesis

Table A.5: Sensitivity analysis: Developed economies

	Baseline	(1)	(2)	(3)	(4)
Control variables					
Current account	-5.99 (4.17)	-12.17*** (2.68)	-6.39* (3.51)	-11.56*** (2.45)	-10.94*** (2.90)
Real economic growth	-29.59*** (4.90)	-32.18*** (3.55)	-34.63*** (4.09)	-32.30*** (3.55)	-24.04*** (3.75)
Country-specific macroeconomic indicators					
Real Exchange rate growth	-1.08 (2.50)	-2.47 (2.12)			
Terms of trade growth	1.17 (2.17)	-0.79 (2.10)			
Trade openness	-0.19 (1.79)	-2.13 (1.33)			
Country-specific financial indicators					
Foreign reserve flow	-2.47 (1.85)		-3.50* (1.87)		
Credit to GDP gap	0.03** (0.02)		0.01 (0.01)		
Trilemma indicators					
Exchange rate Stability index	-1.44 (0.89)			-2.12*** (0.78)	
Monetary Independence index	0.44 (1.07)			-0.75 (0.94)	
Chinn-Ito index of financial openness	-0.18 (0.17)			-0.01 (0.14)	
Economic uncertainty					
Economic Uncertainty Index	0.64 3.30				-1.78 2.83)
Global real GDP index growth	-27.32*** (7.89)				-31.13*** (6.90)
Observations	2598	3147	2933	3031	3222

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors in parenthesis

Table A.6: Sensitivity analysis: Emerging economies

	Baseline	(1)	(2)	(3)	(4)
Control variables					
Current account	-4.77 (4.86)	-8.64*** (2.51)	-8.08** (4.08)	-7.94*** (2.31)	-5.38** (2.18)
Real economic growth	-5.61 (4.54)	-14.36*** (2.39)	-9.84*** (3.56)	-18.04*** (2.03)	-16.41*** (1.94)
Country-specific macroeconomic indicators					
Real Exchange rate growth	2.51 (1.80)	-4.18*** (0.90)			
Terms of trade growth	-0.71 (1.90)	-1.53 (0.99)			
Trade openness	-0.95 (1.65)	-2.10** (0.89)			
Country-specific financial indicators					
Foreign reserve flow	-7.87*** (2.33)		-8.23*** (1.96)		
Credit to GDP gap	0.15*** (0.04)		0.12*** (0.03)		
Trilemma indicators					
Exchange rate Stability index	-1.12 (0.90)			-1.31*** (0.46)	
Monetary Independence index	-2.10* (1.26)			-0.09 (0.62)	
Chinn-Ito index of financial openness	-0.44* (0.24)			-0.07 (0.11)	
Economic uncertainty					
Economic Uncertainty Index	3.36 (2.71)				-1.19 (1.81)
Global real GDP index growth	-36.72*** (11.53)				-28.92*** (6.04)
Observations	1086	2081	1291	2972	3345

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors in parenthesis

Table A.7: Clog-log regression: Baseline

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-7.47*** (2.49)	-7.16 (5.50)	-7.68** (3.18)
Real economic growth	-16.08*** (4.30)	-25.81*** (7.59)	-13.86*** (5.23)
Country-specific macroeconomic indicators			
Real Exchange rate growth	0.31 (1.46)	0.35 (3.39)	0.07 (1.49)
Terms of trade growth	1.03 (1.25)	3.48 (2.26)	-0.69 (1.63)
Trade openness	0.07 (0.41)	-0.15 (1.83)	0.30 (0.40)
Country-specific financial indicators			
Foreign reserve flow	-2.93* (1.68)	-7.75*** (2.60)	-1.65 (1.99)
Credit to GDP gap	0.04*** (0.01)	0.04** (0.02)	0.04** (0.02)
Trilemma indicators			
Exchange rate Stability index	-1.37* (0.71)	-2.50** (1.25)	-0.86 (1.00)
Monetary Independence index	-0.68 (0.67)	1.07 (1.21)	-1.35 (0.91)
Chinn-Ito index of financial openness	-0.26** (0.11)	-0.17 (0.14)	-0.45*** (0.14)
Economic uncertainty			
Economic Uncertainty Index	1.29 (1.24)	0.48 (6.37)	0.86 (1.57)
Global real GDP index growth	-26.73*** (4.88)	-33.11** (14.66)	-30.73*** (8.08)
Constant	-3.01*** (0.48)	-3.30*** (1.28)	-3.05*** (0.70)
Observations	4465	1528	2937

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors (clustered by country) in

parenthesis

Table A.8: Clog-log regression: Developed economies

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-5.19* (2.87)	-6.80 (5.07)	-7.00** (2.78)
Real economic growth	-26.78*** (4.50)	-43.89*** (6.36)	-19.20*** (6.91)
Country-specific macroeconomic indicators			
Real Exchange rate growth	-1.37 (3.29)	-4.53 (4.91)	1.81 (3.46)
Terms of trade growth	1.01 (1.29)	5.63** (2.65)	-0.53 (3.39)
Trade openness	-0.07 (0.38)	0.50 (2.14)	0.22 (0.39)
Country-specific financial indicators			
Foreign reserve flow	-2.08 (2.73)	-6.93** (3.23)	1.62 (1.61)
Credit to GDP gap	0.02* (0.01)	0.03 (0.02)	0.01 (0.01)
Trilemma indicators			
Exchange rate Stability index	-0.80 (0.52)	-3.08* (1.76)	-0.56 (1.00)
Monetary Independence index	0.59 (1.00)	1.96* (1.14)	-1.19 (2.43)
Chinn-Ito index of financial openness	-0.18 (0.12)	-0.07 (0.17)	0.47 (1.10)
Economic uncertainty			
Economic Uncertainty Index	-0.03 (2.38)	-4.72 (6.69)	2.68 (3.50)
Global real GDP index growth	-25.90*** (6.99)	-47.98*** (16.85)	-33.17** (13.02)
Constant	-3.42*** (0.68)	-3.80** (1.49)	-5.02** (0.70)
Observations	2939	1209	1730

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors (clustered by country) in

parenthesis

Table A.9: Clog-log regression: Emerging economies

	Baseline	Pre-1997Q2	Post-1997Q2
Control variables			
Current account	-8.20 (5.00)	-1.18 (16.34)	-13.73** (6.39)
Real economic growth	-10.27 (6.93)	-13.06** (6.41)	-8.43 (7.52)
Country-specific macroeconomic indicators			
Real Exchange rate growth	1.61 (1.88)	5.39 (4.36)	1.39 (2.19)
Terms of trade growth	0.02 (1.93)	-2.13 (6.97)	-1.47 (2.41)
Trade openness	-0.34 (0.80)	-2.03 (2.80)	-0.35 (1.26)
Country-specific financial indicators			
Foreign reserve flow	-4.12** (1.98)	-24.58** (10.20)	-3.43 (0.15)
Credit to GDP gap	0.11*** (0.02)	0.24*** (0.09)	0.13** (0.00)
Trilemma indicators			
Exchange rate Stability index	-0.85 (2.02)	2.31 (3.54)	0.39 (1.66)
Monetary Independence index	-2.18** (0.89)	-10.64* (6.11)	-2.11** (0.95)
Chinn-Ito index of financial openness	-0.36*** (0.13)	-0.70 (0.48)	-0.65*** (0.19)
Economic uncertainty			
Economic Uncertainty Index	4.03** (1.63)	12.63 (11.09)	1.52 (2.21)
Global real GDP index growth	-29.19** (11.93)	44.32 (36.75)	-39.02*** (12.80)
Constant	-3.21*** (0.68)	-2.82* (1.61)	-4.08*** (0.92)
Observations	1526	319	1207

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

robust standard errors (clustered by country) in

parenthesis

Appendix B

Proofs and numerical solutions

B.1 The optimal capital tax solution

First we can show that when $\mu_t = 0$ (or $\mu_t \neq 0$) it implies that $\mu_t^{SP} = 0$ (or $\mu_t^{SP} \neq 0$) and vice-versa. In fact, Ramsey planner allows goods market to clear competitively and sets the tax rate τ_t to restore the constrained efficient allocation by imposing a debt choice, then debt levels in the regulated economy and Ramsey economy should be the same. Consequently, according to households budget constraint, consumptions of tradable goods in the regulated and Ramsey economies are the same too.

We conclude that when the collateral constraint is not binding we then have $[\kappa (y_t^T + p_t^n y_t^N) - d_{t+1}] > 0$ in regulated and Ramsey economies which implies $\mu_t = \mu_t^{SP} = 0$. When the collateral constraint is binding, d_{t+1} is given by the credit limit e.g. $[\kappa (y_t^T + p_t^n y_t^N)]$ in both regulated economy and Ramsey economy so it implies that $\mu_t \neq 0, \mu_t^{SP} \neq 0$. In both cases, taking $\mu_t = \mu_t^{SP}$ keeps the slackness condition satisfied in regulated economy (equation (2.25)). Setting $\tau_t = \tau_t^{\mu_t = \mu_t^{SP}}$ keeps Euler equation (2.22) hold while all other equilibrium conditions in regulated economy are still satisfied.

Suppose that it exists another solution μ_t' and τ_t' that satisfies all equilibrium conditions of regulated economy. Using Euler equation (2.22) under the two solutions $\left\{ (\mu_t', \tau_t'), (\mu_t^{SP}, \tau_t^{\mu_t = \mu_t^{SP}}) \right\}$ we deduce the following relationship:

$$\tau_t' - \tau_t^{\mu_t = \mu_t^{SP}} = R_t (\mu_t^{SP} - \mu_t')$$

When the collateral constraint is not binding $\mu_t^{SP} = \mu_t' = 0$ which implies that $\tau_t' = \tau_t^{\mu_t = \mu_t^{SP}}$. We then find a unique solution for (μ_t, τ_t) given by $(\mu_t^{SP}, \tau_t^{\mu_t = \mu_t^{SP}})$ in states in which the collateral constraint is not binding. When the collateral constraint is binding, setting $\tau_t' = \tau_t^{\mu_t = \mu_t^{SP}}$ ensures that Ramsey and private resource allocations are the same as it leads to the same inter-temporal choices in Ramsey and private economies.

B.2 Numerical Solution Method for unregulated, Ramsey and regulated economies: Endowment shocks driven economy

The computation of the competitive equilibrium requires recursive solving for functions d_{t+1} , p_t^n , c_t^T . We adopt the same algorithm employed by Bianchi [2011] which is based on time iteration algorithm modified to address the occasionally binding endogenous constraint. Next period variables are presented with the prime superscript, the algorithm contains the following steps:

1. We make use of the Markov chain processes publicly published by Bianchi [2011] (available at <https://www.aeaweb.org>). Then, we use the discrete processes grid for the economy's bond position $G_d = \{d_1, d_2, \dots, d_{800}\}$ and the shock state space $G_y^i = \{y_1^i, y_2^i, \dots, y_4^i\}$ with $i=T, N$;
2. Start with guess values for $c_t^T(d, y)$, $d'_t(d, y)$ and $p_t^n(d, y)$ at time t for $\forall d \in G_d$ and $y \in G_y^i$
3. Adopt an interpolation scheme to generate λ' as a function of $(d', y^{i'})$;
4. Set $j = 1$
5. Solve for d'_{t-j} , p_{t-j}^n and c_{t-j}^T :
 - (a) Set $d'_{t-j} = \kappa(p_{t-j}^n y^N + y^T)$ and compute $c_{t-j}^T(d, y)$
 - (b) Compute
$$U = \lambda(c_{t-j}^T(d, y), y^N) - \beta R \lambda'(d', y^{i'})$$
 - (c) If $U > 0$; the credit constraint binds; keep c_{t-j}^T and calculate $p_{t-j}^n = \frac{1-a}{a} \frac{c_{t-j}^T(d, y)}{y^N}$ and $d'_t(d, y) = \kappa(p_{t-j}^n y^N + y^T)$;
 - (d) If else, solve the following equation for c_{t-j}^T with a root finding algorithm:

$$\lambda(c_{t-j}^T(d, y), y^N) - \beta R \lambda'(d', y^{i'}) = 0$$

Then, deduce p_{t-j}^n and d'_t .

6. Evaluate convergence. If $\|x_{t-j} - x_{t-j+1}\| < \epsilon$ for $x = c^T, p^n$ and d' we have found the competitive equilibrium. Otherwise, set $x_{t-j} = \alpha x_{t-j} + (1 - \alpha) x_{t-j+1}$ and $j = j + 1$ and go to step (5). We set the convergence criterion $\epsilon = 10^{-8}$ and $\alpha = 0.2$.

B.3 Traded endowment and foreign interest rate shocks driven economy

For the economy with traded endowment and foreign interest rate shocks, we use the same algorithm presented previously. We modify the algorithm to count for time varying interest rate.

1. We use the Markov chain processes publicly published by [Schmitt-Grohé and Uribe \[2017\]](#) (available at www.columbia.edu). Then, we use the discrete processes grid for the economy's bond position $G_d = \{d_1, d_2, \dots, d_{800}\}$, the shock state spaces $G_y^T = \{y_1^T, y_2^T, \dots, y_{21}^T\}$ and $G_r = \{r_1, r_2, \dots, r_{11}\}$ with $R = 1 + r$;
2. Start with guess values for $c_t^T(d, r, y^T)$, $d'_t(d, r, y^T)$ and $p_t^n(d, r, y^T)$ at time t for $\forall d \in G_d$ and $y^T \in G_y^T$ and $\forall r \in G_r$;
3. Adopt an interpolation scheme to generate λ' as a function of $(d', y^{T'}, r')$;
4. Set $j = 1$
5. Solve for d'_{t-j} , p_{t-j}^n and c_{t-j}^T :
 - (a) Set $d'_{t-j} = \kappa(p_{t-j}^n y^N + y^T)$ and compute $c_{t-j}^T(d, r, y^T)$
 - (b) Compute

$$U = \lambda(c_{t-j}^T(d, r, y^T), y^N) - \beta(1 + r_{t-j})\lambda'(d', y^{T'}, r')$$

- (c) If $U > 0$; the credit constraint binds; keep c_{t-j}^T and calculate $p_{t-j}^n = \frac{1-a}{a} \frac{c_{t-j}^T(d, r, y^T)}{y^N}$ and $d'_t(d, r, y^T) = \kappa(p_{t-j}^n y^N + y^T)$;

(d) If else, solve the following equation for c_{t-j}^T with a root finding algorithm:

$$\lambda(c_{t-j}^T(d, y), y^N) - \beta(1 + r_{t-j})\lambda'(d', y^i) = 0$$

Then, deduce p_{t-j}^n and d'_t .

6. Evaluate convergence. If $\|x_{t-j} - x_{t-j+1}\| < \epsilon$ for $x = c^T, p^n$ and d' we have found the competitive equilibrium. Otherwise, set $x_{t-j} = \alpha x_{t-j} + (1 - \alpha)x_{t-j+1}$ and $j = j + 1$ and go to step (5). We set the convergence criterion $\epsilon = 10^{-8}$ and $\alpha = 0.2$.

B.4 Traded endowment and international interest rate shocks

In what follows, we investigate how our results could be affected by another stochastic structure of the economy. We consider an economy driven by traded endowment and foreign interest rate shocks. We adopt the same analytical framework as [Schmitt-Grohé and Uribe \[2017\]](#), in which the endowment of nontradables is assumed to be constant and normalized to 1; $y_t^N = 1$ for all t. traded endowment and foreign interest rate are assumed to follow a bi-variate auto-regressive $AR(1)$ process given by:

$$\begin{bmatrix} \ln y_t^T \\ \ln \frac{1+r_t}{1+r} \end{bmatrix} = \begin{bmatrix} 0.48 & -0.77 \\ 0.08 & 0.68 \end{bmatrix} \begin{bmatrix} \ln y_{t-1}^T \\ \ln \frac{1+r_{t-1}}{1+r} \end{bmatrix} + \epsilon_t; \epsilon_t \sim N \left(0, \begin{bmatrix} 0.0031 & -0.0015 \\ -0.0015 & 0.0014 \end{bmatrix} \right)$$

With ϵ_t is assumed to be i.i.d. $r = 0.1325$ is the annualized foreign interest rate's, a historical estimation from Argentina's data along the period 1983 : Q1to2001 : Q4. The resulting volatility is 6.5 and 11.7 percent for the interest rate and the natural logarithm of tradable output respectively and a contemporaneous correlation of -0.87 . This leads to a high co-movement of traded output and interest rate that reinforces their cyclical macroeconomic effects on aggregate demand. Boom-cycle of traded output coincides with low interest rate, both ease financial conditions for households and encourage them to

increase their debt holdings, while, Bust-cycle of traded output corresponds to high interest rate levels inducing a contraction in aggregate demand.

We use the same discretized process publicly published by [Schmitt-Grohé and Uribe](#)

Table B.1: Calibration of an economy driven by traded endowment and foreign interest rate shocks

Parameter	Value	Description
κ	0.3328	Parameter of the collateral constraint
β	0.8357	Subjective discount factor
$R_t - 1$	0.1325	World interest rate
σ	2	Inverse of intertemporal elasticity of substitution
α	0.31	Weight on tradables in CES aggregator
y^N	1	Nontradable output
y^T	1	Steady-state tradable output
$n_{y_t^T}$	21	Number of grid points for y_t^T
n_{r_t}	11	Number of grid points for y_t^N
n_d	800	Number of grid points for d_t , equally spaced
$[\underline{d}, \bar{d}]$	[0.5, 1.5]	Range for debt
$[\ln \underline{y}_t^T, \ln \bar{y}_t^T]$	[-0.3706, 0.3706]	Range for tradable output
$[\ln \frac{1+r_t}{1+r}, \ln \frac{1+\bar{r}_t}{1+r}]$	[-0.2040, 0.2040]	Range for interest rate

Source: [Schmitt-Grohé and Uribe \[2017\]](#)

[2017] and the same parameters' calibration (Table B.1). Specially, as in [Schmitt-Grohé and Uribe \[2017\]](#), β is calibrated to maintain the same households' impatience degree as in the endowment-shock economy. This requires setting β at 0.8357. We follow [Schmitt-Grohé and Uribe \[2017\]](#) in setting the range of foreign debt at 0.5 and 1.5.

B.4.1 Bonds decision rules and long term distribution

As in the endowment shock economy, we solve the optimal conditions for the unregulated, Ramsey and regulated economies with τ_t^{MP} and τ_t^{IM} . We use the same set of optimal processes obtained from Ramsey economy solutions to solve the regulated economies with $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SU} .

Figure B.1 displays the average of next period bond holdings in the unregulated and regulated economies, as a function of the average of current debt holdings across all economic states of nature. Our results show a larger constrained region and a flat curve of the

policy function when compared to that of the endowment shocks economy. In addition, the figure highlights the same policy implications of different policy options considered in our analysis as in the endowment economy. In fact, implementing τ_t^{IM} affects both the slope and the intercept of the bond decision rule function. In the regulated economy with τ_t^{MP} , households are encouraged to increase their next period debt holdings when the current amount of debt is low and avoid them when the current debt level becomes higher.

To investigate the long run economic dynamic of the unregulated and regulated economies, we simulate the set of processes for one million years. Figure (B.2) displays the ergodic distribution of bond holdings in each economy. It confirms a moderate accumulated foreign debt in the regulated economies with τ_t^{MP} and τ_t^{IM} . In fact, Figure 2.3 shows a low density distributions of bond holdings in the regulated economies with τ_t^{MP} and τ_t^{IM} . Indeed, by implementing τ_t^{MP} and τ_t^{IM} , the economy has a probability of 11.7% and 2.9% to accumulate an amount of foreign debt that does not exceed 81.5% and 70.4% of traded output respectively, while, the Ramsey economy accumulated a high level of private debt equivalent to 85% of traded endowment. Concerning the unregulated economy, the highest probability of 2.9% is associated with an amount of foreign debt above 98.3% of traded output, while the probability for the regulated economy with τ_t^{IM} to accumulated such a debt level is null.

Accordingly, the average of debt to aggregate output ratios in regulated economies with τ_t^{MP} and τ_t^{IM} are 17.3% and 23.9% respectively, against 25.4% in the private economy and 25.1% in the Ramsey economy (Table B.2).

B.4.2 Crises frequency and severity

In terms of crisis frequency and severity, implementing a policy aiming to lessen the impatience of domestic private agents reduces the frequency of crises by more than ten times when compared to the unregulated economy. However, such a policy has a welfare cost of about 0.45 in percent of the permanent consumption. The regulated economy with τ_t^{MP} displays a crisis frequency of about once every 34 years, against 12 and 7 in Ramsey and the private economies respectively, with a welfare gain of about 0.94 percent instead of

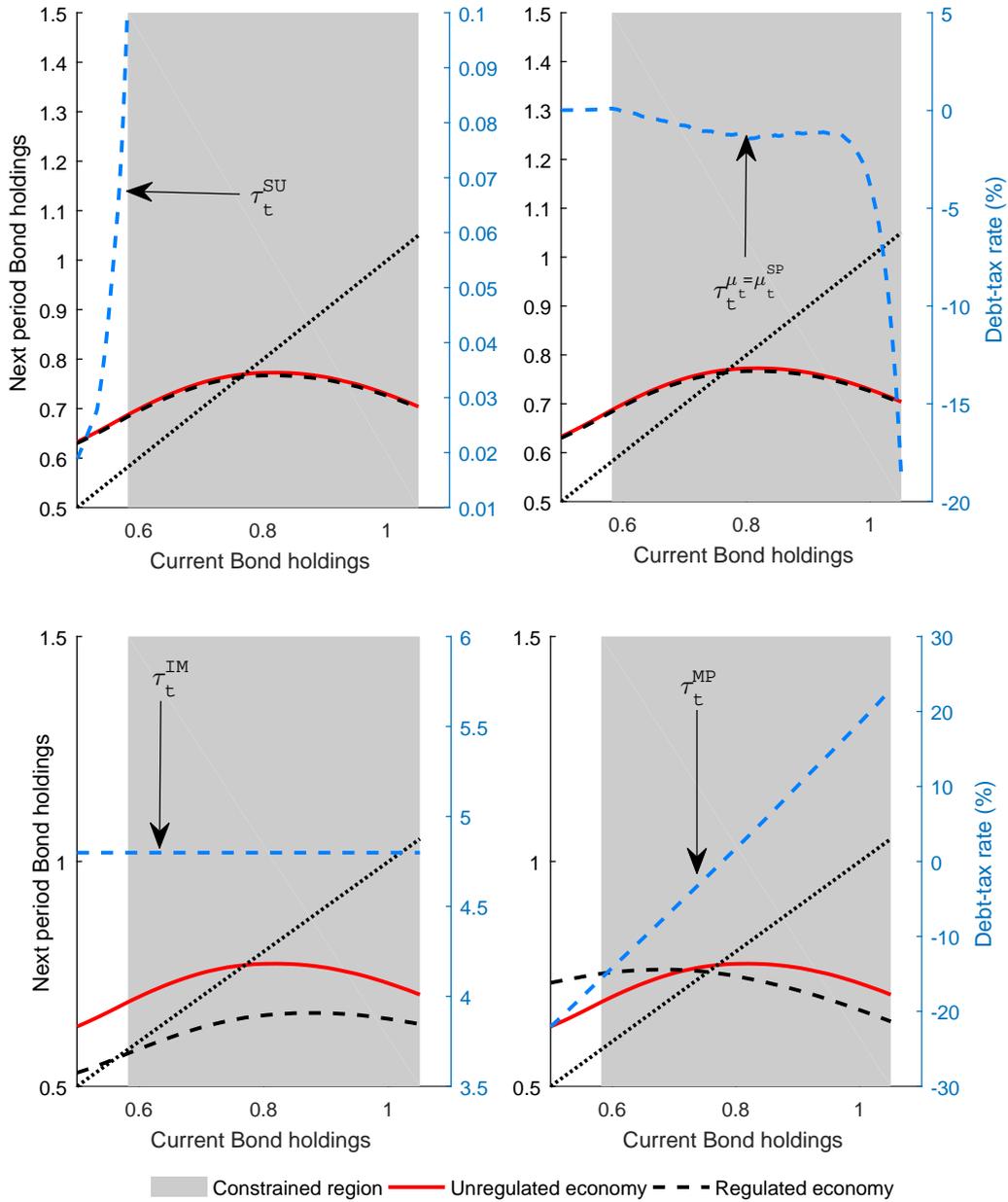


Figure B.1: Bond decision rules (the average over all economic state of nature)

0.05 percent of permanent consumption in the Ramsey economy. During crisis periods, the average of private consumption fall is 16 percent in average (Table B.3) in the regulated economies with τ_t^{MP} and τ_t^{IM} . Nevertheless, the laissez-faire economy experiences

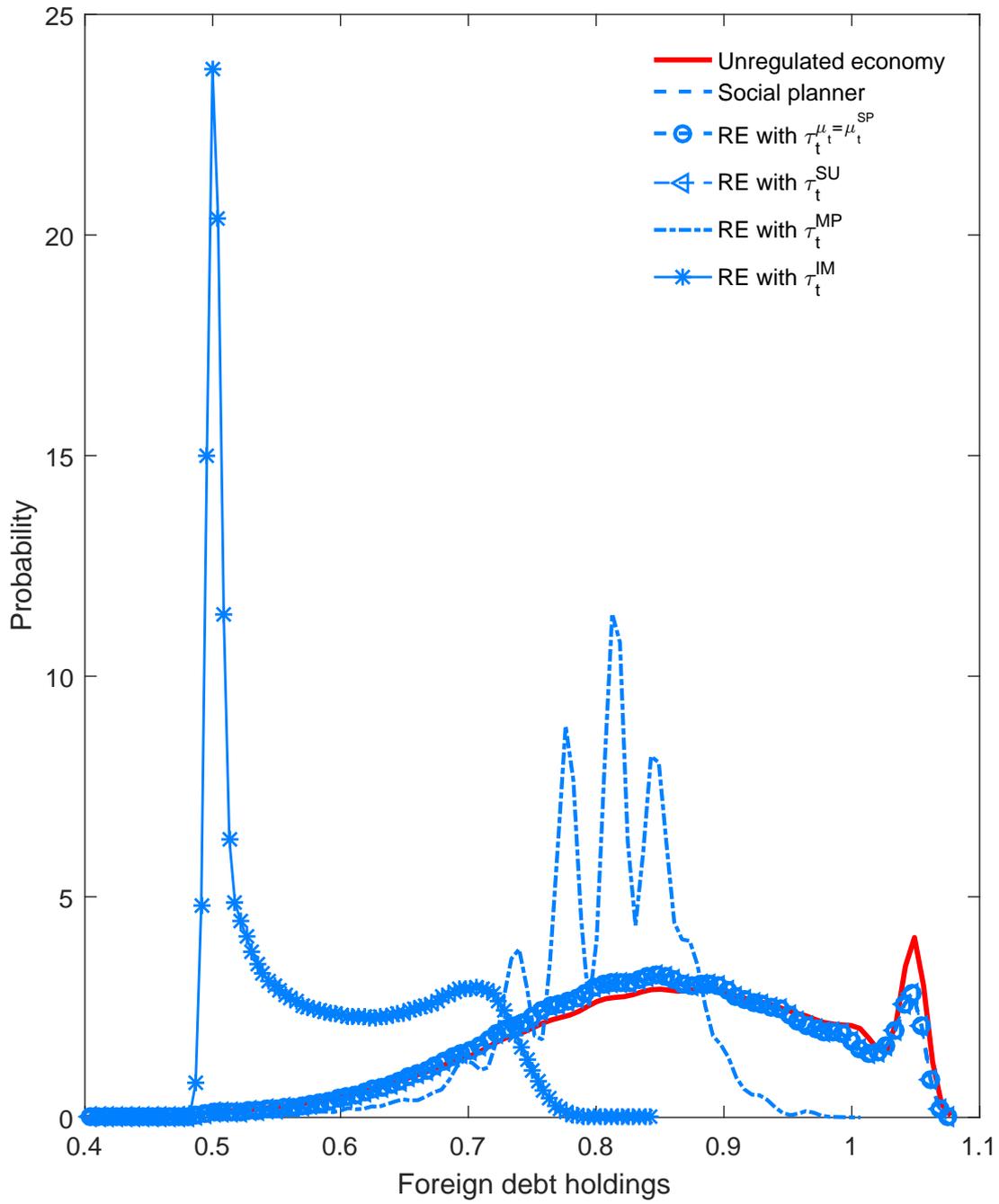


Figure B.2: The ergodic distribution of foreign debt holdings

Table B.2: Debt-to-output ratios, Frequency of Crises and Welfare

	Debt-to-Output Ratio	Frequency of Crises	Welfare gain ^a
Unregulated economy	25.4%	7 years	-
Ramsey economy	25.1%	12 years	0.0545
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	25.1%	12 years	0.0541
Regulated economy with τ_t^{SU}	25.1%	12 years	0.0547
Regulated economy with τ_t^{MP}	23.9%	34 years	0.9401
Regulated economy with τ_t^{IM}	17.3%	75 years	-0.4151

Source: Authors' calculations

^aIn percent of permanent consumption

a more pronounced drop in private consumption of about 21.5 percent against 19.4 in the Ramsey economy. The decline of private consumption is associated with a significant output loss of about 32.5 percent of the long term average of aggregate output in the unregulated economy, against 30.9 and 28.4 in the Ramsey economy and the economy regulated with τ_t^{IM} respectively. As a result, the decline of aggregate consumption and production leads to a positive trade balance. In addition, the economy displays an appreciation of the real exchange rate of about 40.6 in the Ramsey economy, and a depreciation in the regulated economies with τ_t^{IM} and τ_t^{MP} of about 34.4.

Table B.3: Severity of Financial Crises

^a	Output	Consumption	Relative price	Trade balance-to-GDP
Unregulated economy	-32.5	-21.5	-42.6	13.9
Ramsey economy	-30.9	-19.4	-40.6	11.7
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	-30.9	-19.4	-40.6	11.7
Regulated economy with τ_t^{SU}	-30.9	-19.4	-40.6	11.7
Regulated economy with τ_t^{IM}	-28.37	-15.8	34.4	4
Regulated economy with τ_t^{MP}	-28.39	-16	34.4	8.8

Source: Authors' calculations

^aAll variable are responses on impact expressed as percentage deviations from averages in the corresponding ergodic distribution, except for trade balance-to-GDP which is the average of this ratio during crisis periods.

B.4.3 Macroeconomic volatility

Our results emphasize a low macroeconomic volatility in the regulated economy with τ_t^{IM} (Table(B.4)), followed by the regulated economy with macroprudential policy. Ramsey and private economies displays a higher volatility of all main macroeconomic variables.

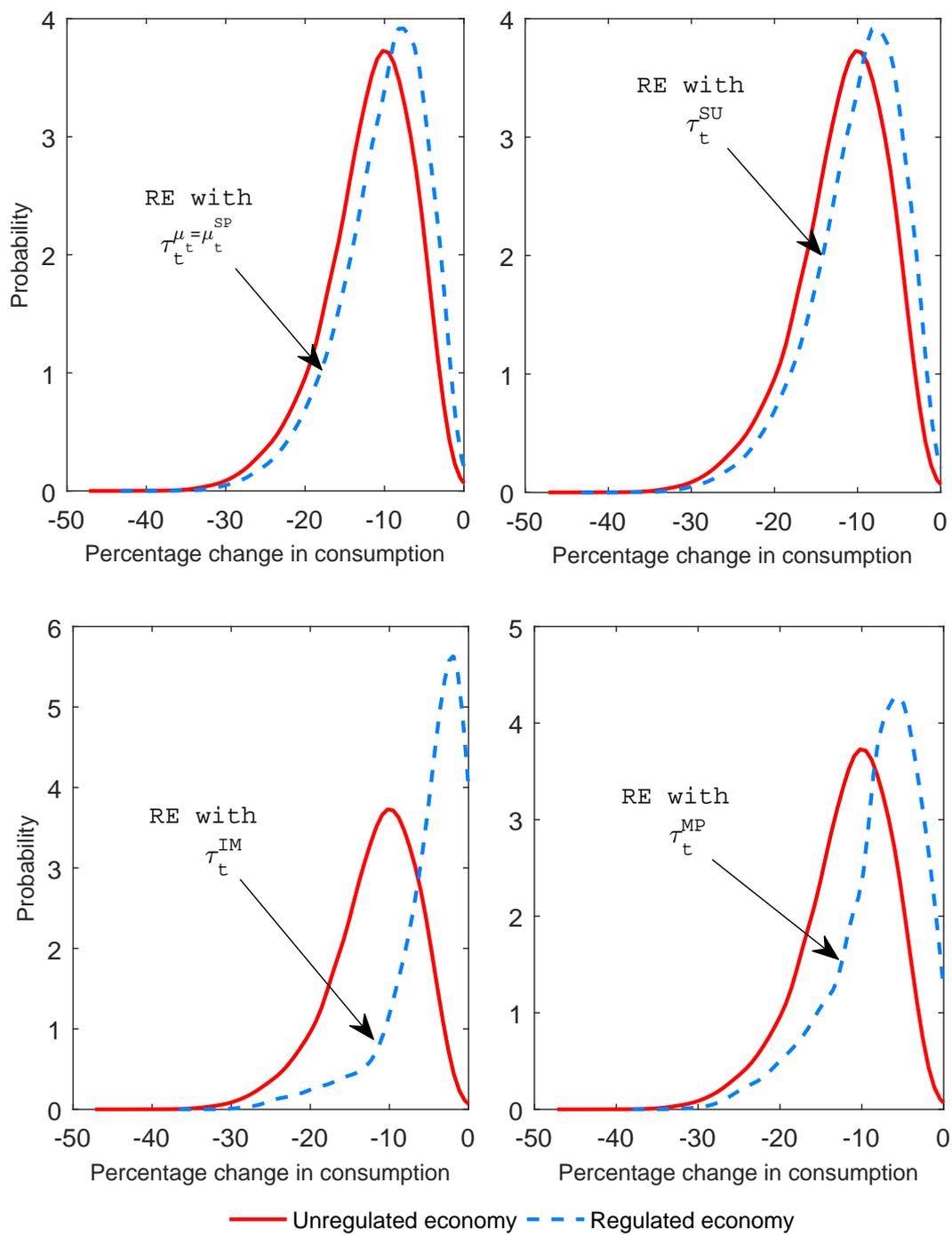


Figure B.3: The ergodic distribution consumption drops during crisis periods

Table B.4: The macroeconomic volatility

	The Unregulated economy	The Ramsey economy	The Regulated economy		
			With $\tau_t^{\mu_t=\mu_t^{SP}}$	With τ_t^{SU}	With τ_t^{MP}
Aggregate output	19.07	18.9	18.9	18.9	18.2
Aggregate consumption	6.2	6.1	6.1	6.1	5.8
Consumption of tradables	19.27	18.9	18.9	18.9	15.8
Relative price	23.12	22.8	22.8	22.8	21.6
Trade balance-to-GDP	3.92	3.5	3.5	3.5	3.0
					With τ_t^{IM}
					16.6
					5.1
					18.9
					19.1
					2.0

Table B.5: Aggregate output correlation with other variables ($corr(y_t, \cdot)$)

	The Unregulated economy	The Ramsey economy	The Regulated economy		
			With $\tau_t^{\mu_t=\mu_t^{SP}}$	With τ_t^{SU}	With τ_t^{MP}
Aggregate consumption	0.98	0.98	0.98	0.98	0.99
Consumption of tradables	0.99	0.99	0.99	0.99	0.99
Relative price	0.99	0.99	0.99	0.99	0.99
Trade balance-to-GDP	-0.75	-0.77	-0.77	-0.77	-0.78
					With τ_t^{IM}
					0.99
					0.99
					0.99
					-0.75

B.4.4 Boom-bust cycles under endowment and international interest rate shocks

To characterize the typical boom-bust cycle, we extract all windows containing a boom-bust cycle from the simulated data. This yields 13 non-overlapping boom-bust episodes every century equivalent to 89,794 windows. We take the average dynamics of an economy over all boom-bust episodes as the typical boom-bust cycle. As previously, we consider the median rather than the average for debt-tax rates $\tau_t^{\mu_t=\mu_t^{SP}}$, τ_t^{SU} as their distributions are negatively skewed.

Figure B.4 displays with solid line the cyclical behavior of the unregulated economy, with dashed lines the three regulated economies. The exogenous boom-bust cycle in traded and foreign interest rate produces endogenous boom-bust cycles in total output ($y_t = y_t^T + p_t y_t^N$), consumption, the relative price of nontradables, and the foreign debt holdings.

The counter-cyclical of traded output and foreign interest rate produces a pro-cyclical of households' financial conditions. Output expansion coincides with a low interest rate environment which helps households to rise their consumption by accumulating a large amount of foreign debt in such periods. However, the resulting trade balance remains positive. The optimal and macroprudential tax rates are increased during this period. τ_t^{IM} decreases when the interest rate raises.

During bust cycle, interest rate goes up gradually as output declines. As in the economy driven by endowment shocks, the constrained efficient allocation achieved by Ramsey planner is characterized by an economic contraction as much large as the contraction observed in the unregulated economy. Nevertheless, the cyclical dynamics in the regulated economy with τ_t^{MP} and τ_t^{IM} are characterized by a lower aggregate output contraction due to a relatively weak response of private and exchange rate responses to exogenous shocks. Figure B.4 highlights also the pro-cyclical of the optimal policy tax during the typical boom-bust cycle. By contrast, τ_t^{MP} and τ_t^{IM} are counter-cyclical, i.e. they are increased during goods times and lowered during bust cycle.

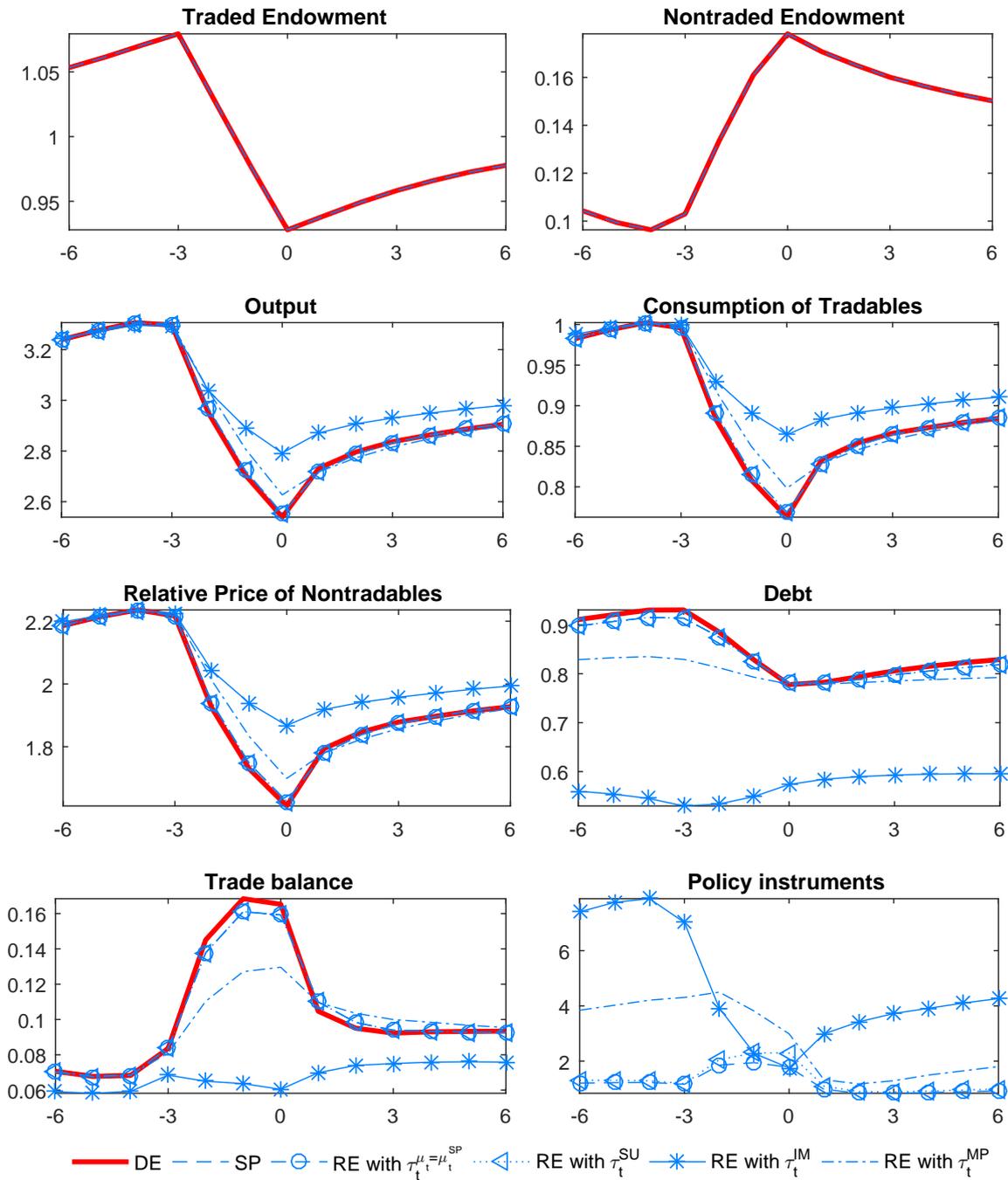


Figure B.4: The Typical Boom-Bust Cycle in the Endowment-Shock Economy

Table B.6: Cyclicalty of capital control policy instruments

	unconditional median	corr($y_{t,\cdot}$)
Regulated economy with $\tau_t^{\mu_t=\mu_t^{SP}}$	1.1%	0.1307 ^a and -0.0867 ^b
Regulated economy with τ_t^{SU}	1.2%	-0.0867
Regulated economy with τ_t^{MP}	3.1%	0.4804
Regulated economy with τ_t^{IM}	5.4%	0.9083

^aincluding all simulated data

^bexcluding crisis periods

B.4.5 Typical crisis under endowment and international interest rate shock

In order to investigate the economic dynamic during a typical crisis period, we extract all eleven-year windows centered around a period in which the collateral constraint binds. This yields 32,713 windows.

Figure B.5 displays with solid lines the dynamics of the unregulated economy during crisis period. The time of the crisis is normalized to period 0. During the crisis, traded endowment is 11.8% below its trend and the interest rate reaches 20.9 percent. In the unregulated economy, the decline of traded endowment and an the increase of foreign interest rate trigger a Fisherian debt deflation. The decline of the collateral value tightens financial conditions of households, whom respond by cutting back consumption of tradable. As a result, c_t^T declines by 34.5% leading to a large improvement in the trade balance of about 11.6% of tradable output. Second, the decline of c_t^T and y_t^T leads to a depreciation of the real exchange rate of about 34.5% and then a decline of aggregate output of about 29.3%. Consequently, the Fisherian debt-deflation aggravates the fall in the collateral value. As the economy is forced to deleverage, foreign debt fall by about 20.4%. Figure B.5 displays with broken lines the typical crisis in Ramsey and regulated economies. The implementation of the optimal capital taxes, $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{SP} , generates a similar output contraction as in the private economy. However, under τ_t^{MP} and τ_t^{IM} , the regulated economies display stable dynamic behavior during the typical crisis period. As households are enforced to accumulate a moderate debt levels, their borrowing abilities are unaffected by the fluctuations in traded endowment and the foreign interest rate. As a

result, households smooth their consumption by increasing their debt holding during the crisis by about 3% in the regulated economy under τ_t^{MP} and about 6.7% in the regulated economy under τ_t^{IM} .

The resulting crisis dynamics of policy instruments point out their pro-cyclicality except for $\tau_t^{\mu_t=\mu_t^{SP}}$ and τ_t^{IM} that display negative values during the typical crisis period.

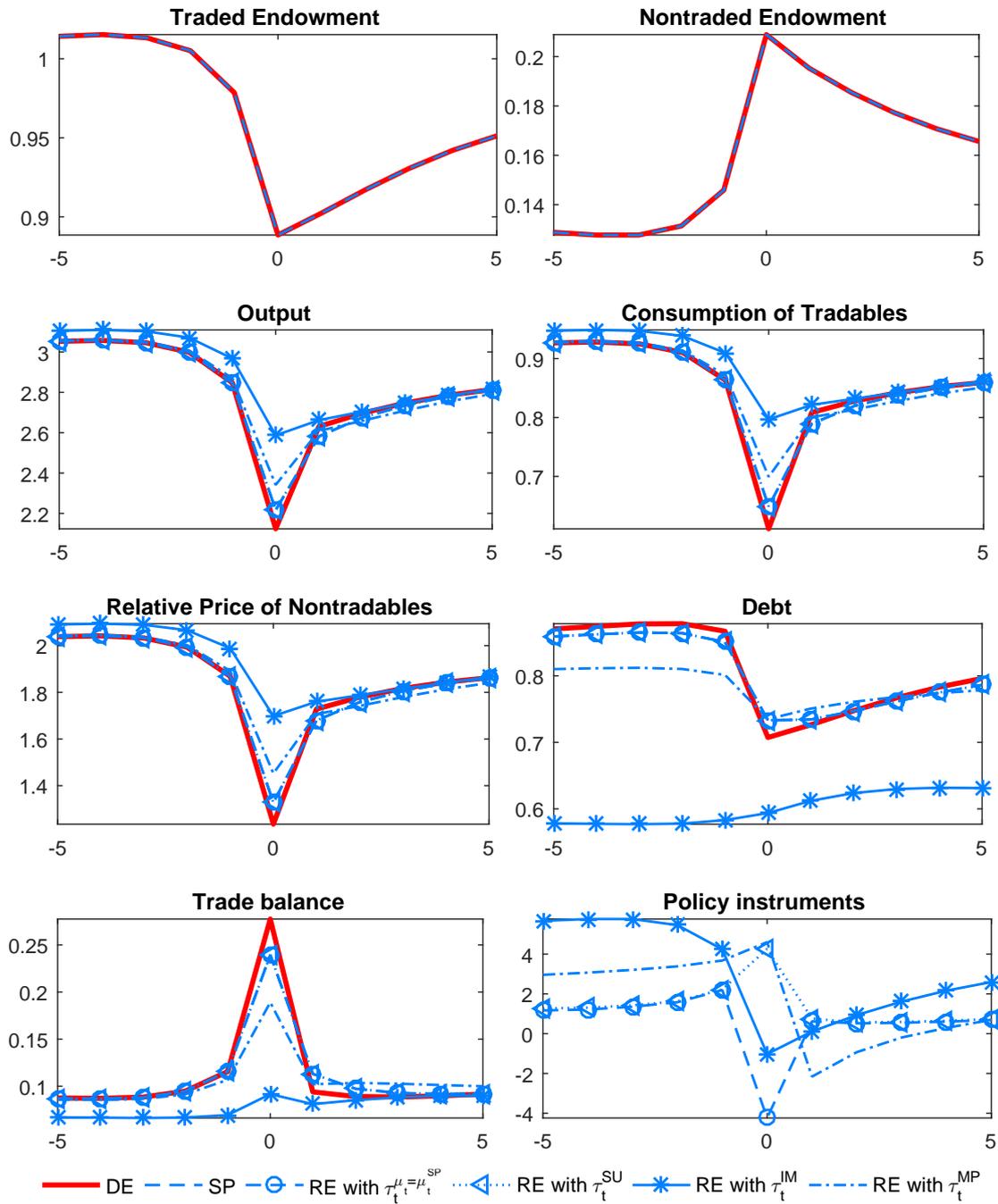


Figure B.5: The Typical crisis in the Endowment-Shock Economy

Appendix C

Model derivations and solutions of chapter 4

C.1 Households

The economy is populated by a continuum of identical households that consume, work and save. the representative household seeks to maximize the utility function given in equation (4.1) taking account of the budget constraint in equation (4.2). Hence, the maximization problem is described by the Lagrangian as follows:

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{H_t^{1+\phi}}{1-\phi} + \lambda_t [W_{h,t}H_t + R_{t-1}B_{h,t} + R_{t-1}^* S_t \psi_{t-1} B_{h,t} + \Pi_t + T_t - P_t C_t - B_{h,t+1} - S_t B_{h,t+1}^*] \right\} \quad (\text{C.1})$$

Optimality conditions or first order conditions are deduced from the derivatives of the Lagrangian with respect to C_t , H_t , $B_{h,t+1}$ and $B_{h,t+1}^*$.

$$\begin{aligned} \lambda_t &= \frac{C_t^{-\sigma}}{P_t} \\ \frac{W_{h,t}}{P_t} &= H_t^\phi C_t^\sigma \\ \beta R_t E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \right] &= 1 + \varphi_B (B_{h,t+1} - B_h) \\ \beta R_t^* E_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{S_{t+1}}{S_t} \right] &= 1 + \varphi_B^* (S_t B_{h,t}^* - S B_h^*) \end{aligned}$$

The optimal mix of domestic and imported consumption goods are given by the derivatives of the Lagrangian with respect to $C_{H,t}$ and $C_{M,t}$, by replacing $P_t C_t$ by $P_{H,t} C_{H,t} + P_{M,t} C_{M,t}$. The resulting optimal condition is:

$$\frac{C_{H,t}}{C_{M,t}} = \frac{\alpha}{1 - \alpha} \left(\frac{P_{H,t}}{P_{M,t}} \right)^{-\gamma}$$

C.2 Firms

C.2.1 Domestic production firms

Cost minimization

Production firms take as given the price of labour and capital to minimize their costs:

$$\max_{H_t(j), H_{e,t}(j), K_t(j)} W_{h,t} H_t(j) + W_{e,t} H_{e,t}(j) + R_t^k K_t(j)$$

Subject to:

$$Y_t(j) = A_t L_t(j)^{1-\alpha_p} K_t(j)^{\alpha_p}$$

The associated Lagrangian is:

$$\mathcal{L} = W_{h,t} H_t(j) + W_{e,t} H_{e,t}(j) + R_t^k K_t(j) + MC_t (Y_t(j) - A_t L_t(j)^{1-\alpha_p} K_t(j)^{\alpha_p})$$

First order conditions:

$$\begin{aligned} W_{h,t} &= (1 - \alpha_p) (1 - \Omega) MC_t \frac{Y_t(j)}{H_t(j)} \\ W_{e,t} &= (1 - \alpha_p) (1 - \Omega) MC_t \frac{Y_t(j)}{H_{e,t}(j)} \\ R_t^k &= \alpha_p MC_t \frac{Y_t(j)}{K_t(j)} \end{aligned}$$

C.2.2 Importing firms

Importing firms face nominal rigidities á la Calvo; each period there is a fixed fraction $1 - \theta_M$ of firms that can re-optimize its nominal price, i.e. $P_{M,t}^*(j)$. The price setting problem becomes:

$$\begin{aligned} \max_{\{P_{M,t}^*(j)\}_{t=0}^{\infty}} E_t \sum_{k=0}^{\infty} (\beta\theta_M)^k \frac{\lambda_{t+k}}{\lambda_t} \{P_{M,t}^*(j) - S_{t+k}P_t^*\} Y_{M,t+k}(j) \\ \text{s.t. } Y_{M,t+k}(j) = \left[\frac{P_{M,t}^*(j)}{P_{M,t+k}} \right]^{-\lambda} Y_{M,t+k} \end{aligned}$$

The equation for the optimal price is:

$$P_{M,t}^*(j) = \frac{\lambda}{\lambda - 1} \frac{E_t \sum_{k=0}^{\infty} (\beta\theta_M)^k \lambda_{t+k} P_{M,t+k}^\lambda S_{t+k} P_t^* Y_{i,t+k}}{E_t \sum_{k=0}^{\infty} (\beta\theta_M)^k \lambda_{t+k} P_{M,t+k}^\lambda Y_{M,t+k}}$$

Given:

$$P_{M,t}(j) = \left[\theta_M P_{M,t-1}^{1-\lambda}(j) + (1 - \theta_M) (P_{M,t}^*(j))^{1-\lambda} \right]^{\frac{1}{1-\lambda}}$$

Accordingly, imported inflation evolves according the following equation:

$$\hat{\pi}_{M,t} = \frac{(1 - \beta\theta_M)(1 - \theta_M)}{\theta_M} \left(\hat{s}_t + \hat{p}_t^* - \hat{p}_{M,t} \right) + \beta E_t (\hat{\pi}_{M,t+1})$$

With \hat{x}_t log-linearized version of x with $x = \{S_t, P_t^*, P_{M,t}\}$.

C.2.3 Unfinished capital goods producers

Unfinished capital producers combine investment I_t with rented capital K_t to produce unfinished capital goods K_{t+1} and sell them at price Q_t to entrepreneurs.

Profit maximization consists on:

$$\max_{I_t} \Pi_t = Q_t K_{t+1} - P_t I_t - \overline{Q}_t K_t$$

With:

$$K_{t+1} = \left(\frac{I_t}{K_t} - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 \right) K_t + (1 - \delta) K_t$$

The optimal choices of investment I_t and capital K_t are given by the first order condition of profit maximization which yields the following optimality conditions:

$$\begin{aligned} \frac{Q_t}{P_t} &= \left[1 - \psi \left(\frac{I_t}{K_t} - \delta \right) \right]^{-1} \\ \bar{Q}_t &= Q_t \left\{ \psi \left(\frac{I_t}{K_t} - \delta \right) - \frac{\psi}{2} \left(\frac{I_t}{K_t} - \delta \right)^2 + (1 - \delta) \right\} \end{aligned}$$

Capital producers choose the mix of imported and domestic investment by maximizing their profits:

$$\max_{I_{H,t}, I_{M,t}} \Pi_t = Q_t K_{t+1} - P_{H,t} I_{H,t} - P_{M,t} I_{M,t} - \bar{Q}_t K_t$$

The optimal mix of domestic and imported inputs evolves according to:

$$\frac{I_{H,t}}{I_{M,t}} = \frac{\alpha}{1 - \alpha} \left(\frac{P_{H,t}}{P_{M,t}} \right)^{-\gamma}$$

C.3 Entrepreneurs

Omitting the entrepreneurs' specific indices for notational simplicity, at period t , each entrepreneur buys K_{t+1} at price Q_t per unit of capital, that will be used in period $t + 1$. The entrepreneur has access to a stochastic technology in transforming $Q_t K_{t+1}$ to $w_{t+1} Q_t R_{t+1}^E K_{t+1}$, with $w_{t+1} R_{t+1}^E$ represents the gross return on capital. w_{t+1} is a random variable designing the idiosyncratic productivity of the entrepreneur. It is assumed to be i.i.d, across time and across firms, with a continuous and once-differentiable c.d.f., $F(w)$, over a non-negative support, and $E[w] = 1$. R_{t+1}^E denotes the expected gross return to holding a unit of capital from t to $t + 1$.

At the end of time t , each entrepreneur has a net worth of about $P_t N_{t+1}$ used as internal funds to purchase $Q_t K_{t+1}$. Due to the absence of self-financing, each entrepreneur borrows

an amount of D_{t+1}^E from financial intermediaries to fulfill the difference between his net worth and his expenditure, such that:

$$D_{t+1}^E = Q_t K_{t+1} - P_t N_{t+1}$$

As in [Bernanke et al. \[1999\]](#), we assume that entrepreneur and lender engage in a Costly State Verification (CSV) contract of the type first analyzed by [Townsend \[1979\]](#). Indeed, the idiosyncratic productivity w_{t+1} is private information for the entrepreneur implying that lender can not observe for free the entrepreneur's realized gross return. Thus, lender must pay a monitoring cost, μ , in default case interpretable as a bankruptcy cost. This cost is proportional to the project's ex-post gross payoff, i.e. $\mu w_{t+1} R_{t+1}^E Q_t K_{t+1}$. Thus, the entrepreneur and the lender negotiate a financial contract that determines a gross non-default loan rate denoted Z_t and a cutoff value ϖ_{t+1} , such that for values of w_{t+1} greater than or equal to ϖ_{t+1} , the entrepreneur is able to reimburse his debt. That is ϖ_{t+1} and Z_t are defined as:

$$\varpi_{t+1} R_{t+1}^E Q_t K_{t+1} = Z_t D_{t+1}^E \quad (\text{C.2})$$

If $w_{t+1} \geq \varpi_{t+1}$, the entrepreneur repays the lender the promised amount $Z_t D_{t+1}^E$ and keeps the difference, $w_{t+1} R_{t+1}^E Q_t K_{t+1} - Z_t D_{t+1}^E$. Otherwise, when $w_{t+1} < \varpi_{t+1}$, the entrepreneur fails to repay the contractual return and declares default. Then, the bank receives a net return of about $(1 - \mu) w_{t+1} R_{t+1}^E Q_t K_{t+1}$ while the defaulting entrepreneur receives nothing.

To determine ϖ_{t+1} and Z_t we follow [Bernanke et al. \[1999\]](#) by assuming the loan risk is perfectly diversifiable, then the optimal contract equates the expected return of the lender and the opportunity cost of his funds which is the riskless rate, R_t . Consequently, the loan contract must satisfy:

$$[1 - F(\varpi_{t+1})] Z_t D_{t+1}^E + (1 - \mu) \int_0^{\varpi_{t+1}} \varpi R_{t+1}^E Q_t K_{t+1} dF(\varpi) = R_t D_{t+1}^E$$

With $F(\varpi_{t+1}) = P_r(\varpi < \varpi_{t+1})$ is the probability of default. Using equation (C.2) to replace $Z_t D_{t+1}^E$, we can deduce the required expected return as follows:

$$\left\{ [1 - F(\varpi_{t+1})] \varpi_{t+1} + (1 - \mu) \int_0^{\varpi_{t+1}} \varpi dF(\varpi) \right\} R_{t+1}^E Q_t K_{t+1} = R_t [Q_t K_{t+1} - P_t N_{t+1}]$$

then:

$$[1 - F(\varpi_{t+1})] \varpi_{t+1} + (1 - \mu) \int_0^{\varpi_{t+1}} \varpi dF(\varpi) = \frac{R_t}{R_{t+1}^E} \left[1 - \frac{P_t N_{t+1}}{Q_t K_{t+1}} \right] \quad (\text{C.3})$$

As stressed by [Bernanke et al. \[1999\]](#), the derivative of the required return of the entrepreneur' project given in equation (C.3), which is $[1 - F(\varpi_{t+1})] - \mu \varpi_{t+1} dF(\varpi_{t+1})$, highlights two different effects of ϖ_{t+1} variations. A unit increase of ϖ_{t+1} increases both the non-default pay-off $[1 - F(\varpi_{t+1})]$, and the expected default costs $\mu \varpi_{t+1} dF(\varpi_{t+1})$. By imposing an assumption on hazard rate such that:

$$\frac{\partial (w h(w))}{\partial w} > 0$$

Where $h(w) = \frac{dF(w)}{1-F(w)}$. The required expected return is thus a concave function of ϖ_{t+1} that reaches a maximum at an unique interior value ϖ^* . The imposed regularity condition on hazard rate is relatively weak condition that is satisfied by most conventional distributions including the log-normal. Accordingly, for values of ϖ_{t+1} below the maximum, the function is increasing and concave. In addition to regulatory condition, we assume that $R_t < R_{t+1}^E$ to avoid a debt state that delivers unfeasible values of ϖ_{t+1} under which the required expected return is satisfied.

Optimal debt contract

The optimal contract maximizes the payoff to the entrepreneur subject to the lender earning the required return:

$$\text{Max}_{K_{t+1}, \varpi_{t+1}} \left(\int_{\varpi_{t+1}}^{\infty} w f(w) dw \right) R_{t+1}^E Q_t K_{t+1}$$

subject to (C.3) and denoting $f(w)$ as the p.d.f of w .

As in [Bernanke et al. \[1999\]](#), we define the following terms to simplify the maximization problem. $\Gamma(\varpi_{t+1})$ is the expected gross share of profits going to the lender evolving according to:

$$\Gamma(\varpi) = \int_0^{\varpi} w f(w) dw + \varpi \int_{\varpi}^{\infty} w f(w) dw$$

Likewise, $1 - \Gamma(\varpi)$ is the share going to the entrepreneur. $\mu G(\varpi_{t+1})$ is the expected monitoring cost defined as:

$$\mu G(\varpi_{t+1}) = \mu \int_0^{\varpi} w f(w) dw$$

Thus, the entrepreneur maximization problem becomes:

$$\text{Max}_{K_{t+1}, \varpi_{t+1}} (1 - \Gamma(\varpi_{t+1})) R_{t+1}^E Q_t K_{t+1}$$

Subject to:

$$[\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})] R_{t+1}^E Q_t K_{t+1} = R_t (Q_t K_{t+1} - P_t N_{t+1})$$

We define the premium on external financing as $s_t = \frac{R_{t+1}^E}{R_t}$ and $k_t = \frac{Q_t K_{t+1}}{P_t N_{t+1}}$ the capital/wealth ratio. We denote, λ_t the Lagrange multiplier associated to the entrepreneur's maximization system:

$$\text{max } L = (1 - \Gamma(\varpi_{t+1})) s_t k_t + \lambda_t [(\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})) s_t k_t - (k_t - 1)]$$

We thus deduce the optimality conditions of choosing s_t, k_t as follows:

$$\begin{aligned} \frac{\partial L}{\partial \varpi_{t+1}} : -\Gamma'(\varpi_{t+1}) s_t k_t + \lambda_t [\Gamma'(\varpi_{t+1}) - \mu G'(\varpi_{t+1})] s_t k_t &= 0 \\ \frac{\partial L}{\partial k_t} : (1 - \Gamma(\varpi_{t+1})) s_t + \lambda_t [\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})] s_t - \lambda_t &= 0 \\ \frac{\partial L}{\partial \lambda_t} : [\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})] s_t k_t - (k_t - 1) &= 0 \end{aligned}$$

According to the F.O.C with respect to ϖ_{t+1} , we can write the Lagrange multiplier as a function of ϖ_{t+1} :

$$\lambda_t(\varpi_{t+1}) = \frac{\Gamma'(\varpi_{t+1})}{\Gamma'(\varpi_{t+1}) - \mu G'(\varpi_{t+1})}$$

We then deduce the expression of the external finance premium $s_t(\varpi_{t+1})$ that evolves following:

$$s_t(\varpi_{t+1}) = \frac{\lambda_t(\varpi_{t+1})}{1 - \Gamma(\varpi_{t+1}) + \lambda_t(\varpi_{t+1}) [\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})]}$$

Accordingly, we can deduce ϖ_{t+1} by resolving the equation $s_t(\varpi_{t+1}) = \frac{R_{t+1}^E}{R_t}$. Then, given a cutoff ϖ_{t+1} the F.O.C implies a unique capital/wealth ratio (leverage ratio):

$$k_t(\varpi_{t+1}) = 1 + \frac{\lambda_t(\varpi_{t+1}) [\Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1})]}{1 - \Gamma(\varpi_{t+1})}$$

The log-normal distribution

We follow [Bernanke et al. \[1999\]](#) by assuming a log-normal distribution of the cutoff value ϖ_{t+1} , such that $\ln(w) \sim N(-\frac{1}{2}\sigma^2, \sigma^2)$. Accordingly, $E(w) = 1$ and

$$\begin{aligned} \Gamma(\varpi_{t+1}) &= \Phi(z - \sigma) + \varpi_{t+1} [1 - \Phi(z)] \\ \Gamma(\varpi_{t+1}) - \mu G(\varpi_{t+1}) &= (1 - \mu) \Phi(z - \sigma) + \varpi_{t+1} [1 - \Phi(z)] \end{aligned}$$

With $z \equiv \frac{(\ln(w) + 0.5\sigma^2)}{\sigma}$ and $\Phi(\cdot)$ is the c.d.f. of the standard normal. We deduce then, Γ' and G' :

$$\begin{aligned} \Gamma'(\varpi_{t+1}) &= [1 - \Phi(z)] \\ \Gamma'(\varpi_{t+1}) - \mu G'(\varpi_{t+1}) &= [1 - \Phi(z)] - \Phi'(z - \sigma) \frac{\mu}{\sigma \varpi_{t+1}} \end{aligned}$$

With Φ' is the standard normal p.d.f.

C.4 Capital inflows

The foreign bond Euler equations (analogous to the equations 4.5 and 4.6) imply that:

$$\varphi_1^* \left(\frac{B_{f,t+1}}{S_t} - \frac{B_f}{S} \right) - \varphi_2^* (B_{f,t+1}^* - B_f) = \beta^* E_t \left[\frac{\lambda_{t+1}^*}{\lambda_t^*} (1 - \tau_t) R_t \frac{S_t}{S_{t+1}} - R_t^* \right]$$

ceteris paribus, $B_{f,t+1}$ is given by:

$$\frac{B_{f,t+1}}{S_t} - \frac{B_f}{S} = \beta^* \left[(1 - \tau_t) R_t \frac{S_t}{S_{t+1}} - R_t^* \right] \quad (\text{C.4})$$

Bibliography

Gustavo Adler, Ruy Lama, and Juan Medina. Foreign exchange intervention under policy uncertainty. 2016.

Pierre-Richard Agénor, Koray Alper, and Luiz A Pereira da Silva. Sudden floods, macroprudential regulation and stability in an open economy. *Journal of International Money and Finance*, 48:68–100, 2014.

Philippe Aghion, Philippe Bacchetta, and Abhijit Banerjee. A corporate balance-sheet approach to currency crises. *Journal of Economic Theory*, 119(1):6–30, 2004.

Joshua Aizenman, Menzie D Chinn, and Hiro Ito. Assessing the emerging global financial architecture: Measuring the trilemma’s configurations over time. Technical report, National Bureau of Economic Research, 2008.

Ignazio Angeloni and Ester Faia. A tale of two policies: Prudential regulation and monetary policy with fragile banks. Technical report, Kiel working paper, 2009.

Susanto Basu and John G Fernald. Returns to scale in us production: Estimates and implications. *Journal of political economy*, 105(2):249–283, 1997.

Francis M Bator. The anatomy of market failure. *The quarterly journal of economics*, 72(3):351–379, 1958.

Ben S Bernanke and Frederic S Mishkin. Inflation targeting: a new framework for monetary policy? *Journal of Economic perspectives*, 11(2):97–116, 1997.

- Ben S Bernanke, Mark Gertler, and Simon Gilchrist. The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics*, 1:1341–1393, 1999.
- Javier Bianchi. Overborrowing and systemic externalities in the business cycle. *American Economic Review*, 101(7):3400–3426, 2011.
- Javier Bianchi and Enrique G Mendoza. Optimal time-consistent macroprudential policy. *Journal of Political Economy*, 126(2):588–634, 2018.
- Olivier Blanchard and Jordi Gali. Real wage rigidities and the new keynesian model. Technical report, National Bureau of Economic Research, 2005.
- Olivier Blanchard, Giovanni Dell Ariccia, and Paolo Mauro. Rethinking macroeconomic policy. *Revista de Economía Institucional*, 12(22):61–82, 2010.
- Olivier Blanchard, Jonathan D Ostry, Atish R Ghosh, and Marcos Chamon. Are capital inflows expansionary or contractionary? theory, policy implications, and some evidence. *IMF Economic Review*, 65(3):563–585, 2017.
- Olivier J Blanchard, Mr Giovanni Dell’Ariccia, and Mr Paolo Mauro. *Rethinking macro policy II: getting granular*. International Monetary Fund, 2013.
- Claudio Borio. Towards a macroprudential framework for financial supervision and regulation? *CESifo Economic Studies*, 49(2):181–215, 2003.
- Claudio Borio. Implementing a macroprudential framework: Blending boldness and realism. *Capitalism and Society*, 6(1), 2011.
- Guillermo A Calvo. Staggered prices in a utility-maximizing framework. *Journal of monetary Economics*, 12(3):383–398, 1983.
- Guillermo A Calvo. Capital flows and capital-market crises: the simple economics of sudden stops. *Journal of applied Economics*, 1(1):35–54, 1998.

- Guillermo A Calvo, Leonardo Leiderman, and Carmen M Reinhart. The capital inflows problem: Concepts and issues. *Contemporary Economic Policy*, 12(3):54–66, 1994.
- Guillermo A Calvo, Leonardo Leiderman, and Carmen M Reinhart. Inflows of capital to developing countries in the 1990s. *Journal of economic perspectives*, 10(2):123–139, 1996.
- Guillermo A Calvo, Alejandro Izquierdo, and Ernesto Talvi. Sudden stops, the real exchange rate, and fiscal sustainability: Argentina’s lessons. Technical report, National Bureau of Economic Research, 2003.
- Guillermo A Calvo, Alejandro Izquierdo, and Luis-Fernando Mejia. On the empirics of sudden stops: the relevance of balance-sheet effects. Technical report, National Bureau of Economic Research, 2004.
- Guillermo A Calvo, Alejandro Izquierdo, and Luis-Fernando Mejía. Systemic sudden stops: the relevance of balance-sheet effects and financial integration. Technical report, National Bureau of Economic Research, 2008.
- Eduardo A Cavallo and Jeffrey A Frankel. Does openness to trade make countries more vulnerable to sudden stops, or less? using gravity to establish causality. *Journal of International Money and Finance*, 27(8):1430–1452, 2008.
- R. Chang and A. Velasco. Liquidity crises in emerging markets: Theory and policy. *National Bureau of Economic Research*, 1999.
- Roberto Chang and Andrés Velasco. Economic policy incentives to preserve lives and livelihoods. Technical report, National Bureau of Economic Research, 2020.
- Varadarajan V Chari, Patrick J Kehoe, and Ellen R McGrattan. Sticky price models of the business cycle: can the contract multiplier solve the persistence problem? *Econometrica*, 68(5):1151–1179, 2000.
- Menzie D Chinn and Hiro Ito. A new measure of financial openness. *Journal of comparative policy analysis*, 10(3):309–322, 2008.

- Piet Clement. The term 'macroprudential': origins and evolution. 2010.
- Mr Fabio Comelli. *Estimation and out-of-sample prediction of sudden stops: Do regions of emerging markets behave differently from each other?* Number 15-138. International Monetary Fund, 2015.
- Vítor Constâncio. Margins and haircuts as a macroprudential tool. In *Remarks by Vítor Constâncio, Vice-President of the ECB, at the ESRB international conference on the macroprudential use of margins and haircuts, Frankfurt on Main*, 2016a.
- Vítor Constâncio. The role of stress testing in supervision and macroprudential policy. *Stress Testing and Macroprudential Regulation*, page 51, 2016b.
- G. Corsetti, P. Pesenti, and N. Roubini. What caused the asian currency and financial crisis? part i: A macroeconomic overview. *National Bureau of Economic Research*, (6833), 1998.
- Andrew Crockett. Marrying the micro-and macro-prudential dimensions of financial stability. *BIS speeches*, 21, 2000.
- Michael B Devereux, Philip R Lane, and Juanyi Xu. Exchange rates and monetary policy in emerging market economies. *The Economic Journal*, 116(511):478–506, 2006.
- Ian Dobbs. Externality, efficiency and the pareto principle. *International Review of Law and Economics*, 1(2):167–181, 1981.
- William Easterly, Roumeen Islam, and Joseph E Stiglitz. Volatility and macroeconomic paradigms for rich and poor. In *Advances in Macroeconomic Theory*, pages 352–372. Springer, 2001.
- Sebastian Edwards. Financial openness, sudden stops, and current-account reversals. *American Economic Review*, 94(2):59–64, 2004.
- Selim Elekdag̃ and Ivan Tchakarov. Balance sheets, exchange rate policy, and welfare. *Journal of economic dynamics and control*, 31(12):3986–4015, 2007.

- Ester Faia and Tommaso Monacelli. Optimal interest rate rules, asset prices, and credit frictions. *Journal of Economic Dynamics and control*, 31(10):3228–3254, 2007.
- Emmanuel Farhi and Ivan Werning. Dealing with the trilemma: Optimal capital controls with fixed exchange rates. Technical report, National Bureau of Economic Research, 2012.
- Emmanuel Farhi and Ivan Werning. Dilemma not trilemma? capital controls and exchange rates with volatile capital flows. *IMF Economic Review*, 62(4):569–605, 2014.
- Emmanuel Farhi and Iván Werning. A theory of macroprudential policies in the presence of nominal rigidities. *Econometrica*, 84(5):1645–1704, 2016.
- Gian Maria Milesi Ferretti and Assaf Razin. Current account reversals and currency crises: empirical regularities. In *Currency crises*, pages 285–323. University of Chicago Press, 2000.
- Stanley Fischer. The asian crisis: A view from the imf. *Washington DC*, 22, 1998.
- Irving Fisher. The debt-deflation theory of great depressions. *Econometrica: Journal of the Econometric Society*, pages 337–357, 1933.
- R.P. Flood and P.M. Garber. Collapsing exchange-rate regimes: some linear examples. *Journal of international Economics*, 17(1-2):1–13, 1984.
- I FM. Financial sector assessment program (fsap)-lessons from the pi/ot and issues going forward, 2000.
- David Fokke Ihno Folkerts-Landau and Carl-Johan Lindgren. *Toward a framework for financial stability*. International Monetary Fund, 1998.
- Bank for International Settlements. *Recent innovations in international banking*. Bank for International Settlements, 1986.
- Kristin J Forbes and Francis E Warnock. Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of international economics*, 88(2):235–251, 2012.

Justin Fox and Alan Sklar. *The myth of the rational market: A history of risk, reward, and delusion on Wall Street*. Harper Business New York, 2009.

International Monetary Fund, Bank for International Settlements, and the Secretariat of the Financial Stability Board. Guidance to assess the systemic importance of financial institutions. Technical report, International Monetary Fund, Bank for International Settlements, and Financial Stability Board, 2009.

International Monetary Fund, Bank for International Settlements, and the Secretariat of the Financial Stability Board. Elements of effective macroprudential policies. Technical report, International Monetary Fund, Bank for International Settlements, and Financial Stability Board, 2016.

Peter Gabriel and Adam Reiff. Price setting in hungary-a store-level analysis. *Managerial and Decision Economics*, 31(2-3):161–176, 2010.

Jordi Gali and Tommaso Monacelli. Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734, 2005.

Mark Gertler, Simon Gilchrist, and Fabio M Natalucci. External constraints on monetary policy and the financial accelerator. *Journal of Money, Credit and Banking*, 39(2-3):295–330, 2007.

Atish R Ghosh, Jonathan D Ostry, and Mahvash S Qureshi. When do capital inflow surges end in tears? *American Economic Review*, 106(5):581–85, 2016.

Marvin Goodfriend and Robert G King. The new neoclassical synthesis and the role of monetary policy. *NBER macroeconomics annual*, 12:231–283, 1997.

Solange Gouvea et al. Price rigidity in brazil: Evidence from cpi micro data. *Central Bank of Brazil Working Paper*, 143, 2007.

Bruce C Greenwald and Joseph E Stiglitz. Externalities in economies with imperfect information and incomplete markets. *The quarterly journal of economics*, 101(2):229–264, 1986.

- Luca Guerrieri and Matteo Iacoviello. Occbin: A toolkit for solving dynamic models with occasionally binding constraints easily. *Journal of Monetary Economics*, 70:22–38, 2015.
- Martin Guzman, Jose Antonio Ocampo, and Joseph E Stiglitz. Real exchange rate policies for economic development. *World Development*, 110:51–62, 2018.
- Gyorgy Gyomai and Marc Wildi. Oecd composite leading indicators for g7 countries. 2012.
- Boris Hofmann and Bilyana Bogdanova. Taylor rules and monetary policy: a global ‘great deviation’? *BIS quarterly review September*, 2012.
- IMF. Key aspects of macroprudential policy-background paper, 2013.
- XIII IMF. The liberalization and management of capital flows: An institutional view. *Washington DC. IMF*, 14, 2012.
- Olivier Jeanne and Anton Korinek. Managing credit booms and busts: A pigouvian taxation approach. Technical report, National Bureau of Economic Research, 2010a.
- Olivier Jeanne and Anton Korinek. Excessive volatility in capital flows: A pigouvian taxation approach. *American Economic Review*, 100(2):403–07, 2010b.
- Callum J Jones, Thomas Philippon, and Venky Venkateswaran. Optimal mitigation policies in a pandemic: Social distancing and working from home. Technical report, National Bureau of Economic Research, 2020.
- Michel Juillard et al. *Dynare: A program for the resolution and simulation of dynamic models with forward variables through the use of a relaxation algorithm*, volume 9602. CEPREMAP Paris, 1996.
- Prakash Kannan, Pau Rabanal, and Alasdair M Scott. Monetary and macroprudential policy rules in a model with house price booms. *The BE Journal of Macroeconomics*, 12(1), 2012.

- Michael Keane and Richard Rogerson. Micro and macro labor supply elasticities: A reassessment of conventional wisdom. *Journal of Economic Literature*, 50(2):464–76, 2012.
- Shigeto Kitano and Kenya Takaku. Capital controls and financial frictions in a small open economy. *Open Economies Review*, 28(4):761–793, 2017.
- Nobuhiro Kiyotaki and John Moore. Credit cycles. *Journal of political economy*, 105(2): 211–248, 1997.
- Anton Korinek. Excessive dollar borrowing in emerging markets: Balance sheet effects and macroeconomic externalities. 2010.
- Anton Korinek. The new economics of prudential capital controls: A research agenda. *IMF Economic Review*, 59(3):523–561, 2011.
- Anton Korinek. Regulating capital flows to emerging markets: An externality view. *Journal of International Economics*, 111:61–80, 2018.
- Anton Korinek and Enrique G Mendoza. *From sudden stops to fisherian deflation: Quantitative theory and policy*. Annual Reviews, 2014.
- Anton Korinek and Damiano Sandri. Capital controls or macroprudential regulation? *Journal of International Economics*, 99:S27–S42, 2016.
- Anton Korinek and Alp Simsek. Liquidity trap and excessive leverage. *American Economic Review*, 106(3):699–738, 2016.
- P. Krugman. *In International finance and financial crises*. Springer, Dordrecht, 1999.
- Paul Krugman. A model of balance-of-payments crises. *Journal of money, credit and banking*, 11(3):311–325, 1979.
- Paul Krugman. Crises: the next generation. In *Conference Honoring Assaf Razin, Tel Aviv*, 2001.
- Paul Krugman. How did economists get it so wrong? *New York Times*, 2(9):2009, 2009.

- Jean-Jacques Laffont. Note historique sur les effets externes. *L'Actualité économique*, 51 (3):420–433, 1975.
- Zheng Liu and Mark M Spiegel. Optimal monetary policy and capital account restrictions in a small open economy. *IMF Economic Review*, 63(2):298–324, 2015.
- Robert E Lucas. Macroeconomic priorities. *American economic review*, 93(1):1–14, 2003.
- B Malkiel. Efficient market hypothesis, w: P newman, m. milgate i j. eatwell (red.) the new palgrave dictionary of money and finance, 1992.
- Burton G Malkiel and Eugene F Fama. Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, 25(2):383–417, 1970.
- Ronald I McKinnon and Huw Pill. Credible liberalizations and international capital flows: The " overborrowing syndrome". In *Financial Deregulation and Integration in East Asia, NBER-EASE Volume 5*, pages 7–50. University of Chicago Press, 1996.
- Juan Pablo Medina, David Rappoport, Claudio Soto, et al. Dynamics of price adjustments: Evidence from micro level data for chile. *Central Bank of Chile Working Paper*, 432, 2007.
- Enrique G Mendoza. Credit, prices, and crashes: Business cycles with a sudden stop. In *Preventing currency crises in Emerging markets*, pages 335–392. University of Chicago Press, 2002.
- Enrique G Mendoza. Lessons from the debt-deflation theory of sudden stops. *American Economic Review*, 96(2):411–416, 2006.
- Enrique G Mendoza. Sudden stops, financial crises, and leverage. *American Economic Review*, 100(5):1941–66, 2010.
- Enrique G Mendoza. Macroprudential policy: Promise and challenges. Technical report, National Bureau of Economic Research, 2016.
- Hyman P Minsky. The financial instability hypothesis. 1992.

- Frederic S Mishkin. Monetary policy strategy: lessons from the crisis. Technical report, National Bureau of Economic Research, 2011.
- Srobona Mitra, Jaromír Beneš, Silvia Iorgova, Kasper Lund-Jensen, Christian Schmieder, and Tiago Severo. Toward operationalizing macroprudential policies: When to act. *Grappling with Crisis Legacies, Global Financial Stability Report*, pages 103–149, 2011.
- M. Obstfeld. The logic of currency crises. *National Bureau of Economic Research*, (4640), 1994.
- Maurice Obstfeld. The global capital market: benefactor or menace? *Journal of economic perspectives*, 12(4):9–30, 1998.
- Vilfredo Pareto. *Cours d'économie politique*, volume 1. Librairie Droz 1964, 1896.
- Arthur Cecil Pigou. The economics of welfare. Technical report, 1932.
- Alessandro Rebucci and Chang Ma. Capital controls: A survey of the new literature. Technical report, National Bureau of Economic Research, 2019.
- Hélène Rey. Dilemma not trilemma: the global financial cycle and monetary policy independence. Technical report, National Bureau of Economic Research, 2015.
- Hélène Rey. International channels of transmission of monetary policy and the mundellian trilemma. *IMF Economic Review*, 64(1):6–35, 2016.
- Dani Rodrik et al. Who needs capital-account convertibility? *Essays in international finance*, pages 55–65, 1998.
- Julio J Rotemberg. Sticky prices in the united states. *Journal of Political Economy*, 90(6):1187–1211, 1982.
- Julio J Rotemberg and Michael Woodford. An optimization-based econometric framework for the evaluation of monetary policy: Expanded version, 1998.
- Victoria Saporta. The role of macroprudential policy. *Bank of England Discussion Paper*, 2009.

- Stephanie Schmitt-Grohé and Martín Uribe. Closing small open economy models. *Journal of international Economics*, 61(1):163–185, 2003.
- Stephanie Schmitt-Grohé and Martín Uribe. Optimal simple and implementable monetary and fiscal rules. *Journal of monetary Economics*, 54(6):1702–1725, 2007.
- Stephanie Schmitt-Grohé and Martín Uribe. Multiple equilibria in open economy models with collateral constraints: Overborrowing revisited. Technical report, National Bureau of Economic Research, 2016a.
- Stephanie Schmitt-Grohé and Martín Uribe. Downward nominal wage rigidity, currency pegs, and involuntary unemployment. *Journal of Political Economy*, 124(5):1466–1514, 2016b.
- Stephanie Schmitt-Grohé and Martín Uribe. Is optimal capital control policy countercyclical in open economy models with collateral constraints? *IMF Economic Review*, 65(3):498–527, 2017.
- Alasdair Scott, Pau Rabanal, and Prakash Kannan. *Monetary and macroprudential policy rules in a model with house price booms*. Number 9-251. International Monetary Fund, 2009.
- Martin Sewell. History of the efficient market hypothesis. *RN*, 11(04):04, 2011.
- Joseph E Stiglitz. Capital market liberalization, economic growth, and instability. *World development*, 28(6):1075–1086, 2000.
- Lawrence H Summers. International financial crises: causes, prevention, and cures. *American Economic Review*, 90(2):1–16, 2000.
- John B Taylor. Discretion versus policy rules in practice. In *Carnegie-Rochester conference series on public policy*, volume 39, pages 195–214. Elsevier, 1993.
- Robert M Townsend. Optimal contracts and competitive markets with costly state verification. *Journal of Economic theory*, 21(2):265–293, 1979.

D Filiz Unsal. *Capital flows and financial stability: monetary policy and macroprudential responses*. Number 11-189. International Monetary Fund, 2011.

Jacob Viner. Cost curves and supply curves. *Zeitschrift für nationalökonomie*, 3(1): 23–46, 1932.

Charles J Whalen. The us credit crunch of 2007: A minsky moment. Technical report, Public policy brief//Jerome Levy Economics Institute of Bard College, 2007.

List of Figures

1.1	NCF in emerging and developed countries (in billions of dollars,excluding China)	18
1.2	Composition of the NCF by group of countries across decades (*excluding China)	19
1.3	Correlation between NCF towards emerging and developed countries (excluding China)	20
1.4	Time-varying vs. fixed filter in NCF: Argentina	23
1.5	Time-varying vs. fixed filter in NCF: United Kingdom	24
1.6	Number of potential (PSS) and observed Sudden Stops (SS)	25
1.7	Number of SS by decades and group of countries	26
1.8	Number of PSS by decades and group of countries	27
1.9	Macroeconomic dynamic during a typical sudden stop episode	37
1.10	Asset price dynamics during a typical sudden stop episode	38
1.11	Financial conditions during a typical sudden stop episode	39
2.1	Feedback loop of the endogenous borrowing constraint	49
2.2	Bond decision rules (the average over all economic state of nature)	66
2.3	The ergodic distribution of foreign debt holdings	67
2.4	The ergodic distribution consumption drops during crisis periods	68
2.5	The Typical Boom-Bust Cycle in the Endowment-Shock Economy	74
2.6	The Typical crisis in the Endowment-Shock Economy	75
3.1	The structure of the economy	81

3.2	Aggregate productivity shock sequence	102
3.3	Foreign interest rate shock sequence	103
3.4	Aggregate productivity shock sequence	104
3.5	Foreign interest rate shock sequence	105
3.6	Aggregate productivity shock sequence	106
3.7	Foreign interest rate shock sequence	107
3.8	Aggregate productivity shock sequence	108
3.9	Foreign interest rate shock sequence	109
4.1	The structure of the economy	114
4.2	Macroeconomic dynamics under a positive domestic productivity shock .	134
4.3	Macroeconomic dynamics under a positive foreign interest rate shock . .	135
4.4	Macroeconomic dynamics under a negative exogenous shock in capital inflows	136
B.1	Bond decision rules (the average over all economic state of nature)	168
B.2	The ergodic distribution of foreign debt holdings	169
B.3	The ergodic distribution consumption drops during crisis periods	171
B.4	The Typical Boom-Bust Cycle in the Endowment-Shock Economy	174
B.5	The Typical crisis in the Endowment-Shock Economy	177

List of Tables

1	The macro- and microprudential perspectives compared Borio [2003]	3
1.1	NCF reversals and SSs: episodes and duration	25
1.2	Sudden Stop duration and severity	28
1.3	Panel logit regressions: baseline pre and post 1997Q2	33
1.4	Panel logit regressions: Developed economies	40
1.5	Panel logit regressions: Emerging market economies	41
2.1	Policies to correct the pecuniary externality of the endogenous collateral constraint	57
2.2	Calibration of the Economy	60
2.3	Debt-to-output ratios, Frequency of Crises and Welfare	63
2.4	The Severity of Financial Crises	65
2.5	The macroeconomic volatility	69
2.6	The aggregate output correlation with other variables ($corr(y_t, \cdot)$)	69
2.7	Cyclicalilty of capital control policy instruments	71
3.1	Parameters' calibration	91
3.2	Variance decomposition in percent of total variance	94
3.3	Optimal parameters' of policy rules	96
3.4	Macroeconomic volatility under aggregate productivity shocks (Standard deviation in %)	98
3.5	Macroeconomic volatility under foreign interest rate shocks (Standard de- viation in %)	98

3.6	Sensitivity Analysis: optimal parameters' values for policy rules	99
3.7	Sensitivity Analysis: The macroeconomic volatility under foreign interest rate shocks	100
3.8	Sensitivity Analysis: The macroeconomic volatility under productivity shocks	100
4.1	Parameters' calibration	130
4.2	Optimized parameters of the policy rules	131
4.3	Welfare gain results, in Percent of Steady-State Consumption	132
4.4	The macroeconomic volatility (Approximated theoretical standard devia- tion, in percent)	137
A.1	Countries included in the event analysis	143
A.2	Sudden stop episodes	144
A.3	Data definition and source	149
A.4	Sensitivity analysis: Baseline	154
A.5	Sensitivity analysis: Developed economies	155
A.6	Sensitivity analysis: Emerging economies	156
A.7	Clog-log regression: Baseline	157
A.8	Clog-log regression: Developed economies	158
A.9	Clog-log regression: Emerging economies	159
B.1	Calibration of an economy driven by traded endowment and foreign interest rate shocks	166
B.2	Debt-to-output ratios, Frequency of Crises and Welfare	170
B.3	Severity of Financial Crises	170
B.4	The macroeconomic volatility	172
B.5	Aggregate output correlation with other variables ($corr(y_t, \cdot)$)	172
B.6	Cyclicality of capital control policy instruments	175

Résumé

La pandémie actuelle de Covid-19 soulève de sérieuses inquiétudes quant à l'avenir de la mondialisation et la capacité des pays à éviter, à titre individuel, une profonde récession et, collectivement, une nouvelle crise financière mondiale. Depuis son apparition, un nombre croissant de travaux de recherche examinent les réponses optimales en matière de politiques économiques qui permettront aux autorités publiques de gérer et sortir de la crise (voir par exemple [Chang and Velasco \[2020\]](#), [Jones et al. \[2020\]](#)).

Toutefois, le débat actuel sur l'architecture économique et financière internationale et ses conséquences sur la conduite et l'autonomie des politiques nationales, est loin d'être sans précédent. En effet, l'économie mondiale a été fréquemment frappée par des crises économiques et financières remettant à chaque fois en question l'efficacité des politiques de libéralisation tout en conduisant, néanmoins, à une meilleure compréhension de la dynamique des crises et des réponses adéquates des politiques publiques.

Plus récemment, la crise financière mondiale qui a débuté en 2007 a remis en question deux principes fondamentaux largement admis avant la crise, **(i)** l'hypothèse de l'efficacité des marchés financiers¹ n'a pas conduit à une autorégulation des marchés financiers mettant fin aux politiques de laissez-faire ([Minsky \[1992\]](#), [Whalen \[2007\]](#), [Krugman \[2009\]](#), [Fox and Sklar \[2009\]](#)), **(ii)** l'intégration financière internationale et la libéralisation complète du compte capital n'améliorent pas nécessairement la croissance économique et le bien-être social ([Calvo et al. \[1994\]](#), [Stiglitz \[2000\]](#), [Korinek \[2018\]](#)).

¹L'hypothèse de l'efficacité du marché stipule que les marchés financiers sont efficaces. Un marché efficace est un marché dans lequel les prix "reflètent toujours pleinement" l'ensemble des informations disponibles ([Malkiel and Fama \[1970\]](#)), autrement dit le prix n'est pas affecté par la révélation de l'ensemble des informations à tous les participants du marché ([Malkiel \[1992\]](#))

Leaning against the wind : Le rôle prometteur des politiques macroprudentielles

Le premier constat (i) a relancé le débat "lean" vs. "clean" ² remettant en cause principalement les stratégies politiques utilisées avant la crise pour gérer l'économie, en particulier la conduite de la politique monétaire et le rôle des banques centrales dans le maintien de la stabilité financière. En effet, un consensus a émergé avant la crise dans les sphères publique et académique, considérant le ciblage flexible de l'inflation³ comme un cadre efficace de politique monétaire. Il permet aux banques centrales d'atteindre leur objectif de stabilité macroéconomique à travers la stabilisation de l'inflation à moyen terme et la production à court terme autour de leurs niveaux d'équilibre, sans qu'il y ait un arbitrage entre la stabilisation de l'inflation et celle de la production (Bernanke and Mishkin [1997], Bernanke et al. [1999], Blanchard and Gali [2005], Blanchard et al. [2013]). Cette orientation politique s'est implicitement basée sur l'hypothèse d'une dichotomie entre stabilité macroéconomique et stabilité financière, et a donc sous-estimé le rôle du secteur financier comme l'un des principaux déterminants du cycle économique (Mishkin [2011]). Par conséquent, les politiques financières avant la crise agissaient dans deux champs d'action distincts :

- politique monétaire axée sur la stabilité des prix,
- dispositifs de surveillance réglementaire prudentielle focalisant sur la stabilité des institutions individuelles plutôt que sur le système financier dans son ensemble (Blanchard et al. [2010], Borio [2011]).

²Devrait-on intervenir avant ou après l'éclatement de la bulle?

³La justification du cadre flexible de ciblage de l'inflation a été fournie par huit principes de base dérivés de la science de la politique monétaire (Goodfriend and King [1997]) ; 1) l'inflation est toujours et partout un phénomène monétaire ; 2) la stabilité des prix présente des avantages importants ; 3) il n'y a pas de compromis à long terme entre le chômage et l'inflation ; 4) les attentes jouent un rôle crucial dans la détermination de l'inflation et dans la transmission de la politique monétaire à la macroéconomie ; 5) les taux d'intérêt réels doivent augmenter avec une inflation plus élevée (le principe de Taylor) ; 6) la politique monétaire est sujette au problème de l'incohérence temporelle ; 7) l'indépendance de la banque centrale contribue à améliorer l'efficacité de la politique monétaire ; 8) l'engagement en faveur d'un ancrage nominal fort est essentiel pour produire de bons résultats en matière de politique monétaire ; Mishkin [2011] a ajouté le neuvième principe relatif aux frictions financières et aux cycles économiques ; 9) les frictions financières jouent un rôle important dans le cycle économique.

Ainsi et au lendemain de l'éclatement de la bulle immobilière américaine, les autorités monétaires ont été appelées à intensifier leurs interventions et à renforcer leurs cadres de réglementation et de surveillance en ajoutant une dimension macroprudentielle fortement axée sur la surveillance du risque systémique⁴. Depuis, les politiques macroprudentielles sont devenues des politiques purement dédiées à la surveillance du risque systémique et à la stabilité financière. Elles sont indépendantes des autres politiques contracycliques, fiscale et monétaire, et elles ont des objectifs et des outils bien spécifiques (Constâncio [2016]).

Dans un document de référence, Borio [2003] a délimité les périmètres des politiques macro et microprudentielles en définissant les objectifs et les caractéristiques de chaque type de politiques:

- les politiques macroprudentielles doivent avoir comme objectif d'éviter les pertes importantes de production réelle résultant d'une crise financière. Plus particulièrement, ces politiques portent sur la surveillance du stress financier sur le marché, tenant compte à la fois du comportement agrégé des institutions financières et de la structure du système financier (interconnexion entre les institutions financières)
- l'objectif de la politique microprudentielle reste la protection des consommateurs en assurant la sécurité et la solidité des institutions individuelles.

L'approche descendante des politiques macroprudentielles, contrairement à l'approche ascendante des politiques microprudentielles, consiste à établir des stress-tests macroéconomiques afin d'examiner la stabilité des institutions financières plutôt que des institutions individuelles en réponse à un choc (voir Tableau.1).

⁴Fund et al. [2016] définissent le risque systémique comme " le risque d'une perturbation généralisée de la fourniture de services financiers qui est causé par une déficience de tout ou d'une partie du système financier et qui peut entraîner des conséquences négatives graves pour l'économie réelle"

Table 1: Comparaison entre politiques macro- et microprudentielles

	Macroprudentielles	Microprudentielles
Objectif Approximatif	Limiter le stress financier sur le marché	Limiter le stress financier des institutions financières individuelles
Objectif ultime	Éviter les coûts de perte de production (PIB)	Protection des consommateurs (investisseurs/dépôtaires)
Modèle de risque	Endogène (en partie)	Exogène
Corrélations et expositions communes à toutes les institutions	Important	Non pertinent
Calibration des contrôles pruden- tentiels	En termes de stress du système dans son ensemble ; du haut vers le bas	En termes de risques des institutions individuelles ; du bas vers le haut

Source : [Borio \[2003\]](#)

Vers une approche plus pragmatique de la libéralisation du compte capital : Le rôle prometteur du contrôle des capitaux et des politiques macroprudentielles

Concernant le deuxième constat (ii), la dernière crise financière de 2007 a été caractérisée par un effondrement sans précédent des flux de capitaux internationaux après des années de mondialisation financière de plus en plus importante. Dans certaines économies émergentes, cette baisse combinée à la faiblesse de la demande mondiale, ont mis à rude épreuve leur stabilité financière. Suite à ces évolutions, le débat sur les politiques de libéralisation du compte capital a pris une tournure différente. En effet, une large revue de littérature d’avant crise, reposant sur l’argument de l’efficience “allocative”, soutenait la libéralisation du compte capital comme politique permettant une meilleure allocation des ressources à l’échelle internationale (voir, par exemple, [Fischer \[1998\]](#), [Obstfeld \[1998\]](#), [Summers \[2000\]](#)). Cependant, son impact sur la stabilité macroéconomique et la sécurité financière remet en cause l’argument principal et ses implications en termes de politiques publiques optimales. C’est ainsi qu’un nouveau point de vue sur l’utilité des politiques

de contrôle de capitaux et des politiques macroprudentielles, émerge. Il considère ces dernières comme des mesures visant à renforcer la résilience des économies nationales. Par ailleurs, le Fonds Monétaire International, historiquement fervent partisan de la libre circulation des capitaux, a ajusté son point de vue institutionnel pour tenir compte du pouvoir potentiel de régulation et de stabilisation que ces mesures peuvent avoir sur la stabilité macroéconomique et financière (IMF [2012]).

Le rôle des externalités pécuniaires

La nouvelle littérature sur le contrôle de capitaux et les politiques macroprudentielles repose sur leur capacité à rétablir l'efficacité de l'allocation des ressources dans une situation caractérisée par la présence de frictions financières et d'externalités pécuniaires. D'un point de vue général, les externalités sont définies comme les conséquences de l'activité économique d'un agent sur celle d'autres agents qui ne sont pas impliqués dans cette activité. Viner [1932] distingue les externalités pécuniaires des externalités technologiques comme suit :

- les externalités technologiques désignent une situation dans laquelle l'activité d'un agent a un effet direct sur l'utilité ou la fonction de production d'un autre agent sans influencer les prix,
- les externalités pécuniaires, en revanche, correspondent à des situations où cet effet est indirect et transmis uniquement par le biais des prix⁵.

La pertinence des externalités dans la théorie du bien-être économique repose sur leur implication en termes de compétitivité, d'allocation optimale des ressources et du bien-être. En effet, Bator [1958] soutient que la défaillance du marché est le résultat de la présence d'externalités, en vertu desquelles le premier théorème fondamental du bien-être ne peut pas s'appliquer. L'équilibre concurrentiel n'est donc pas nécessairement Pareto optimal⁶.

⁵Voir Laffont [1975] pour une revue de littérature détaillée sur les effets externes

⁶Sous le régime de la libre concurrence, les prix sont établis de manière à donner à chaque échangeur le maximum de (son) ophélimité. En d'autres termes, l'optimalité de Pareto stipule qu'il n'existe pas d'autre répartition possible des ressources qui puisse améliorer le bien être d'un individu sans dégrader celui d'un autre (Dobbs [1981], Greenwald and Stiglitz [1986])

Par conséquent, les externalités pécuniaires pourraient conduire à une inefficience au sens de Pareto et à des pertes importantes du bien-être ([Greenwald and Stiglitz \[1986\]](#)). Dans ce cas, l'intervention publique s'avère nécessaire afin de corriger la défaillance du marché et optimiser l'allocation des ressources et du bien-être ([Pigou \[1932\]](#)).

Dans le contexte du débat actuel sur la libre circulation des capitaux, deux formes d'externalités pécuniaires sont étudiées de manière approfondie ([Rebucci and Ma \[2019\]](#)). Un premier volet de la littérature se concentre sur les externalités pécuniaires découlant de la présence d'une contrainte du collatéral endogène introduite dans les modèles macroéconomiques pour économie ouverte par [Mendoza \[2002\]](#). Dans son modèle, [Mendoza \[2002\]](#) suppose que les banques nationales transmettent les capitaux étrangers libellés en devises étrangères aux résidents à travers l'octroi de prêts généralement libellés en monnaie nationale. Les agents sont soumis à des contraintes du collatéral dont la valeur dépend des prix des actifs nationaux ce qui les empêche d'accumuler un stock de dette dépassant une fraction de leurs revenus courants. Au niveau agrégé, l'économie ne peut pas cumuler un stock de dette qui dépasse une fraction de la production nationale (PIB). Dans un tel environnement, les externalités pécuniaires se manifestent à travers l'impact des variations des prix sur la valeur du collatéral et donc sur les conditions financières des agents privés. En effet, suite à un choc négatif, si le niveau de l'endettement est suffisamment élevé, la baisse de la production pourrait entraîner la saturation de la contrainte. Par conséquent, les conditions financières des agents privés se resserreraient, entraînant la baisse de leur dépenses en consommation et investissement. La baisse de la dépense agrégée affecterait alors à la baisse les prix et donc la valeur du collatéral, ce qui entraînerait un nouveau resserrement des conditions financières et une baisse plus prononcée de la production. Au final, la présence de la contrainte du collatéral endogène amplifie le choc à travers deux canaux principaux : les ventes forcées (*fire sales*) et la spirale dette-déflation([Fisher \[1933\]](#)).

En utilisant le même cadre analytique, [Korinek \[2011, 2018\]](#) montre que ces externalités affectent la stabilité financière et que les autorités de régulation doivent les prendre en considération. [Jeanne and Korinek \[2010b\]](#) suggèrent l'utilisation d'une taxe pigouvienne

pour inciter les agents privés, principalement les banques, à internaliser correctement les externalités qu'ils créent. [Mendoza \[2016\]](#) montre que la politique macro-prudentielle est un outil puissant qui permet au régulateur financier de réduire de manière significative l'ampleur et la fréquence des crises. [Bianchi \[2011\]](#) montre que l'externalité pécuniaire au sens de [Mendoza \[2002\]](#) conduit à un surendettement et que la taxe optimale sur le contrôle des capitaux est positive en moyenne, tandis que [Schmitt-Grohé and Uribe \[2017\]](#) indique que cette taxe est procyclique et ne peut donc pas être considérée comme un instrument macroprudentiel. [Bianchi and Mendoza \[2018\]](#) montrent que dans les économies ouvertes avec des contraintes du collatéral sur le stock de la dette, l'économie non réglementée est caractérisée par le surendettement par rapport à l'économie réglementée.

Un deuxième volet de la littérature met en exergue les externalités de la demande agrégée résultant de la présence de rigidités nominales et d'une politique monétaire contrainte. La contrainte sur la politique monétaire peut résulter d'un taux d'intérêt au voisinage de la borne zéro ou d'un taux de change fixe. Dans un tel environnement, l'économie est axée sur la demande et les agents privés sont, comme dans le cas précédent de la contrainte du collatéral, incapables d'internaliser les effets de leurs décisions individuelles sur la demande agrégée. Par conséquent, les conditions financières deviennent procycliques. Elles stimuleraient excessivement la demande agrégée pendant la phase d'expansion du cycle économique, ce qui aggraverait les vulnérabilités financières. Pendant le cycle de récession, l'accumulation des déséquilibres financiers pourrait plonger l'économie dans une récession plus sévère. Dans ce cadre, [Farhi and Werning \[2016\]](#) fournit une théorie générale sur la capacité des politiques macroprudentielles et de contrôle des capitaux à corriger les distorsions générées par les externalités de la demande agrégée. [Schmitt-Grohé and Uribe \[2016\]](#) montrent que les politiques prudentielles de contrôle des capitaux sont souhaitables pour réduire l'impact des externalités découlant de la libre circulation des capitaux, dans une économie avec un taux de change fixe et des rigidités nominales sur le marché du travail. [Korinek and Simsek \[2016\]](#) étudient le rôle des politiques macroprudentielles dans une économie avec rigidités des prix et un taux d'intérêt au voisinage de la borne zéro. Leur principale conclusion est que les politiques macroprudentielles

améliorent le bien-être des ménages car elles fournissent des outils supplémentaires pour lutter contre l’endettement excessif ex ante.

Une nouvelle motivation en faveur de l’utilisation des politiques du contrôle des capitaux et macroprudentielles se base sur l’existence d’un cycle financier mondial et ses implications sur les économies nationales. En effet, [Rey \[2015\]](#) met en évidence de nouveaux éléments empiriques confirmant la procyclicité des marchés financiers mondiaux, traduite par une hausse et une baisse simultanées des flux de capitaux, des prix des actifs, de la croissance du crédit et de l’endettement. Sa principale conclusion précise que le cycle financier mondial transforme l’impossible *trinité*⁷ en un *dilemme*. Autrement dit, pour assurer l’indépendance de la politique monétaire, les flux de capitaux devraient être gérés directement en utilisant des politiques de contrôle des capitaux, ou indirectement en mettant en oeuvre des mesures macroprudentielles, quel que soit le régime de change. En effet, le cycle financier mondial est déterminé par des facteurs exogènes qui échappent au contrôle des gouvernements⁸ ce qui porte atteinte à l’efficacité et à l’autonomie des politiques nationales des pays ouverts à l’échange. Ainsi, la mise en oeuvre de politiques de gestion du compte capital vise à renforcer l’efficacité de ces politiques ([Angeloni and Faia \[2009\]](#), [Kannan et al. \[2012\]](#)). Néanmoins, en utilisant un modèle keynésien d’équilibre général pour une petite économie ouverte avec des rigidités nominales, [Farhi and Werning \[2014\]](#) constatent que le régime de change est essentiel. Ils soulignent, également, que les contrôles des capitaux “lean against the wind” même lorsque le taux de change est flexible.

Déclaration de thèse et contributions

Cette nouvelle littérature sur les politiques du contrôle prudentiel des capitaux fournit de nouvelles orientations pour les politiques publiques, basées sur les avancées théoriques et empiriques présentées dans la section précédente. En particulier, elle jette un nouvel

⁷L’impossible trinité stipule que les décideurs politiques ne peuvent choisir que deux des trois options : Taux de change fixe, libre circulation des capitaux et politique monétaire indépendante ([Obstfeld et al. \[2005\]](#)).

⁸Par exemple, les chocs de la politique monétaire américaine sont transmis au niveau international et affectent les conditions financières même dans les économies adoptant le ciblage d’inflation

éclairage sur les causes des crises de change⁹ dans les économies émergentes, et sur les politiques optimales qui devraient être mises en oeuvre pour les éviter. Avant la crise asiatique de 1997 – 1998, l’approche dominante dans la littérature relative aux crises de balance des paiements considérait ces dernières comme le résultat d’une mauvaise conduite des politiques publiques mettant en péril la soutenabilité du régime de change (modèles de première génération, [Krugman \[1979\]](#), [Flood and Garber \[1984\]](#)). En effet, la plupart des pays d’Amérique latine touchés par la crise de la dette souveraine, qui a eu lieu entre 1982 et 1989, ont adopté des politiques macroéconomiques non soutenables, notamment une politique budgétaire accommodante financée par une création monétaire incompatible avec un régime de taux de change fixe. Néanmoins, la série d’attaques spéculatives visant la plupart des monnaies du Système Monétaire Européen durant la période 1992 – 1993 a remis en question l’idée selon laquelle le seignuriage est la seule cause de l’instabilité monétaire. Ainsi, un autre point de vue est apparu, expliquant la crise comme le produit des attentes des investisseurs concernant la soutenabilité du régime de change et l’incertitude liée à la volonté d’un gouvernement de défendre la parité du taux de change ou de mener une politique monétaire plus expansionniste (modèles de deuxième génération, [Obstfeld \[1994\]](#)). La principale conclusion de ces modèles met l’accent sur la présence d’un cas de figure où la crise est auto-réalisatrice. Dans ce cas, une détérioration de la confiance des investisseurs motivée par des craintes sur la soutenabilité du régime de change génère une dépréciation de la monnaie. Cette baisse du cours de change alimente le pessimisme des investisseurs et conduit, in fine, à des attaques spéculatives. Au lendemain de la crise asiatique, une troisième génération de modèles a émergé. [Krugman \[2001\]](#) organise cette génération en trois variantes principales. La première version porte sur l’investissement motivé par l’aléa moral. Dans ces modèles, une attention particulière est accordée à l’asymétrie des devises et à l’aléa moral qui conduisent les banques à prendre des risques excessifs et au surendettement de l’économie ([McKinnon and Pill \[1996\]](#), [Corsetti et al. \[1998\]](#), [Krugman \[1999\]](#)). La deuxième version, généralement associée aux

⁹La crise de change, également appelée crise de la balance des paiements, est une crise qui survient suite aux attaques spéculatives sur la monnaie d’un pays entraînant une dépréciation excessive du taux de change et un défaut de paiement de la dette souveraine

travaux de [Chang and Velasco \[1999\]](#), préconise le rôle de l'illiquidité du marché financier international comme facteur principal des krachs monétaires. Enfin, la troisième variante étudie le rôle de l'effet d'amplification financière qui résulte de la détérioration des bilans des agents privés associée à une baisse des prix des actifs ([Krugman \[1999\]](#), [Aghion et al. \[2004\]](#)).

Dans le cadre des modèles de la troisième génération, cette thèse étudie l'efficacité des politiques prudentielles pour la gestion des capitaux et leur capacité à prévenir et réduire la fréquence des crises de change dans les économies émergentes. Une attention particulière est accordée aux politiques optimales monétaire, du contrôle des capitaux et macroprudentielles comme mesures de lutte contre les crises financières provoquées par des arrêts soudains (Sudden Stops) des flux de capitaux internationaux. Les arrêts soudains sont définis comme des épisodes où un renversement soudain de la dynamique des flux de capitaux internationaux, est suivi d'une forte baisse de la production, d'une chute des prix des actifs et d'une contraction du crédit au secteur privé ([Calvo et al. \[1996\]](#), [Mendoza \[2002\]](#)).

La thèse est organisée en quatre chapitres:

- dans **le chapitre 1**, nous avons examiné les régularités empiriques qui caractérisent les épisodes de Sudden Stops au niveau des flux net entrant des capitaux. En outre, nous avons exploré la relation qui existe entre la probabilité d'occurrence de tels épisodes et un nombre de facteurs internes et externes. Notre analyse a été réalisée sur une base de données trimestrielles comprenant 75 pays émergents et développés. Nos principaux résultats font ressortir la crise asiatique comme un point de rupture qui a affecté (*i*) la dynamique de long terme des flux de capitaux vers les pays émergents vs. développés, ainsi que (*ii*) les facteurs qui expliquent significativement les crises de Sudden Stops dans les deux groupes de pays.
- dans **le chapitre 2**, nous avons analysé trois politiques prudentielles de contrôle de capitaux dans un modèle d'Équilibre Général Stochastique Dynamique (DSGE¹⁰)

¹⁰Dynamic Stochastic General Equilibrium

pour petite économie ouverte (SOE¹¹) avec des externalités pécuniaires dues à des contraintes du collatéral (Mendoza [2002], Bianchi [2011]). Nous avons proposé une solution qui permet de déduire l’expression de la taxe optimale qui souffre d’indétermination en période de crise. Sur la base de cette solution, on déduit une explication de son comportement procyclique au cours d’un cycle typique d’expansion-récession comme souligné dans Schmitt-Grohé and Uribe [2017]. Cependant, contrairement à Schmitt-Grohé and Uribe [2017], nos résultats suggèrent que la taxe optimale est procyclique en période de crise. En outre, nous avons examiné les résultats de deux politiques alternatives, à savoir une taxe fixe sur la dette extérieure et une politique macroprudentielle simple basée sur le ciblage du ratio de la dette extérieure au PIB. Nos résultats montrent que la mise en oeuvre de la politique macroprudentielle conduit à un gain du bien-être relativement plus élevé que celui de l’économie réglementée avec une taxe fixe, et sept fois plus élevé que celui de l’économie de Ramsey.

- dans le **chapitre 3**, on élargit le cadre analytique du chapitre précédent en introduisant une autorité monétaire et une technologie de production endogène. Nous étudions les résultats des politiques de stérilisation et de contrôle des capitaux dans une économie avec des externalités pécuniaires découlant de la présence d’une contrainte d’emprunt. Dans ce modèle, l’autorité monétaire a la possibilité d’utiliser des politiques de stérilisation et du contrôle des capitaux en plus d’une politique monétaire basée sur la règle de Taylor. Notre principal résultat suggère que la réponse optimale des politiques de stérilisation et du contrôle de capitaux, combinée avec la politique monétaire, “leans against the wind” en visant à lisser les flux de capitaux. En effet, lorsque l’économie connaît une forte entrée des flux de capitaux, la réponse optimale de ces politiques consiste à éviter que les ménages accumulent des niveaux élevés de la dette, soit en augmentant l’offre des obligations d’État pour absorber le surplus de liquidité sur le marché du crédit national, soit en augmentant la taxe sur l’entrée des capitaux.

¹¹Small Open Economy

- dans le **chapitre 4**, nous avons étudié l'impact des politiques du contrôle de capitaux et macroprudentielles sur la dynamique de l'investissement privé dans une économie fortement dépendante des financements extérieurs. Nous avons adopté comme cadre analytique un modèle SOE-DSGE avec des frictions financières à la [Bernanke et al. \[1999\]](#). Notre principal résultat suggère que la politique optimale dépend de la source des chocs exogènes. Lorsque l'économie est frappée par un choc exogène de productivité, la mise en oeuvre de la politique monétaire permet d'obtenir le gain le plus élevé du bien-être. Lorsque l'économie subit un choc exogène externe et inattendu, les autres politiques alternatives notamment une règle de Taylor augmentée (ciblant la croissance du crédit) améliorent sensiblement le bien-être social des ménages. En outre, un arrêt soudain des entrées de capitaux étrangers, résultant soit d'un choc exogène négatif sur les flux de capitaux, soit d'une augmentation inattendue des taux d'intérêt dans le reste du monde, plonge l'économie dans une crise financière. En effet, une baisse inattendue des entrées de capitaux entraîne une chute de l'offre de crédit. Par conséquent, les entrepreneurs réduisent l'accumulation de leurs dettes en diminuant leur dépense agrégée en investissement. Ainsi, la production globale baisse considérablement. Dans ce cas, la politique optimale du contrôle de capitaux s'avère contra-cyclique. Elle stabilise les flux de capitaux et atténue leur impact sur la croissance économique en baissant la taxe sur les capitaux sortant. Le gain du bien-être lié à l'utilisation de telles politiques est considérablement élevé. En revanche, l'adoption d'une politique macroprudentielle au sens large entraîne une augmentation du bien-être similaire à celle obtenue dans un scénario où seule une politique monétaire fondée sur la règle de Taylor est mise en oeuvre. De même, la politique macroprudentielle dans ce cas est contra-cyclique dans la mesure où une baisse de la prime de régulation sur le financement externe des entreprises, est recommandée quand l'économie est en récession.

Chapter 1

Sudden Stops across countries and decades: An empirical investigation

La mobilité financière accrue que connaissent les économies développées et émergentes depuis quelques décennies se caractérise par des épisodes récurrents de réduction des flux de capitaux, dont certains se terminent par des épisodes d'arrêts soudains et des crises financières. Quatre principales régularités empiriques ([Mendoza \[2002\]](#), [Calvo et al. \[2004\]](#), [Mendoza \[2010\]](#), [Calvo et al. \[2008\]](#)) caractérisent ces épisodes : (1) un renversement soudain de la dynamique des flux de capitaux internationaux (un passage rapide d'un déficit du compte courant à un excédent au début de la crise), (2) une forte baisse de la production, (3) une chute des prix des actifs et (4) une contraction du crédit au secteur privé.

Les études de ces épisodes ont été initiées par [Calvo et al. \[1996\]](#). Depuis, un nombre croissant de travaux de recherche se consacre à l'analyse de ces crises et aux réponses politiques appropriées pour y remédier ([Mendoza \[2002\]](#), [Korinek \[2010\]](#), [Jeanne and Korinek \[2010a\]](#), [Bianchi \[2011\]](#), [Korinek and Mendoza \[2014\]](#)). D'un point de vue empirique, de nombreux progrès ont été réalisés au cours des deux dernières décennies ([Edwards \[2004\]](#), [Calvo et al. \[2008\]](#), [Cavallo and Frankel \[2008\]](#)) mettant en évidence le rôle d'un certain nombre de facteurs internes (push) et externes (pull) dans l'explication de ce genre de crises. Les principaux résultats montrent qu'une plus grande ouverture financière et

commerciale semble réduire la probabilité de ce genre d'épisodes. En revanche, les pays présentant des vulnérabilités financières internes élevées, telles que la dollarisation ou le faible niveau des réserves de change officielles, ont plus de chances de subir des Sudden Stops. En outre, des études plus récentes montrent un impact significatif des facteurs externes et de la contagion sur la probabilité d'occurrences de tels épisodes ([Forbes and Warnock \[2012\]](#), [Comelli \[2015\]](#), [Ghosh et al. \[2016\]](#)).

Dans ce chapitre, nous avons examiné les régularités empiriques des arrêts soudains des entrées nettes de capitaux en utilisant des données trimestrielles de 75 économies développées et émergentes sur une période allant de 1960 à 2017. De plus, nous avons exploré la relation entre la probabilité d'occurrences de tels épisodes et un nombre de facteurs nationaux et mondiaux, tels que les termes de l'échange, l'ouverture commerciale et financière en plus de la croissance économique mondiale.

Nous avons adopté la même mesure des entrées nettes de capitaux que celle présentée par [Calvo et al. \[2004\]](#). La valeur ajoutée de notre étude réside dans l'adoption d'un filtre qui varie dans le temps et qui est calculé sur la base d'une fenêtre glissante afin d'isoler les périodes de réduction des flux de capitaux et les épisodes d'arrêt soudain. L'avantage d'adopter une telle approche est de réduire l'impact de la taille de l'échantillon sur la robustesse des résultats, et de tenir compte des changements structurels affectant la dynamique des flux financiers sur la période de l'étude. En effet, l'adoption d'un filtre fixe comme celui adopté par [Calvo et al. \[2004\]](#) a une incidence sur la qualité des résultats dans la mesure où une forte volatilité des flux de capitaux dans une période donnée peut affecter le seuil du filtre sur l'ensemble de l'échantillon. Cela peut réduire le nombre d'épisodes d'arrêt brutal à prendre en compte.

Selon notre méthodologie, 443 épisodes de baisse des entrées nettes de capitaux ont été sélectionnés dont 149 finissent en crises financières ou économiques (1/3 dans les pays développés et 2/3 dans les économies émergentes). L'approche trimestrielle de notre étude nous a permis d'examiner l'évolution des principaux agrégats macroéconomiques et financiers de chaque groupe de pays autour de la crise. Il en ressort que même si nous constatons une évolution similaire des variables macroéconomiques au cours des

trimestres entourant un épisode de Sudden Stop, la crise est plus aiguë et plus dévastatrice en moyenne dans les pays émergents. Cependant, on constate une aggravation de la situation des pays développés dans la période après 1997.

En ce qui concerne l'analyse économétrique, nous avons adopté un modèle logit sur données panel qui tient compte des effets fixes afin d'estimer la relation entre la probabilité conditionnelle d'occurrences d'un arrêt brutal et un ensemble de facteurs nationaux et mondiaux généralement utilisés dans la littérature comme déterminants de telles crises. Nos résultats soulignent un impact significatif des flux de réserves officielles de change et de la stabilité des taux de change dans l'explication de tels épisodes avant 1997. Cependant, la déviation du ratio dette-PIB de son niveau d'équilibre et un faible indice d'ouverture financière sont associés à une plus grande probabilité d'occurrences de Sudden Stops après 1997.

Chapter 2

Optimal vs. simple capital control rules in a sudden stop environment

L'objectif de ce chapitre a été d'examiner la cyclicité des politiques du contrôle prudentiel des capitaux dans le cas d'une économie émergente caractérisée par des épisodes de "Sudden Stop" et d'évaluer leur impact sur le bien-être social. Notre cadre analytique est basé sur un modèle SOE-DSGE avec deux secteurs, échangeables et non échangeables. On suppose que les agents privés ont accès au marché financier international où ils peuvent s'endetter pour satisfaire leurs besoins en consommation. Ils sont soumis à une contrainte du collatéral endogène telle que formulée par [Mendoza \[2002\]](#). Au niveau agrégé, la contrainte empêche l'économie d'accumuler un niveau de dette externe qui dépasse une fraction de la production nationale (PIB).

Afin d'étudier l'apport des politiques du contrôle des capitaux et macroprudentielles dans un tel environnement, nous avons considéré d'abord un planificateur social qui cherche à maximiser le bien être social en internalisant l'effet de la contrainte sur le choix intertemporel des agents privés. Pour corriger les externalités associées, le planificateur social impose une taxe sur l'endettement externe déduite de manière optimale. Comme cette taxe souffre d'indétermination, nous avons proposé une solution qui permet à l'économie de converger vers une allocation des ressources, similaire à celle obtenue dans l'économie de Ramsey (planificateur social). De surcroît, notre solution explique la pro-cyclicité de

la taxe optimale soulevée par [Schmitt-Grohé and Uribe \[2017\]](#). Selon cette solution:

- en période d’expansion, notamment lorsque la contrainte du collatéral n’est pas saturée pendant la période actuelle et suivante, la taxe optimale est nulle. Dans ce cas, les choix intertemporels des agents privés et ceux du planificateur social coïncident.
- en période de récession, le planificateur de Ramsey n’impose une taxe positive que lorsque l’économie est sur le point d’atteindre la limite de la dette dans la période suivante. En effet, pendant de telles périodes, l’allocation des ressources dans l’économie de Ramsey diffère de celle des agents privés. Ces derniers n’internalisent pas aujourd’hui le coût de l’accumulation de la dette sur leur capacité future du remboursement et d’acquisition d’une unité supplémentaire de dette.

Contrairement à [Schmitt-Grohé and Uribe \[2017\]](#), nos résultats suggèrent que la taxe optimale doit baisser pour atteindre des valeurs négatives pendant une période de crise. En effet, pendant ces périodes les agents privés sous-évaluent la richesse et la mise en place d’une taxe négative (une subvention) pourrait les encourager à augmenter leur endettement au niveau maximal possible, et ainsi réduire la gravité de la crise. Toutefois, nos résultats soulignent que la mise en oeuvre d’une taxe sur la dette basée sur notre solution ou celle de [Schmitt-Grohé and Uribe \[2017\]](#) implique le même degré de gravité de la crise, ce qui suggère que la taxe optimale ex post n’est pas pertinente.

De plus, nous avons étudié deux politiques alternatives du contrôle des capitaux. Une politique macroprudentielle (i) basée sur le ciblage du ratio dette privée/PIB, et une taxe constante (ii) sur la dette qui vise à réduire la propension des agents privés à consommer plus de ressources en accumulant des niveaux de dette élevés. Nos résultats suggèrent que la politique macroprudentielle (i) est “the second best policy” qui génère le bien-être social le plus élevé et réduit à la fois la volatilité de l’économie et la fréquence des crises. Elle conduit à un gain de bien-être relativement plus élevé que celui de l’économie réglementée avec une taxe constante (ii) et plus de sept fois plus élevé que celui du planificateur Ramsey.

Chapter 3

Sterilization and capital control policies for managing debt-creating capital inflows

Comme le souligne [Stiglitz \[2000\]](#), la libéralisation du compte capital sans un cadre réglementaire adéquat pourrait être systématiquement associée à une instabilité et une volatilité économiques plus importantes, et à une probabilité plus élevée de récession. Elle apporte un arbitrage supplémentaire pour les autorités monétaires entre la stabilisation de l'économie ou/et la stabilisation des flux de capitaux. Des travaux récents soulignent le rôle prometteur de politiques alternatives susceptibles d'exacerber cet arbitrage, telles que les politiques prudentielles de contrôle des capitaux ([Rey \[2015\]](#), [Farhi and Werning \[2014\]](#), [Korinek and Sandri \[2016\]](#)).

L'efficacité des politiques de contrôle prudentiel des capitaux est justifiée par les effets d'amélioration du bien-être qui leur sont associés, comme le souligne par exemple [Korinek \[2010\]](#). En particulier, elles permettent d'atténuer l'effet négatif des externalités pécuniaires associées aux flux de capitaux et à l'endettement en devises étrangères. En outre, [Jeanne and Korinek \[2010b\]](#) montre le rôle d'une taxe pigouvienne variable dans le temps, sur les emprunts étrangers pour inciter les emprunteurs à internaliser les externalités qui résultent de leur comportement d'emprunt extérieur. Dans un papier de

référence, [Bianchi \[2011\]](#) démontre qu'une allocation efficace peut être récupérée grâce à des contrôles de capitaux, ou à l'imposition des exigences réglementaires sur les réserves ou sur les emprunts extérieurs. [Farhi and Werning \[2012\]](#) soutient que les contrôles des capitaux peuvent atténuer la volatilité des capitaux internationaux causée par les chocs des primes de risque.

De même, les politiques de restriction du compte de capital incluent également le rôle potentiel des interventions stérilisées. [Guzman et al. \[2018\]](#) indiquent que les réglementations du compte de capital et les interventions stérilisées peuvent constituer les meilleures politiques complémentaires aux politiques macroéconomiques contra-cycliques habituelles dans les économies connaissant des cycles d'expansion et de ralentissement des flux de capitaux. Ils discutent les circonstances dans lesquelles le coût associé aux stérilisations pourrait être compensé. [Adler et al. \[2016\]](#) soulignent que les avantages de l'utilisation des interventions sur les taux de change comme outil stabilisateur supplémentaire, sont plus importants dans les régimes où la politique monétaire se concentre de manière crédible sur la stabilisation de la production et de l'inflation. [Blanchard et al. \[2013\]](#) font valoir que des interventions stérilisées visant à stabiliser l'inflation peuvent être souhaitables dans des économies où les frictions financières sont plus importantes et les marchés plus fortement segmentés. [Liu and Spiegel \[2015\]](#) constatent que les contrôles de capitaux et les interventions stérilisées sont efficacement complémentaires de la politique monétaire et améliorent le bien-être social. [Blanchard et al. \[2017\]](#) montrent que les interventions stérilisées neutralisent totalement les effets des flux d'obligations, laissant le taux de change et les taux d'intérêt inchangés. Toutefois, lorsque des interventions stérilisées sur le marché des changes sont utilisées en réponse à des entrées de capitaux non obligataires, elles peuvent éviter l'appréciation du taux de change, mais cela s'accompagne d'une baisse plus importante du taux de rendement des actifs non obligataires.

Dans ce chapitre, nous avons évalué la complémentarité entre la politique monétaire et celle du contrôle des capitaux et les interventions stérilisées dans un modèle non linéaire d'équilibre général SOE-DSGE, caractérisé par deux régimes (avec et sans crise économique). Le modèle est basé sur la version linéaire présentée par [Liu and Spiegel](#)

[2015]. Nous supposons que :

- l'économie est soumise à des cycles d'expansion-contraction des flux de capitaux,
- les entrées de capitaux passent par un secteur bancaire national parfaitement concurrentiel qui joue l'intermédiaire entre les investisseurs internationaux et les agents privés résidents,
- les ménages sont soumis à une contrainte de liquidité du type [Mendoza \[2002\]](#), en terme agrégé, l'économie ne peut pas accumuler un montant de dette qui dépasse une fraction de la production nationale.

Les entreprises nationales n'utilisent que la main-d'oeuvre pour produire un seul bien fini de consommation et fixent les prix selon le système de fixation des prix à la *Rotemberg* ([Rotemberg \[1982\]](#)). Dans un tel environnement, la contrainte d'emprunt amplifie les chocs tant exogènes qu'endogènes de l'économie. En effet, lorsque le reste du monde est en crise, la baisse de la production nationale due à la faiblesse de la demande extérieure, pourrait saturer la contrainte de crédit. Par conséquent, les ménages peuvent réagir en réduisant leur dépense agrégée ce qui entraînerait une nouvelle contraction de la consommation privée et plongerait l'économie dans une récession beaucoup plus prononcée. Ainsi, les décideurs politiques pourraient être confrontés à un arbitrage entre la stabilisation de l'économie et la stabilisation des entrées de capitaux. En fait, l'assouplissement de la politique monétaire pourrait accroître les sorties de capitaux, ce qui entraînerait un resserrement des conditions financières des ménages. Dans le cas contraire et suite à un choc de productivité négatif, la baisse de la production nationale entraînerait la saturation de la contrainte de crédit empêchant les ménages de lisser leur consommation en augmentant leur niveau de dette. Ainsi, le déclin de la consommation privée entraînerait une nouvelle réduction importante du PIB.

Pour étudier les politiques de stérilisation, nous avons assumé une substituabilité imparfaite entre les actifs financiers. Pour les politiques de contrôle de capitaux, nous avons considéré une taxe sur les flux de capitaux qui varie dans le temps. Nous avons résolu le modèle en utilisant le paquetage *OccBin*, un paquetage compatible avec *Dynare*

(Juillard et al. [1996]) et développé par Guerrieri and Iacoviello [2015]. Guerrieri and Iacoviello [2015] adaptent une approche de perturbation du premier ordre et l'appliquent par morceaux pour résoudre les modèles dynamiques avec des contraintes du collatéral quiaturent occasionnellement. Ensuite, nous avons généré des cycles d'expansion et de contraction des flux de capitaux en considérant une séquence de chocs de productivité et du taux d'intérêt étranger.

Nos principaux résultats soulignent la procyclicité des interventions stérilisées et des contrôles de capitaux. Les restrictions sur le compte capital sont renforcées pendant les cycles d'expansion des flux de capitaux et assouplies pendant les cycles de récession. En outre, telles politiques avec une politique monétaire axée sur la stabilité des prix et de la production, donnent de meilleurs résultats en comparaison avec l'adoption d'une simple politique monétaire. Elles réduisent considérablement la volatilité de l'économie associée aux fluctuations du taux d'intérêt étranger et aux chocs de productivité internes. Toutefois, les interventions stérilisées entraînent une plus grande volatilité des flux de capitaux.

Chapter 4

Financial acceleration and optimal prudential capital controls in a SOE subject to floods and sudden stops

Rey [2015] met en évidence de nouvelles preuves empiriques sur la procyclicité du marché financier mondial, caractérisée par un co-mouvement des flux de capitaux, des prix des actifs, de la croissance du crédit et de l'endettement. Elle conclut que le cycle financier mondial transforme le *trilemma* en un *dilemma*. Pour assurer l'indépendance de la politique monétaire, les flux de capitaux devraient être gérés directement en utilisant des politiques de contrôle des capitaux, ou indirectement en mettant en oeuvre des mesures macroprudentielles, quel que soit le régime de change. En fait, comme le cycle financier mondial est déterminé par des facteurs exogènes mondiaux qui échappent au contrôle des gouvernements, les politiques économiques nationales deviennent contraintes par l'évolution de ces facteurs. Ainsi, la politique de gestion des comptes de capitaux vise à renforcer l'efficacité de ces politiques (Angeloni and Faia [2009], Kamman et al. [2012]) et à réduire la fréquence des crises. L'objectif de ce chapitre est de contribuer à cette nouvelle littérature sur le *dilemma* en examinant les complémentarités entre les politiques monétaires macroprudentielles et de contrôle des capitaux, dans une économie émergente avec un compte de capital ouvert et un taux de change flexible. Nous avons adopté un modèle

SOE-DGSE avec frictions financières à la Bernanke (Bernanke et al. [1999]) et des rigidités nominales (Gali and Monacelli [2005], Devereux et al. [2006], ?, Farhi and Werning [2012]). Il y a trois types d'entreprises dans l'économie :

- les entreprises de production nationale qui produisent des biens de consommation finale différenciés, qui sont vendus sur les marchés intérieurs ou à l'étranger. Elles utilisent à la fois le capital et le travail comme intrants. Ces entreprises pratiquent une tarification en monnaie locale à la Calvo [1983]. Par conséquent, les prix des biens de consommation finale sont rigides.
- les entreprises importatrices qui ont également un pouvoir sur le marché en fixant les prix de leurs marchandises selon le même mécanisme (Calvo [1983]). La rigidité des prix dans les secteurs exportateur et importateur implique l'absence de la loi du prix unique et l'absence d'une répercutions complète des variations du taux de change sur les prix,
- des entreprises compétitives qui combinent l'investissement et le capital loué pour produire des biens d'investissement non-finis qui sont ensuite vendus aux entrepreneurs.

Comme dans ce genre de modèle, les entrepreneurs jouent un rôle clé. Ils transforment les biens d'investissement non-finis et les louent aux entreprises de production. Pour acquérir du capital, chaque entrepreneur utilise sa richesse nette issue de ses précédents investissements ainsi que son revenu salarial¹. En raison de l'absence de possibilité d'autofinancement, chaque entrepreneur doit emprunter sur le secteur financier national et doit faire face à un risque idiosyncratique impactant sa prime de financement externe. La présence du risque idiosyncratique agit comme accélérateur financier dans la mesure où elle implique une procyclicité des conditions financières. En effet, en période d'expansion, le risque idiosyncratique baisse induisant une baisse des coûts d'endettement des entrepreneurs qui trouvent plus de facilité à augmenter leur dépense en investissement. La hausse de l'investissement entraîne une amélioration de la croissance économique qui baisse davantage le risque idiosyncratique et ainsi de suite. En période de récession, le

¹Émanant de l'offre de travail aux entreprises de production nationales

risque idiosyncratique augmente se traduisant par une prime de financement externe plus élevée. Cela empêche les entrepreneurs de détenir un niveau de dette leur permettant de lisser leurs dépenses en investissement. Par conséquent, l'investissement privé diminue, induisant une contraction de l'activité économique et donc une augmentation plus importante du risque idiosyncratique.

Notre cadre diffère des études existantes sur un point important. Nous avons assumé que l'investissement privé est financé par la dette, et que cette dernière est principalement alimentée par les flux de capitaux. Cette hypothèse vise à mettre en évidence le mécanisme par lequel les cycles d'expansion et de contraction des flux de capitaux générés de manière exogène, sont transmis à l'économie nationale. En fait, dans un tel environnement, les conditions financières sont doublement procycliques; dans les périodes d'expansions, les agents nationaux bénéficient à la fois d'une baisse de la prime de financement externe et une hausse de la liquidité sur le marché financier due aux entrées de capitaux. En revanche, pendant les périodes de récession, l'augmentation de la prime de financement externe combinée aux sorties de capitaux crée un effet d'amplification qui se traduit par un ralentissement économique plus sévère.

Dans ce chapitre, nous avons examiné la réponse optimale des politiques monétaire du contrôle de capitaux et macroprudentielle, dans une économie soumise à des chocs exogènes². Nos résultats montrent que l'optimalité des politiques en question dépend de la source des chocs. Lorsque l'économie est frappée par un choc de productivité, la mise en oeuvre de la politique monétaire permet d'obtenir le gain le plus élevé du bien-être. Lorsque l'économie subit un choc exogène externe et inattendu, les autres politiques alternatives notamment la règle de Taylor augmentée (ciblant la croissance du crédit) améliorent sensiblement le bien-être social des ménages. En outre, un arrêt soudain des entrées de capitaux étrangers, induit soit par un choc exogène négatif sur les flux de capitaux, soit par une augmentation inattendue des taux d'intérêt dans le reste du monde, entraîne l'économie dans une crise financière. En effet, une baisse inattendue des entrées

²Trois chocs ont été particulièrement examinés: un choc négatif de productivité, un choc positif du taux d'intérêt dans le reste du monde et un choc négatif sur la demande étrangère pour la dette privée nationale.

de capitaux entraîne une chute de l'offre de crédit. Par conséquent, les entrepreneurs réduisent l'accumulation de leurs dettes en diminuant leurs dépenses en investissement. Ainsi, la production agrégée baisse considérablement. Dans ce cas, la politique optimale de contrôle des capitaux s'avère contra-cyclique. Elle cherche à stabiliser les flux de capitaux et atténuer leur impact sur la croissance économique en baissant la taxe sur les capitaux sortant. Le gain de bien-être lié à l'utilisation de telles politiques est considérablement élevé. En revanche, l'adoption d'une politique macroprudentielle au sens large, entraîne une augmentation du bien-être similaire à celle obtenue dans un scénario où seule une politique monétaire fondée sur la règle de Taylor est mise en oeuvre. De même, la politique macroprudentielle dans ce cas est contra-cyclique, dans la mesure où une baisse de la prime de régulation sur le financement externe des entreprises est recommandée, quand l'économie est en récession.

Bibliography

- Gustavo Adler, Ruy Lama, and Juan Medina. Foreign exchange intervention under policy uncertainty. 2016.
- Philippe Aghion, Philippe Bacchetta, and Abhijit Banerjee. A corporate balance-sheet approach to currency crises. *Journal of Economic Theory*, 119(1):6–30, 2004.
- Ignazio Angeloni and Ester Faia. A tale of two policies: Prudential regulation and monetary policy with fragile banks. Technical report, Kiel working paper, 2009.
- Francis M Bator. The anatomy of market failure. *The quarterly journal of economics*, 72(3):351–379, 1958.
- Ben S Bernanke and Frederic S Mishkin. Inflation targeting: a new framework for monetary policy? *Journal of Economic perspectives*, 11(2):97–116, 1997.
- Ben S Bernanke, Mark Gertler, and Simon Gilchrist. The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics*, 1:1341–1393, 1999.
- Javier Bianchi. Overborrowing and systemic externalities in the business cycle. *American Economic Review*, 101(7):3400–3426, 2011.
- Javier Bianchi and Enrique G Mendoza. Optimal time-consistent macroprudential policy. *Journal of Political Economy*, 126(2):588–634, 2018.
- Olivier Blanchard and Jordi Gali. Real wage rigidities and the new keynesian model. Technical report, National Bureau of Economic Research, 2005.

- Olivier Blanchard, Giovanni Dell Ariccia, and Paolo Mauro. Rethinking macroeconomic policy. *Revista de Economía Institucional*, 12(22):61–82, 2010.
- Olivier Blanchard, Jonathan D Ostry, Atish R Ghosh, and Marcos Chamon. Are capital inflows expansionary or contractionary? theory, policy implications, and some evidence. *IMF Economic Review*, 65(3):563–585, 2017.
- Olivier J Blanchard, Mr Giovanni Dell’Ariccia, and Mr Paolo Mauro. *Rethinking macro policy II: getting granular*. International Monetary Fund, 2013.
- Claudio Borio. Towards a macroprudential framework for financial supervision and regulation? *CESifo Economic Studies*, 49(2):181–215, 2003.
- Claudio Borio. Implementing a macroprudential framework: Blending boldness and realism. *Capitalism and Society*, 6(1), 2011.
- Guillermo A Calvo. Staggered prices in a utility-maximizing framework. *Journal of monetary Economics*, 12(3):383–398, 1983.
- Guillermo A Calvo, Leonardo Leiderman, and Carmen M Reinhart. The capital inflows problem: Concepts and issues. *Contemporary Economic Policy*, 12(3):54–66, 1994.
- Guillermo A Calvo, Leonardo Leiderman, and Carmen M Reinhart. Inflows of capital to developing countries in the 1990s. *Journal of economic perspectives*, 10(2):123–139, 1996.
- Guillermo A Calvo, Alejandro Izquierdo, and Luis-Fernando Mejía. On the empirics of sudden stops: the relevance of balance-sheet effects. Technical report, National Bureau of Economic Research, 2004.
- Guillermo A Calvo, Alejandro Izquierdo, and Luis-Fernando Mejía. Systemic sudden stops: the relevance of balance-sheet effects and financial integration. Technical report, National Bureau of Economic Research, 2008.

- Eduardo A Cavallo and Jeffrey A Frankel. Does openness to trade make countries more vulnerable to sudden stops, or less? using gravity to establish causality. *Journal of International Money and Finance*, 27(8):1430–1452, 2008.
- R. Chang and A. Velasco. Liquidity crises in emerging markets: Theory and policy. *National Bureau of Economic Research*, 1999.
- Roberto Chang and Andrés Velasco. Economic policy incentives to preserve lives and livelihoods. Technical report, National Bureau of Economic Research, 2020.
- Mr Fabio Comelli. *Estimation and out-of-sample prediction of sudden stops: Do regions of emerging markets behave differently from each other?* Number 15-138. International Monetary Fund, 2015.
- Vítor Constâncio. Margins and haircuts as a macroprudential tool. In *Remarks by Vítor Constâncio, Vice-President of the ECB, at the ESRB international conference on the macroprudential use of margins and haircuts, Frankfurt on Main*, 2016.
- G. Corsetti, P. Pesenti, and N. Roubini. What caused the asian currency and financial crisis? part i: A macroeconomic overview. *National Bureau of Economic Research*, (6833), 1998.
- Michael B Devereux, Philip R Lane, and Juanyi Xu. Exchange rates and monetary policy in emerging market economies. *The Economic Journal*, 116(511):478–506, 2006.
- Ian Dobbs. Externality, efficiency and the pareto principle. *International Review of Law and Economics*, 1(2):167–181, 1981.
- Sebastian Edwards. Financial openness, sudden stops, and current-account reversals. *American Economic Review*, 94(2):59–64, 2004.
- Emmanuel Farhi and Ivan Werning. Dealing with the trilemma: Optimal capital controls with fixed exchange rates. Technical report, National Bureau of Economic Research, 2012.

- Emmanuel Farhi and Ivan Werning. Dilemma not trilemma? capital controls and exchange rates with volatile capital flows. *IMF Economic Review*, 62(4):569–605, 2014.
- Emmanuel Farhi and Iván Werning. A theory of macroprudential policies in the presence of nominal rigidities. *Econometrica*, 84(5):1645–1704, 2016.
- Stanley Fischer. The asian crisis: A view from the imf. *Washington DC*, 22, 1998.
- Irving Fisher. The debt-deflation theory of great depressions. *Econometrica: Journal of the Econometric Society*, pages 337–357, 1933.
- R.P. Flood and P.M. Garber. Collapsing exchange-rate regimes: some linear examples. *Journal of international Economics*, 17(1-2):1–13, 1984.
- Kristin J Forbes and Francis E Warnock. Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of international economics*, 88(2):235–251, 2012.
- Justin Fox and Alan Sklar. *The myth of the rational market: A history of risk, reward, and delusion on Wall Street*. Harper Business New York, 2009.
- International Monetary Fund, Bank for International Settlements, and the Secretariat of the Financial Stability Board. Elements of effective macroprudential policies. Technical report, International Monetary Fund, Bank for International Settlements, and Financial Stability Board, 2016.
- Jordi Gali and Tommaso Monacelli. Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734, 2005.
- Atish R Ghosh, Jonathan D Ostry, and Mahvash S Qureshi. When do capital inflow surges end in tears? *American Economic Review*, 106(5):581–85, 2016.
- Marvin Goodfriend and Robert G King. The new neoclassical synthesis and the role of monetary policy. *NBER macroeconomics annual*, 12:231–283, 1997.
- Bruce C Greenwald and Joseph E Stiglitz. Externalities in economies with imperfect information and incomplete markets. *The quarterly journal of economics*, 101(2):229–264, 1986.

- Luca Guerrieri and Matteo Iacoviello. Occbin: A toolkit for solving dynamic models with occasionally binding constraints easily. *Journal of Monetary Economics*, 70:22–38, 2015.
- Martin Guzman, Jose Antonio Ocampo, and Joseph E Stiglitz. Real exchange rate policies for economic development. *World Development*, 110:51–62, 2018.
- XIII IMF. The liberalization and management of capital flows: An institutional view. *Washington DC. IMF*, 14, 2012.
- Olivier Jeanne and Anton Korinek. Managing credit booms and busts: A pigouvian taxation approach. Technical report, National Bureau of Economic Research, 2010a.
- Olivier Jeanne and Anton Korinek. Excessive volatility in capital flows: A pigouvian taxation approach. *American Economic Review*, 100(2):403–07, 2010b.
- Callum J Jones, Thomas Philippon, and Venky Venkateswaran. Optimal mitigation policies in a pandemic: Social distancing and working from home. Technical report, National Bureau of Economic Research, 2020.
- Michel Juillard et al. *Dynare: A program for the resolution and simulation of dynamic models with forward variables through the use of a relaxation algorithm*, volume 9602. CEPREMAP Paris, 1996.
- Prakash Kannan, Pau Rabanal, and Alasdair M Scott. Monetary and macroprudential policy rules in a model with house price booms. *The BE Journal of Macroeconomics*, 12(1), 2012.
- Anton Korinek. Excessive dollar borrowing in emerging markets: Balance sheet effects and macroeconomic externalities. 2010.
- Anton Korinek. The new economics of prudential capital controls: A research agenda. *IMF Economic Review*, 59(3):523–561, 2011.
- Anton Korinek. Regulating capital flows to emerging markets: An externality view. *Journal of International Economics*, 111:61–80, 2018.

- Anton Korinek and Enrique G Mendoza. *From sudden stops to fisherian deflation: Quantitative theory and policy*. Annual Reviews, 2014.
- Anton Korinek and Damiano Sandri. Capital controls or macroprudential regulation? *Journal of International Economics*, 99:S27–S42, 2016.
- Anton Korinek and Alp Simsek. Liquidity trap and excessive leverage. *American Economic Review*, 106(3):699–738, 2016.
- P. Krugman. *In International finance and financial crises*. Springer, Dordrecht, 1999.
- Paul Krugman. A model of balance-of-payments crises. *Journal of money, credit and banking*, 11(3):311–325, 1979.
- Paul Krugman. Crises: the next generation. In *Conference Honoring Assaf Razin, Tel Aviv*, 2001.
- Paul Krugman. How did economists get it so wrong? *New York Times*, 2(9):2009, 2009.
- Jean-Jacques Laffont. Note historique sur les effets externes. *L'Actualité économique*, 51(3):420–433, 1975.
- Zheng Liu and Mark M Spiegel. Optimal monetary policy and capital account restrictions in a small open economy. *IMF Economic Review*, 63(2):298–324, 2015.
- B Malkiel. Efficient market hypothesis, w: P newman, m. milgate i j. eatwell (red.) the new palgrave dictionary of money and finance, 1992.
- Burton G Malkiel and Eugene F Fama. Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, 25(2):383–417, 1970.
- Ronald I McKinnon and Huw Pill. Credible liberalizations and international capital flows: The "overborrowing syndrome". In *Financial Deregulation and Integration in East Asia, NBER-EASE Volume 5*, pages 7–50. University of Chicago Press, 1996.

- Enrique G Mendoza. Credit, prices, and crashes: Business cycles with a sudden stop. In *Preventing currency crises in Emerging markets*, pages 335–392. University of Chicago Press, 2002.
- Enrique G Mendoza. Sudden stops, financial crises, and leverage. *American Economic Review*, 100(5):1941–66, 2010.
- Enrique G Mendoza. Macroprudential policy: Promise and challenges. Technical report, National Bureau of Economic Research, 2016.
- Hyman P Minsky. The financial instability hypothesis. 1992.
- Frederic S Mishkin. Monetary policy strategy: lessons from the crisis. Technical report, National Bureau of Economic Research, 2011.
- M. Obstfeld. The logic of currency crises. *National Bureau of Economic Research*, (4640), 1994.
- Maurice Obstfeld. The global capital market: benefactor or menace? *Journal of economic perspectives*, 12(4):9–30, 1998.
- Maurice Obstfeld, Jay C Shambaugh, and Alan M Taylor. The trilemma in history: tradeoffs among exchange rates, monetary policies, and capital mobility. *Review of Economics and Statistics*, 87(3):423–438, 2005.
- Arthur Cecil Pigou. The economics of welfare. Technical report, 1932.
- Alessandro Rebucci and Chang Ma. Capital controls: A survey of the new literature. Technical report, National Bureau of Economic Research, 2019.
- Hélène Rey. Dilemma not trilemma: the global financial cycle and monetary policy independence. Technical report, National Bureau of Economic Research, 2015.
- Julio J Rotemberg. Sticky prices in the united states. *Journal of Political Economy*, 90(6):1187–1211, 1982.

- Stephanie Schmitt-Grohé and Martín Uribe. Downward nominal wage rigidity, currency pegs, and involuntary unemployment. *Journal of Political Economy*, 124(5):1466–1514, 2016.
- Stephanie Schmitt-Grohé and Martín Uribe. Is optimal capital control policy counter-cyclical in open economy models with collateral constraints? *IMF Economic Review*, 65(3):498–527, 2017.
- Joseph E Stiglitz. Capital market liberalization, economic growth, and instability. *World development*, 28(6):1075–1086, 2000.
- Lawrence H Summers. International financial crises: causes, prevention, and cures. *American Economic Review*, 90(2):1–16, 2000.
- Jacob Viner. Cost curves and supply curves. *Zeitschrift für nationalökonomie*, 3(1):23–46, 1932.
- Charles J Whalen. The us credit crunch of 2007: A minsky moment. Technical report, Public policy brief//Jerome Levy Economics Institute of Bard College, 2007.

Titre : Quatre essais sur la régulation optimale des flux de capitaux internationaux de court terme

Mots clés : Economie Internationale, Crises financières, Finance Internationale

Résumé : La libéralisation du compte capital dans les pays émergents est généralement accompagnée par des troubles financiers mettant en péril la stabilité macroéconomique et financière de pays. Néanmoins, un nombre croissant de travaux de recherche sur les politiques de contrôle prudentiel des flux de capitaux, montrent que ces dernières peuvent limiter significativement ces troubles et les effets indésirables associés à la libéralisation financière. Particulièrement, les politiques de contrôle de capitaux et macroprudentielles sont de plus en plus recommandées afin de faire face aux crises financières dues à un arrêt brutal (Sudden Stop) des flux de capitaux de court terme.

La présente thèse explore, dans un premier temps, les facteurs qui déterminent la fréquence des épisodes de Sudden Stops, en mobilisant

des données trimestrielles de 75 pays avancés et émergents sur une période allant de 1960 à 2017. Nos principaux résultats soulignent qu'un niveau d'ouverture financière élevé ainsi qu'un faible écart du ratio Crédit sur PIB réduisent la probabilité d'occurrence de ces crises.

Dans un second temps, nous examinons le comportement cyclique et l'optimalité des politiques du contrôle prudentiel des flux de capitaux dans des environnements caractérisés par des Sudden Stops, à l'aide des modèles Stochastiques Dynamiques d'Équilibre Général pour Petite Économie Ouverte avec Contrainte du Collatéral qui sature Occasionnellement. Nos résultats corroborent le consensus émergent sur la capacité de ces politiques à améliorer le bien-être social, réduire la fréquence des crises et contribuer à la stabilité macroéconomique et financière.

Title : Four essays on the optimal regulation of short-term international capital flows

Keywords : International Economics, Financial Crises, International Finance

Abstract : Capital account liberalization in emerging market economies is generally considered as a source of financial instability. Nevertheless, a growing literature highlights a promising rule of prudential capital control policies aiming at mitigating the risk associated with financial liberalization. Especially, capital control and macroprudential policies are increasingly recommended to deal with Sudden Stop in short-term capital flows.

The present thesis explores the push and pull factors that determine the probability of experiencing a Sudden Stop crisis, using an extended data-set comprising quarterly data on 75 developed and emerging market economies over the time period 1960-2017.

Our main results show that a high financial openness index and a low credit-to-GDP gap reduce the likelihood of such events.

In addition, we examine the cyclical behavior and the optimality of a number of prudential capital control policies in different environments characterized by Sudden Stops, using Dynamic Stochastic General Equilibrium models (DSGE) for Small Open Economies (SOE), with Occasionally Binding Collateral Constraints. Our results corroborate the emerging consensus on the ability of these policies to improve the social welfare, to reduce the frequency of such crises, and to contribute to the macroeconomic and financial stability.