Inflation targeting and fiscal rules in developing countries : interactions and macroeconomic consequences

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Inflation Targeting and Fiscal Rules in Developing Countries: Interactions and Macroeconomic Consequences

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La faculté n'entend donner aucune approbation ou improbation aux opinions émises dans la thèse. Ces opinions doivent être considérées comme propres à leur auteur.

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List of acronyms

AE	Advanced Economy
ATT	Average Treatment effect on the Treated
BBR(s)	Budget Balance Rule(s)
CAB	Cyclically-Adjusted overall fiscal Balance
CAPB	Cyclically-Adjusted Primary fiscal Balance
CAPE	Cyclically-Adjusted-Primary Expenditure
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CEMAC	Central African Economic and Monetary Community
CERDI	Centre d'Etudes et de Recherches sur le Développement International
CFA	Communauté Financière Africaine
CPI	Consumer Price Index
DID	Differences-in-Differences
DR(s)	Debt Rule(s)
ECB	European Central Bank
ECCU	Eastern Caribbean Currency Union
ECOWAS	Economic Community of West African States
EIT	Eclectic Inflation Targeting
EME	Emerging Market Economy
EMS	European Monetary System
EMU	Economic and Monetary Union of the European Union
ER(s)	Expenditure Rule(s)
ERM	Exchange Rate Mechanism
FB	(Overall) Fiscal Balance
FD	Fiscal Discipline
FDI	Foreign Direct Investment
Fed	Federal Reserve
FFIT	Full-Fledged Inflation Targeting
FOC	First Order Condition
FR(s)	Fiscal Rule (s)

FRer	Country having adopted fiscal rule (FR)
GDP	Gross Domestic Product
GFS	Government Financial Statistics
GMM	Generalized Method of Moments
ICRG	International Country Risk Guide
IFS	International Financial Statistics
IMF	International Monetary Fund
IT	Inflation Targeting
ITer(s)	Inflation Targeter(s): countries having adopted Inflation Targeting
ITL	Inflation Targeting Lite
LIC	Low Income Country
MCI	Monetary Conditions Index
MP	Monetary Policy
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PCE	Personal Consumption Expenditure price index
PFB	Primary Fiscal Balance
PFM	Public Financial Management
PS	Propensity Score
PSM	Propensity Scores-Matching
PWT	Penn World Table
QI	Quality of Institutions
QOG	Quality Of Government
REER	Real Effective Exchange Rate
ROSC	Reports on the Observance of Standards and Codes
RR(s)	Revenue Rule(s)
SBS	(Primary) Structural Fiscal Balance
SGP	Stability and Growth Pact
UK	United Kingdom
US	United States (of America)
VAT	Value Added Tax
WAEMU	West African Economic and Monetary Union
WAMZ	West African Monetary Zone
WDI	World Development Indicators
WEO	World Economic Outlook
2SLS	Two Stages Least Squares

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GENERAL INTRODUCTION

"*The primary usefulness of […] fiscal rules consists of establishing a depoliticized framework for fiscal policy – much like the depoliticization of monetary policy under successful inflation targeting*" (Kopits, 2001, p. 8)

Since the early 1990s, rules-based macroeconomic policy frameworks are gaining considerable popularity among policymakers and academics around the world. On the monetary area, Inflation Targeting (IT) emerged as the new framework for the conduct of monetary policy (MP) while in the fiscal area, Fiscal Rules (FRs) turned out to be the framework of reference for conducting fiscal policy soundly, away from political pressures. Both frameworks (IT and FRs) function in the form of numerical targets placed officially and durably on macroeconomic aggregates (inflation and fiscal variables for IT and FRs respectively), - hence the term *rules-based* -, proceeds with ex-ante forecasts of these aggregates, and are supported by institutional infrastructures – transparency and accountability mechanisms *inter alia* - to frame the regular communications with the financial markets and the general public, regarding the different policy objectives, stances and decisions (see Bernanke and Mishkin, 1997; Svensson, 1999; Mishkin, 2000; Truman, 2003 for IT; and Von Hagen, 1992; Kopits & Symansky, 1998; Alesina et *al.*,1999 for FRs).[1]

According to the last IMF's classification of MP frameworks, around 44 countries can be considered as operating under IT.[2] But given that this classification includes the member States of the Economic and Monetary Union (EMU) of the European Union in the group of Inflation Targeters (ITers) while there is no consensus that the European Central Bank (ECB) practices IT, excluding these countries allows seeing that there are actually around 30 countries practicing explicitly IT.[3] Besides the relative important number of countries having adopted IT, another worth highlighting fact is that this new MP regime proliferated worldwide, gaining the developed as well as the developing world. First adopted by the Reserve Bank of New Zealand in 1990, IT rapidly spread among industrialized countries: Bank of Canada (1991), the Bank of England (1992), Sweden's Riksbank (1993), the Reserve Bank of Australia (1993), the Swiss National Bank (2000) and the Norges Bank (2001). In the developing world, IT reached the Emerging Market Countries (EMEs), the Transition Economies and the Low Income Countries (LICs). Since the late 1990s, various forms of IT have indeed been introduced in several EMEs (Brazil (1999), Chile (1999), Israel (1997),

[1] Further detailed discussion on the definition of IT and FRs is developed in the first chapter of this thesis.

[2] See IMF's Classification of Exchange Rate Arrangements and Monetary Frameworks, available at http://www.imf.org/external/np/mfd/er/index.asp.

[3] It is worth noting that even though the ECB displays much characteristics of an IT central bank, it does not self-declare officially as an ITer. Actually, the ECB publishes inflation forecasts but emphasizes that these predictions are purely indicative and do not constitute any commitment regarding the conduct of the MP (See Svensson, 2000). Moreover, the ECB self-describes as using two "pillars to achieve its objective of price stability, namely the broad money growth and the expected inflation". Accordingly, Carare & Stone (2006) for instance rather classified the ECB as an *eclectic* (or *implicit*) *ITer*, *i.e.* a central bank that already enjoys enough credibility so that it can achieve price stability without a clear commitment to IT.

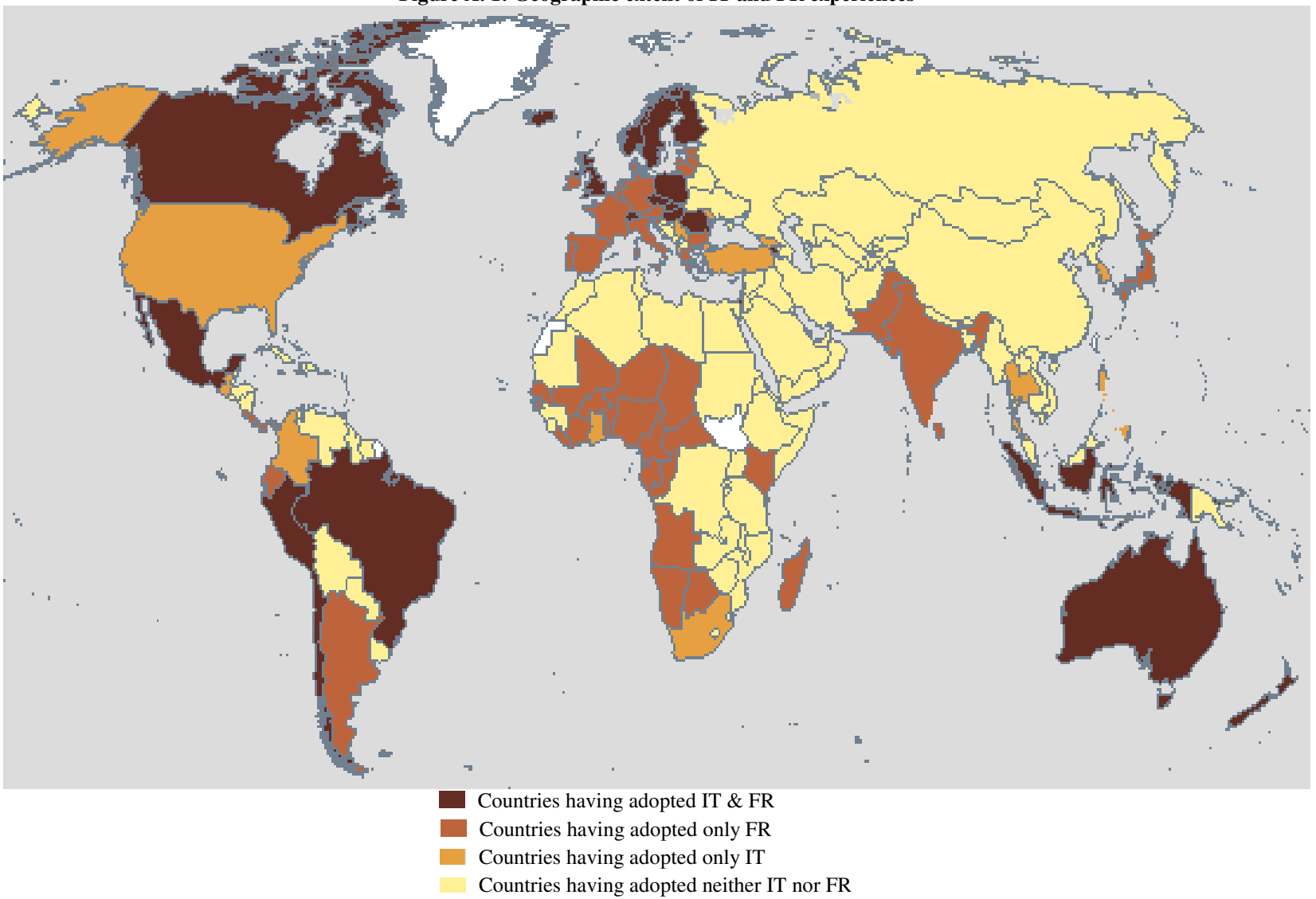
Korea (2000), South Africa (2000), Thailand (2000), Mexico (2001), the Philippines (2002), and Indonesia (2005)) as well as in some Transition countries, notably the Czech Republic (1998), Poland (1998), Hungary (1998), and Romania (2005). Most recently, some LICs also "*boarded the IT ship*", the Bank of Ghana being the pioneering central bank in this path. As pointed out by Gemayel et *al.* (2011), Serbia, Armenia, Albania, Moldova and Georgia are about to join the ITers' club shortly. Undoubtedly, the very recent (on January 25, 2012) commitment of the Federal Reserve (Fed) to follow an explicit inflation target marks a decisive step toward the popularization of this new MP strategy. Further, the fact that more than 35 developing countries, including notably China, Russia and several African countries (Angola, Botswana, Egypt, Guinea, Kenya, Morocco, Tunisia, Nigeria, Sudan and Uganda) are considering the prospect of switching to IT in a near future (see *e.g.*, Batini, et *al.*, 2006; and Warburton & Davies, 2012) suggests that the increasingly widespread adoption of IT is not going to stop, with a growing dominance of developing countries within the ITers' club.

Regarding FRs, a close look at the very recent fiscal rules database collected by the IMF's Fiscal Affairs Department (IMF, 2009) allows measuring the scope of the growing interest of policymakers for FRs around the world.[4] Indeed, a noticeable fact emerging from the analysis of this dataset is the spectacular increase in the number of countries having experienced FRs. Until the early 1990s, less than 10 countries enacted FRs, with Japan (1947), Indonesia (1967) and Germany (1972) being the first countries to place constraints on their fiscal aggregates. But since the mid-1990s, an impressive number of countries introduced various forms of FRs at the national as well as at the supranational level, so that the IMF estimates the number of countries having a FR to 80 in early 2009, including, 33 EMEs and 26 LICs. The recognition of the role of these fiscal constraints for preserving fiscal discipline, which is the cornerstone of the viability of the currency unions that emerged throughout the world (EMU, WAEMU, CEMAC, ECCU), was one of the main factors behind this new massive wave of FRs adoption (IMF, 2009).[5] This new wave of FRs, started with the New Zealand Fiscal Responsibility Act of 1994, and contrary to the first one, is backed up with strong enforcement mechanisms, including among others, transparency and responsibility procedures (Kopits, 2001). Figure A.1 below provides an overview of this increasingly widespread adoption of IT and/or FRs.

[4] The database is available at www.imf.org/external/np/pp/eng/2009/121609.pdf (p. 59-68).

[5] EMU=Economic and Monetary Union of the European Union (17countries); WAEMU: West African Monetary and Economic Union (8 countries); CEMAC= Central African Economic and Monetary Community (6 countries); ECCU= Eastern Caribbean Currency Union (6 countries).

Figure A. 1: Geographic extent of IT and FR experiences



To some extent, this concomitance in the popularity of both rules-based policy frameworks – IT and the new wave of FRs started spreading throughout the world nearly at the same time, namely from the first half of the 1990s - is not a pure coincidence. This co-movement in the spreading of both IT and FRs does reflect the recognition of the pivotal role of macroeconomic stability for a strong and balanced long term economic growth, which is the common ultimate goal of both these frameworks. Indeed, at the same period, a vast strand of the literature, led by the very influential paper by Fischer (1993) did stress out the undeniable role of macroeconomic stability, *i.e.* the phenomena which makes sound and predictable the domestic macroeconomic environment, in the quest for a sustainable economic growth, and hence for poverty reduction and improvement of living standards.

"*A stable macroeconomic framework is necessary though not sufficient for sustainable economic growth!*" (Fischer, 1993, p. 1)

In his study, Fischer (1993) points out that macroeconomic instability, as captured by high inflation rates and unsustainable fiscal balances is detrimental to economic growth, an effect that is found to be channeled mainly through an adverse effect on investments and productivity growth. Indeed, one matter of concern related to the instability of the macroeconomic environment is that the unpredictability caused by price instability and/or large budget deficits hampers seriously resource allocation decisions and investments (see also Ramey & Ramey, 1995; or Easterly & Kraay, 2000).[6] Besides, it is worth emphasizing that the relevance of macroeconomic stability is not limited to creating the conditions for setting off economic growth, but also and especially to sustain this positive growth trajectory over a long time period, by preventing financial crises and their associate sharp contractionary effects on output from taking place. In the current context of globalizing financial markets, fiscal discipline and price stability, hence macroeconomic stability, are the cornerstones of the strength of a country's financial system. Consequently, those perceived by the financial markets as recording low long-term *fundamentals* may face severe speculative attacks, resulting in massive reversals of capital flows (the so-called '*sudden stop*'), triggering ultimately financial crises, particularly in the contexts of weak regulations and supervision (Mishkin, 1996; 2003). Such scenarios have been at work in several countries, notably in the

[6] Note however that the concept of macroeconomic stability encompasses other dimensions, including the appropriateness of interest rates, the competitiveness and predictability of the exchanges rates, the viability of the balance of payments and the healthiness of the public and private sector balance sheets (see *e.g.*, Fischer, 1993 or Ocampo, 2005).

sovereign debt crisis of the early 1980s, the Mexican crisis (1994), the Asian financial crisis (1997) and the Argentine crisis (2001).

However, one needs to keep in mind that while examining the *corner solutions*, Fischer did carefully note that most of the African countries of the franc zone have grown slowly since 1980 despite low inflation, suggesting clearly that even though high inflation is not consistent with sustained growth, low inflation and small deficits are not necessarily conducive to high growth even over long periods. Put simply, macroeconomic stability just stands as a prerequisite for a strong and balanced long term economic growth, *i.e.* any endeavor to foster economic growth may be undermined by price volatility and/or unsustainable fiscal policies. In the same vein, it is worth noting that the recent financial crisis revealed to some extent, certain limits of macroeconomic stability, strictly speaking, when it comes to achieving long-lasting growth, as the experience has shown that macroeconomic stability may not be a sufficient condition for financial stability. This sparked the ongoing interest in the literature for accompanying the conduct of MP with macroprudential measures (see, *e.g.*, Cúrdia & Woodford, 2010; Kannan et *al.*, 2009; Lim et *al.*, 2011; and Agénor et *al.*, 2012).[7]

Notwithstanding, even though the recent global recession and financial crisis have highlighted the limits of macroeconomic stability in avoiding and/or mitigating the severity of financial instability, they - especially the Euro debt crisis - have not denied the virtues of sound and prudent policymaking for achieving long-lasting growth. These have rather been reasserted. Indeed, the loose fiscal policies centered in Greece, but also present across the southern Euro Area (Italy, Portugal and Spain) and Ireland, combined with a weak banking system and a lack of a centralized fiscal entity capable of acting in a crisis on behalf of the Euro Area as a whole, have resulted in an unprecedented painful and costly crisis that completely devastated the growth momentum initiated many years before. According to the last European Economic Outlook projections, Portugal and Greece for instance are expected to remain in recession until mid-2012 and early 2013, respectively (IMF, 2011a). Further stylized facts on the fiscal and inflationary consequences of these recent global and financial crises allow realizing that in addition to the need to ensure stability in the financial markets, one of the main policy challenges that this crisis and its associated consequences have re-put at the forefront of

[7] Macroprudential measures are defined as regulatory policies that aim to reduce systemic risks to protect the financial system against shocks (IMF, 2011b).

policy discussions is the imperative for policymakers to work toward the restoration of sound and strong long term *fundamentals*. This includes *inter alia*, a return to fiscal solvency and preserving past gains in terms of well-anchored inflation expectations, a key challenge that is also included in the last African Economic Outlook, as summarized in the following: "most LICs are currently on a faster growth trajectory, but […] these countries should focus squarely on medium-term considerations in setting fiscal policy while tightening monetary policy wherever nonfood inflation has climbed above the single digits" (IMF, 2011c, p. 1).

Indeed, on the one hand, the policy actions taken to buffer the effects of the recent global recession and financial crisis have eroded fiscal positions in several countries. The current debt outlook is markedly worsening, as under current projections the general government gross debt-to-GDP is expected to rise from 73 percent at end of 2007 to 109 percent at end of 2014 in the advanced economies for example (IMF, 2010). The fiscal outlook is significantly stronger for EMEs, as debt ratios are projected to return to pre-crisis levels by 2013, but is not without risks (IMF, 2009). In the LICs, debt dynamics are under control, thanks to the fiscal consolidations, strong growth and debt relief, but may be subject to risks, as many developing countries have let fiscal automatic stabilizers operating in response to the contractionary effects of the crisis (IMF, 2010). In the years ahead, if fiscal adjustments and concessional official aid are not at the rendezvous, then the risk of debt distress may increase. Given this current worsening in the debt outlook around the world, then putting back public debt and fiscal balances on a sustainable path turns out to be a major imperative.

On the other hand, the massive output contraction which followed the recent crisis has raised the spectrum of deflation in many countries, that is, the situation in which MP is caught into the *liquidity trap*, highlighting the importance of having in place an appropriate MP framework to provide the central bankers with enough room to expand the economy during crises without hitting the so-called *Zero-Lower Bound* (see, *e.g.*, Walsh, 2011). Furthermore, the recent hikes in food and oil prices, in addition to have hit severely the purchasing power of poor households, are exerting upward pressures on the general level of prices. Consequently, they raised concerns regarding the likely de-anchorage of inflation expectations along with its associated negative consequences on the stability of the macroeconomic environment. An appropriate MP framework, capable of anchoring credibly inflation expectations while providing the monetary authorities with the necessary flexibility to deal temporally with output shocks is therefore more than ever strongly needed.

Contribution of Inflation Targeting and Fiscal Rules to macroeconomic stability

For macroeconomic stability led by MP, IT seems to be a candidate of choice. Indeed, as pointed out by Bernanke and Mishkin (1997), IT, which functions in the form of a judicious mix of discretion an constraints does have the required qualities to rule out the so-called *inflationary bias* without jeopardizing the potential for smoothing output growth. Accordingly, IT appears well to meet the policy challenges faced by modern monetary policymaking, in non-crisis period as well as during short-run disturbances – such as the current economic environment. In the same vein, IT countries have been found to experience better resilience to the contractionary effects of the crisis than the non-ITers, in terms of unemployment rates, industrial production and GDP growth rates, even though the evidence was found to be weak in the EMEs (de Carvalho Filho, 2010). This stems from the fact that IT countries had relatively higher nominal interest rates than the non-IT countries before the onset of the crisis. Consequently, they had more room to expand the economy without hitting the *Zero Lower Bound* (de Carvalho Filho, 2010; Walsh, 2011; and Kuttner & Posen, 2012). Interestingly, these relatively higher nominal policy rates in IT countries in the pre-crisis period - which underlie the capacity of their central bank to '*lean against the wind*' without hitting the *Zero Lower Bound* - have not been found to be harmful to economic activity (Gemayel et *al.*, 2011).[8] This relative better resilience of IT to the crisis, together with the other macroeconomic benefits[9] found to be associated with its implementation, therefore make this MP regime, an actual candidate for creating permanently a sound and predictable macroeconomic environment (Carney, 2012). This is well reflected in the words of Rose who exclaimed in the following words: "A Stable International Monetary System Emerges: Inflation Targeting is Bretton Woods, Reversed" (Rose, 2007).

Regarding macroeconomic stability led by fiscal policy, beyond the painful adjustments that must be necessarily implemented in the near short term, bold fiscal reforms, including the adoption of credible rules-based fiscal frameworks (FRs), aiming to ensure durably, if not permanently fiscal discipline, appears to be at the core of the policy agenda. Indeed, the tendency of government to run permanently fiscal deficits, the so-called *deficit bias*, can be

[8] Note however that the debate regarding the macroeconomic effects and notably the growth-effects of IT is not clear-cut (see *e.g.*, Ball & Sheridan, 2005; and Brito & Bystedt, 2010).

[9] A vast strand of the empirical literature found evidence supporting that IT has several macroeconomic benefits, in terms of inflation dynamics, output growth volatility, interest rates and exchange rates volatility, notably in developing countries (see *e.g.*, Batini & Laxton, 2007; Gonçalves & Salles, 2008; IMF, 2005; Lin & Ye, 2009; and Mishkin & Schmidt-Hebbel, 2007). Section 1.2.5 of chapter 1 provides a detailed review of these effects.

explained by three main structural factors: i) the *common pool problem* which arises when the various decision makers involved in the budgetary process (legislators, the finance minister, line ministers, etc.) compete for public resources and fail to internalize the current and future costs of their choices (Weingast et *al.*, 1981; von Hagen & Harden, 1995; Hallerberg & von Hagen, 1999; Velasco, 1999; and Krogstrup & Wyplosz; 2010); ii) the *agency problem* which stems from the informational asymmetry, and incentive incompatibilities between the government and voters and within the government hierarchy. Most of the time, it results in manipulation of fiscal policy for electoral purposes (Nordhaus, 1975; Buchanan & Wagner, 1977; Cukierman & Meltzer, 1986; and Dixit, 1998); and iii) the *dynamic inconsistency problem* which pushes governments to use strategically budget deficits to tie the hands of their successors when faced with electoral uncertainty (Alesina & Tabellini, 1990; and Alt & Lassen, 2006).[10] Consequently, delivering fiscal discipline commands to rule out imperatively the roots of this *deficit bias*. In this regard, placing institutional constraints, either in the forms of numerical targets on fiscal aggregates or in the forms of procedures governing the drafting, the approval, the implementation and the monitoring of the budgetary process, *i.e.* introducing FRs, turns out to be one of the most credible and effective arrangements (von Hagen, 1992; Kopits & Symansky, 1998; and Alesina et *al.*, 1999). Indeed, rules-based fiscal frameworks are superior to a discretionary approach, since contrary to the latter, they allow escaping the dynamic inconsistency problem (Kydland & Prescott, 1977; Kopits, 2001; and Debrun et *al.*, 2008) by compelling the government to tie its own hands, such as *Ulysses ordered his sailors to tie him tightly to the mast, no matter how much he would beg, so as not to fall victim to the songs of the Sirens*. FRs also help discarding the *common-pool problem*, through a better centralization and/or hierarchy in the budgetary process (von Hagen, 1992, Hallerberg & von Hagen, 1999; and Ljungman, 2009). Finally, FRs are effective in tackling the *agency problem*, through higher transparency and accountability in the budget process (Kopits & Craig, 1998; Alt & Lassen, 2006; and Shi & Svensson, 2006).

Value Added of the thesis

Relying on the aforementioned undeniable role of IT and FRs in creating the necessary conditions for a strong and balanced long term economic growth, and hence for achieving poverty reduction and for improving living standards, this thesis, which is mainly focused on

[10] For a very recent and detailed literature review on the underlying causes of fiscal deficits, see Eslava (2011).

developing countries – including the LICs and the Middle Income Countries -, aims to extend the reflection on the macroeconomic consequences of these rules-based policy frameworks. To this end, based essentially on empirical analyses, it places a special focus on issues not addressed yet but important in the existing literature.[11] Of particular importance, the thesis examines the extent to which the interactions between IT and FRs as well as the timing for adopting them may influence their respective individual macroeconomic consequences.

Outline and Main Results

The thesis is organized around seven chapters. **Chapter 1** lays the **c**onceptual framework and provides an overview of IT and FR experiences around the world. More precisely, **Chapter 1** defines thoroughly IT and FRs, describes the various forms that their implementation may take and reviews the main motivations underlying their adoption. It also identifies comprehensively the different experiences of both frameworks throughout the world and ends up with a detailed review of the existing evidence on the macroeconomic consequences of both frameworks. On the basis of this conceptual and empirical background, the next three chapters of the thesis then explore "New Evidence on the Macroeconomic Consequences of IT and FRs".

Relying on one of the alleged channels (private investment) through which macroeconomic stability is expected to be conducive to economic growth (as underlined above), **Chapter 2** analyzes the effect of IT on Foreign Direct Investment. The underlying idea is that even though IT is not directly concerned with Foreign Direct Investment (FDI), it may contribute to attract FDI through a side effect, notably by making the macroeconomic environment more sound and predictable. The analysis is conducted on a wide panel dataset of 53 Developing countries over the period 1980-2007. Employing a variety of *propensity scores matching* methods which allow controlling for *self-selection* in IT adoption, we find that IT does help attracting significantly FDI in developing countries. The magnitude of the contribution of IT to FDI inflows is rather important, as IT enhances FDI inflows by at least 1.404 and up to 1.985 percentage points of GDP, depending on the matching technique used. The result is also found to be robust to several robustness checks (alternative *starting* dates of IT adoption,

[11] A detailed literature review of the existing macroeconomic effects of IT and FRs is discussed in chapter 1 (of this thesis), section 1.2.5 and 1.3.5, respectively.

different specifications for the *probit* selection model, different sub-samples, or when controlling for hyperinflation episodes).

Then **Chapter 3** moves to analyzing the influence of IT on the quality of institutions, a variable through which the aforementioned FDI-enhancing effects of IT may be channeled, as it is a key part of the FDI *pull* factors. The chapter tests the idea that adopting an IT regime may provide strong incentives, from a public finance stance viewpoint, for governments to undertake reforms designed to improve the quality of institutions, as IT constrains government discretion when it comes to raising seigniorage revenue. For this purpose, we develop a simple model in which public spending may be financed by taxes and seigniorage, and where the quality of institutions exerts a positive effect on tax collection. To remove the inflation bias of MP, we consider an appropriate inflation target. Then, the model emphasizes the role of the "political context" (the initial cost of reforms) as regards the link between institutional quality and the monetary regime. For high or low values of the political cost of reforms, no relation emerges between these two variables. For intermediate values, on the contrary, a tighter monetary regime induces government to undertake efforts for improving the quality of institutions, in order to increase the efficiency of tax collection, because seigniorage resources become insufficient. Based on a panel dataset of 53 developing countries (the same as that of Chapter 2) examined over the 1984-2007 period, and using the *propensity scores-matching* methods, which allow controlling for *self-selection* in IT adoption, we find that IT does improve institutional quality, in accordance with our theoretical model.

Chapter 4 concludes the investigation of new evidence on the macroeconomic effects of rules-based policy frameworks by proposing a more formal evaluation of the discipline-enhancing effect of FRs, an issue of particular importance in the current context of erosions of fiscal stances around the world. Build upon the ground that not only a few papers have assessed the effectiveness of FRs in shaping fiscal behaviors in the developing world, but also that all these existing studies shared a common drawback, namely ignoring the *self-selection* problem in FRs adoption, Chapter 4 therefore takes advantage of the recently-developed *propensity scores matching* methods, to appraise more formally the impact of FRs on fiscal discipline. It finds that FRs do really improve fiscal discipline, as measured by the structural fiscal balance. The magnitude of the contribution of FRs to fiscal discipline is rather important, as FRs adoption enhances the Cyclically-Adjusted Primary Fiscal Balance by at

least 0.642 and up to 1.180 percentage points of GDP. But this effect varies with the type of rules: while budget balance rules and expenditure rules have significant discipline-enhancing effects, the effect of debt rules appears mixed and not significantly different from zero. Last but not the least, the *treatment* effect was found to differ according to countries' characteristics: number of FRs, time length since FRs adoption, presence of supranational FRs, government fractionalization and government stability.

Recognizing that both IT and FRs share a common ultimate goal, namely conferring credibility to macroeconomic policies, the thesis, in the last three chapters, then wonders about the extent to which the interplay between Monetary and Fiscal Policymakers may matter for the respective individual effects of fiscal and monetary policies.

Contrary to the existing literature which focuses exclusively on the role of fiscal discipline as a precondition for IT adoption, **Chapter 5** extends this literature by considering the reverse direction, namely by exploring the performances of IT adoption in terms of fiscal discipline. Build upon the influential literature on the unpleasant monetarist arithmetic (Sargent & Wallace, 1981), this chapter postulates that IT promotes fiscal discipline through two ways: i) first, IT adoption may catalyze the implementation of sound fiscal policies for preserving the viability of the IT regime itself (a direct *credibility-signaling* argument); ii) second, the commitment to low inflation target which underlies the IT regimes makes it harder for the government to rely on seignoriage revenue for financing its deficits, commanding it to run fiscal surpluses (indirect, *inflation-based*, arguments). Evidence based on a sample of both developing and developed countries shows that IT adoption exerts a positive and significant effect on FD. The result is found to be robust to a wide variety of alternative specifications. In addition, although IT adoption always improves FD, this effect is statistically significant only in developing countries, a result that may fuel the current debate regarding the relevance of IT adoption in general, and particularly for developing countries.

This finding that IT – which is a MP framework, not a fiscal policy framework - shapes fiscal behaviors then provides fertile ground for assuming that the interactions between and/or the timing of adopting IT and FRs may matter for their macroeconomic effects, an issue that we address in **Chapter 6**. More precisely, Chapter 6 analyzes the effects of IT and FRs on fiscal behaviors and on inflation dynamics. Its main novelty is twofold: first, it is the first study which accounts explicitly for the role of the interactions between IT and FR while assessing

their budgetary and inflationary effects. Second, it questions the optimality of the sequence of adoption by examining which of the two following sequences of adoption, namely *introducing FRs first before adopting IT* and *adopting IT first before introducing FRs* leads to better performances. The analysis is based on a wide panel dataset of 152 countries, covering both developed and developing countries, over the period 1990-2009. It finds that some complementarity is at work in the effectiveness of IT and FRs, as adopting both IT and FRs leads to better results in terms of running primary (or overall) fiscal surpluses and in terms of bringing down average inflation than adopting only one of these two frameworks. We also highlight the dominance of the sequence which consists of introducing FRs first before adopting IT over the opposite sequence regarding their fiscal and inflationary effects.

Then the thesis extends the analysis of the role of the interplay between monetary and fiscal policymakers to West Africa in **Chapter 7**. In this chapter, we examine the influence of Policy Mix coherence in the Economic Community of West African States (ECOWAS). In line with the literature on the coordination mechanisms of economic policy in Monetary Unions, we test the hypothesis that in ECOWAS, better coherence between monetary and fiscal policies yields higher economic growth. This chapter is innovative in two ways. First, through an interaction between the monetary conditions index and the primary structural fiscal balance, it highlights coherence-type complementarities between MP and fiscal policy with regard to their effects on economic activity. Second, it shows that the influence of policy mix coherence on the effect of MP is different according to the stance of the economy within the four possible regimes of policy mix, mostly in the West African Economic and Monetary Union (WAEMU) subsample, where integration is deeper than in the non-WAEMU countries, thanks to the common currency (the CFA Franc) they share. The analysis is based upon a panel dataset from 1990 to 2006 and remains robust to alternative specifications used to calculate the monetary conditions index. Finally, we conclude and draw some policy recommendations (**General Conclusion**).

Before shifting to Chapter 1, it is worth noting that even though the seven chapters of the dissertation are linked consistently, we tried to render each chapter self-sufficient, for ease of reading. Accordingly, the reader will notice that the presentation of the methodology of *propensity scores-matching* (used in four out of the seven chapters) is repeated throughout these chapters.

Chapter 1

Definitions, Typology and Overview of Inflation Targeting and Fiscal Rule Experiences around the World

"*One difficulty in assessing whether the United States has been practicing inflation targeting is in defining the term*".

(Kohn, 2003, p. 2)

1.1. Introduction

As well stressed out by Kohn (2003), a major difficulty regarding which country to classify as ITer relies on the difficulty in defining the notion of IT itself. Indeed, despite the considerable popularity of IT, there is no consensus on how to define exactly the term. This is reflected in the divergence on the identification of the *starting* dates of IT (Rose, 2007). The main reason underlying these controversies stems from the differences in the understanding of what constitutes really IT. One matter of concern behind these divergences is the extent to which they can influence the results of all studies assessing the impacts of IT. Of particular relevance, the results of this dissertation - which aims to assess the macroeconomic effects of IT – heavily depend on the meaning we give to IT. To some extent, the same applies also to FRs, *i.e.* the results of an assessment of the performances of FRs are strongly conditioned by what we mean by FRs. Given this crucial importance of the definition of IT and FRs for the evaluation of their macroeconomic performances, the validity of the results of this thesis needs thus to rely on a solid conceptual background of IT and FRs.

For this purpose, the present chapter of the thesis provides a broad discussion on the conceptual framework of both IT and FRs. More precisely, the chapter lays the foundations for further analyses by defining both IT and FRs, reviewing comprehensively the countries which have adopted IT and/or introduced FRs to date, and by addressing the following related issues: what are the main characteristics of IT and FRs? Under which forms are they implemented? What are the key institutional parameters surrounding their implementation? What are the pivotal motivations underlying countries' decisions to adopt IT and FRs? Do developing countries behave differently when it comes to implementing IT and FRs? Then, the chapter reviews the existing literature on the macroeconomic consequences of IT and FRs.

1.2. Inflation Targeting

1.2.1. Definition

In the literature, IT is diversely defined. This diversity results from the flexibility of IT practices around the world, and affects the list of countries considered as operating under IT.

According to Kuttner (2004), there are two alternative ways, not mutually exclusive, of thinking about IT: one known as the *practical* definition of IT, and based on the observed characteristics of the framework for conducting monetary policy (MP), and the other, consisting of defining IT in terms of a MP rule. This dual view of IT stems from the fact that IT was first developed in practice by central banks before being formalized theoretically.

Practical definition of IT…

With respect to the first approach of characterizing IT, two tendencies can be distinguished: the first consists of considering central banks' self-declarations as the main criterion for classifying them as an ITers or not. Put simply, if a central bank declare itself as targeting inflation, then it is classified as an ITer. Obviously, such a way of classifying central banks may be misleading for two reasons: on the one hand, some central banks declare themselves as ITers but do not fulfill the other required features to be actually classified as such. This was the case of the central bank of Chile which declares itself as an ITer in 1991 while it keeps on pursuing a crawling exchange rate regime, so that 1999 is rather considered in several studies as its actual *starting* date of IT (see *e.g.*, Rose, 2007). On the other hand, some central banks do not declare themselves as ITers, but do possess much of the features of IT. These include notably the Federal Reserve before its recent (January 25, 2012) explicit commitment to follow an inflation target and the European Central Bank (ECB). It is worth noting that Bernanke & Mihov (1997) even consider the practices of Germany's Bundesbank as those of an IT central bank. Indeed, they point out that the Bundesbank indirectly targeted inflation, using money growth as a quantitative indicator, just as an intermediate in the calibration of its policy.[12] Consequently, this naive self-declaration-based classification of central banks turns out to be inappropriate. The second tendency rather consists of identifying, on the basis of country experiences with IT (see *e.g.*, Bernanke et *al.*, 1999), some objective features to be considered as the pivotal criteria for classifying a central bank as an ITer. In this regard, several definitions exist in the literature, but can be grouped into 3 main ranges:

1) Svensson (1997a) defines IT as a MP *strategy*, first introduced successfully by the Central Bank of New Zealand in 1990 and displaying three main characteristics: i) announcing a numerical target for inflation; ii) implementing a MP which ascribes a major role to inflation

[12] In the face of conflicts between its money growth targets and inflation targets, the Bundesbank generally chose to give greater weight to its inflation targets.

forecasts, hence the term "*inflation-forecast targeting*" attributed to this way of conducting MP; and iii) a higher degree of transparency and accountability.

2) Mishkin (2000) suggests capturing the essence of IT through the five following elements: "i) the public announcement of medium-term numerical targets for inflation; ii) an institutional commitment to price stability as the primary goal of MP, to which other goals are subordinated; iii) an information-inclusive strategy in which many variables and not just monetary aggregates or the exchange rates are used for deciding the setting of policy instruments; (iv) increased transparency of the MP strategy through communications with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and (v) increased accountability of the central bank for attaining its inflation objectives."

3) Truman (2003) finally considers the four following features as the key elements of IT: "i) adopting price stability as the formal goal of MP, ii) articulating a numerical target or sequence of targets, iii) establishing a time horizon to reach the target, and iv) creating an evaluation system to review whether the target has been met".

A relative consensus seems to emerge from these three definitions, except on the point relative to the commitment to price stability as the overriding goal of MP. Indeed, while Mishkin (2000) and Truman (2003) do emphasize the importance of this point, Svensson (1997a) rather suggests that this feature is not essential for characterizing the IT strategy, arguing that IT is compatible with a dual mandate of MP. In the literature, the second definition (Mishkin, 2000) is the most used. This may be explained by the fact that in contexts where inflation expectations are not well anchored yet, notably in developing countries, ascribing a dual mandate to MP without establishing a clear hierarchy between them, *i.e.* without assigning clearly a greater weight on one or other of these two mandates may result in further de-anchorage of inflation expectations. Indeed, such a MP framework may be counterproductive for one of the main features underlying the IT strategy, namely the transparency in communicating with the markets about MP objectives and plans. This lack of transparency may undermine the effectiveness of MP in keeping inflation under track, as this reduces the credibility of the central bank, which is however the cornerstone of modern central banking. Mishkin (2000)' definition of IT therefore appears to be more comprehensive than Svensson (1997a). Furthermore, Mishkin (2000) covers a key element of IT that is missing in Truman (2003), namely that IT employs an information-inclusive strategy for

deciding the setting of MP instruments. As a consequence, Mishkin (2000) provides the most comprehensive definition of IT, and will be the *practical* definition of reference later in this thesis.

It is however worth noting that confusion may still subsist with Mishkin (2000) practical definition of IT, as some criteria remain unclear, leaving room for subjectivity. For instance, what is a "high" level of transparency and or accountability? Further, as pointed out by Amato & Gerlach (2002), the IT frameworks in use have typically been refined considerably over time, suggesting that the definition of IT is not static but dynamic, evolving according to the practice of the framework by central bankers.

Policy rule-based definition of IT…

Regarding this second approach of thinking about IT, other studies suggest thinking of IT in terms of a policy *rule*, viewed broadly as a "guiding principle for formulating MP" (Kuttner, 2004). In this regard, two kinds of distinctions can be made on policy rules: on the one hand, *optimal rules* can be opposed to *ad hoc rules*, *i.e.* those based on an explicit optimization problem *versus* those that rather link the policy *instrument* to a set of macroeconomic variables.[13] Examples of *ad hoc* rules include the so-called *Inflation Forecast-based* rules, which link the current interest rate to the inflation forecasts (Batini & Haldane, 1999). When the coefficient on the output gap and on the deviation of the inflation rate from its targeted level are 0.5 and 1.5 respectively, then the rule fits the classical Taylor rule (Taylor, 1993). *Optimal* rules rather express as a minimization of the expected loss function of the central bank. The solution that results from the minimization of this loss function is an *optimal* MP rule provided that the sum of the coefficients on the deviation of inflation from its targeted level inflation exceeds one, consistently with the Taylor's principle (see Rudebusch & Svensson, 1999; and Williams, 2003). On the other hand, a distinction can be made between *targeting* and *instrument* rules: the first specifies entirely the rules in terms of the targets of MP (inflation and output), while the second rather is formulated in such a way that it renders optimal the setting of the MP *instrument* (namely the short-term interest rate under the control of the central bank).

[13] Note however that both these rules are part of the *contingent* rules, as opposed to *non-contingent* or *unconditional* rules which relate to an inflexible commitment to a rule, prohibiting any reactions to business cycle fluctuations. Central banks following such unconditional rules place a zero weight on output fluctuations in their loss function, and have then been called "Inflation Nutters" by King (1997)

In sum, this yields four alternative ways of specifying a MP rule, as summarized in the following table (*Table 1.1*) borrowed from Kuttner (2004).

Table 1. 1: A Classification of Policy Rules

	Ad hoc	Optimal
Instrument	**(I):** Taylor rule Inflation forecast-based (IFB) rule	**(II):** $i_t = \pi^* + \tilde{a} x_t + \tilde{b}(\pi_t - \pi_t^*)$
Targeting	**(III):** $E_t \pi_{t+k} = \pi^*$	**(IV):** $E_t \sum_{\tau=0}^{\infty} \delta^t \left[(\pi_{t+\tau} - \pi^*)^2 + \gamma x_{t+\tau}^2 \right]$ $E_t \left[(\pi_{t+1} - \pi^*)^2 \right] = -\frac{\lambda}{k} E_t x_{t+1}$

Source: Kuttner (2004). Note: the optimal *instrument* rule example is from Svensson (1997a, Equation 6.11). The examples of *optimal targeting* rules are from Svensson (2003, Equations 5.1 and 5.7). Throughout, π represents the inflation rate, π* the inflation target, *x* is the output gap, and k is the coefficient on the output gap in the inflation equation (Phillips Curve).

In line with this classification of MP rules, Svensson (1997a; 1999) suggests modeling *a posteriori* (ex-post)[14] IT as an "*optimal Targeting rule*" (quadrant 4 of *Table 1.1*) derived from a "reasonable explicit objective function". Besides, Walsh (2002) and Woodford (2004) also describe IT as an optimal targeting rule. On the contrary, Gali (2002) and McCallum (2002) rather model IT simply as an *ad hoc instrument* rule, characterized by some fixed (but not necessarily announced) target of inflation π*, and an inflation coefficient in excess of unity to guarantee that eventually inflation returns to π*.

IT as a framework, not a mechanical policy rule…

Bernanke & Mishkin (1997) disagree with this second approach of thinking about IT as an optimal targeting rule, and rather describe IT as a "*framework, not a mechanical rule*". From their point of view, the best practice of IT should be viewed as a framework of "*constrained discretion*", resulting from a judicious mix of discretion and constraints, allowing to strike the right balance between the inflexibility of strict policy rules (as those suggested by Svensson (1997b; 1999)) and the potential lack of discipline and structure of a discretionary approach of conducting MP. The discretionary component of this framework stems from the autonomy it gives to central bankers for setting the policy instrument in such a way to hit their announced target for inflation, also known as the *operational* (or *instrument*) independence of the central bank. This discretion feature of IT is also materialized by other institutional parameters

[14] Recall that the practice of IT by central bankers preceded its theoretical formalization by academics.

inherent to the inflation target, including the width of the target band, the time horizon of the target, the use of inflation measures more easily controllable by the central bank, such as core or underlying inflation measures (as opposed to headline inflation)[15] and the definition of ex-ante escape clauses. The constraining component of the IT framework refers to the strategy of communication which underlies it, a strategy which mainly consists of setting strong and tough transparency and accountability requirements. These latter allow supporting the credibility of the institutional commitment to price stability. This ultimately helps anchoring inflation expectations, *i.e.* reducing the persistence in inflation dynamics, since transparency and accountability enhance the credibility of MP announcements, hence leading private agents and the financial markets to formulate their inflation expectations with respect to their inflation forecasts and not to the past values of inflation. In this line, it is worth mentioning that IT is also viewed as a "forward-looking" approach of conducting MP (Svensson, 1997a), a notion also present in the inflation Forecast-based view of IT (Batini & Haldane, 1999).

Reconciling the practical and the rule-based definition of IT…

In summary, it turns out that IT is best described in terms of a MP framework (*practical* definition) as well as in terms of an optimal targeting rule (*rule-based* definition), and follows a forward-looking approach in both cases. Accordingly, a reasonable compromise would consist of describing **IT as a forward-looking rule-based framework for conducting MP, first adopted by the Central Bank of New Zealand in 1990**[16] **and characterized by five key elements (**those pointed out by Mishkin (2000)).

[15] Core inflation refers to inflation measures used by central banks to filter out the effect of short-term fluctuations in certain components of the consumer price index (CPI), such as food prices and energy prices, as well as one-off changes in the overall price level, resulting for example from changes in the VAT rate or long-lasting level changes in energy prices (Freedman & Laxton, 2009). Another form that this discretionary feature of IT can take is the use of "adjusted targets", where the principle consists of abandoning the initial target in the face of a larger and /or persistent shock, to use an adjusted target that should then be publicly announced to avoid a loss of policy credibility (see Fraga et *al.*, 2003 for the case of the central bank of Brazil).

[16] Note that 1989 is sometimes considered as the starting date of IT (see *e.g.*, Hu, 2003; Carare & Stone, 2006; Gemayel et *al.*, 2011; or Warburton & Davies, 2012). This stems from the fact that actually, the establishement of IT came into effect with the Reserve Bank of New Zealand Act of 1989. But as well stressed out by Ball & Sheridan (2005), the genuine starting date of IT should range around the first full quarter in which a specific inflation target or target range was in effect, with this target having been announced publicly at some earlier time. The main reason for such a more stringent choice for the beginning of IT lies on the fact that most of the intended effects of IT, namely those which occur through the anchorage of inflation expectations, work only if agents know that they are currently in an IT framework. Besides, from this stringent viewpoint of identifying the *starting* date of IT, if a central bank declares *a posteriori* that it has operated under an IT regime during a given period without pre-announcing it publicly, then that period is not retained as an IT period.

List of Inflation Targeters (ITers)…

After having broadly discussed and summarized the exact meaning of IT, we then deduct the countries that can be classified as operating under IT (ITers). We mainly rely on the last IMF's classification of MP frameworks (adjusted for the exclusion of the Euro area countries, as discussed in the General Introduction), on Rose (2007) and Roger (2009), for identifying the ITers along with their *starting* dates.[17] We also base on newly updated lists taken from Batini et *al.* (2006), Gemayel et *al.* (2011) and Warburton & Davies (2012) to identify the very recent experiences of IT adoption as well as the prospective candidates of IT adoption. *Table 1.2* below shows the ITers along with their *starting* dates.

Table 1. 2: ITers' list along with their *starting* dates

Country	*Starting* dates	Country	*Starting* dates
	Default/Conservative		**Default/Conservative**
New Zealand	1990/1990	Iceland	2001/2001
Canada	1991/1992	Mexico	1999/2001
United Kingdom	1992/1992	Norway	2001/2001
Australia	1993/1994	Peru	2002/2002
Sweden	1993/1995	Philippines	2002/2002
Finland*	1993/1994	Guatemala	2005/2005
Spain*	1995/1995	Indonesia	2005/2005
Israel	1992/1997	Romania	2005/2005
Czech Republic	1998/1998	Slovak Republic*	2005/2005
Poland	1998/1998	Armenia	2006/In transition to FFIT
South Korea	1998/1998	Turkey	2006/2006
Brazil	1999/1999	Serbia	2006/In transition to FFIT
Chile	1991/1999	Ghana	2007/2007
Columbia	1999/1999	Albania	2009/2009
South Africa	2000/2000	Moldova	2010/In transition to FFIT
Thailand	2000/2000	United States of America	2012/2012
Switzerland	2000/2000	Georgia	In transition to FFIT
Hungary	2001/2001		
Prospective candidates for IT			
Angola, Azerbaijan, Belarus, Bolivia, Botswana, China, Costa Rica, Dominican Republic, Egypt, Guinea, Honduras, Jamaica, Kenya, Kyrgyz Republic, Mauritius, Morocco, Nigeria, Pakistan, Paraguay, Papua New Guinea, Russia, Sri Lanka, Sudan, Tunisia, Uganda, Ukraine, Uruguay, Vietnam, Venezuela and Zambia,			

Sources: Batini et *al.* (2006), Rose (2007), Roger (2009), Gemayel et *al.* (2011), Warburton & Davies, 2012), and the IMF's classification of exchange rate arrangements and monetary policy frameworks (available at: http://www.imf.org/external/np/mfd/er/index.asp).
Notes: * The country ceases practicing IT when he joined the Euro area. FFIT = Full-fledged IT.

Following Rose (2007), for some countries, two *starting* dates are considered: the first refers to the *starting* date self-announced by the central as its official *starting* date of IT and is called *default starting* date of IT. The second refers to the date retained by academics as the genuine

[17] Rose (2007) is the most consensual and commonly source used for identifying the *starting* dates of IT. We also fill up Rose's dates with dates from Roger (2009) who provides the most comprehensive overview on IT adoption experiences between 2005 and 2009, just before the very recent experiences identified in IMF's updated classification of MP frameworks and in Warburton & Davies (2012).

date from which the central bank began meeting the required criteria to be classified as an ITer (as discussed in Mishkin (2000)) and are called *conservative starting* dates of IT. Also note that some authors (see, *e.g.*, Mishkin & Schmidt-Hebbel, 2007) rather use these two kinds of dates to differentiate between the starting of the converging-target period (when countries adopt IT with disinflation still underway) and the starting of the stationary-target period (when disinflation is over). It appears that around 35 countries have already experienced IT up to date and that no country has abandoned it yet for economic duress patterns. But following their adhesion to the Euro area, Finland, Spain and Slovakia which adopted IT in 1993, 1995 and 2005 respectively, abandoned it in 1999 (for the first two countries) and in 2009 (for the latter). This leaves us with 32 countries that are currently classified as ITers.

1.2.2. Typology of Inflation Targeting

In the literature, it is well acknowledged that IT is a multifaceted strategy and that its practice varies from one central bank to another (Truman, 2003; Carare & Stone, 2006; and Miao, 2009). Consequently, several forms of the implementation of IT have been found in the literature.

Strict IT versus Flexible (or soft) IT…

A first distinction has been made between the so-called "strict" IT and "flexible" IT. Flexible IT means that MP aims at stabilizing *both* inflation around the inflation target and the real economy, while strict IT aims at stabilizing inflation *only*, without regard to the stability of the real economy (Bernanke, 2003; and Svensson, 2009). But as underlined by the same authors, such a distinction is nothing than a misconception of IT, at least with respect to the current practices of IT around the world.[18] Indeed, they emphasize that no central bank in the world does still behave as a strict ITer, since there is no central bank that treats the stabilization of employment and output as unimportant policy objectives. Echoing the famous phrase coined by King (1997), they stress out that there are no "inflation nutters heading major central banks". Put differently, nowadays, all ITers follow flexible IT, a point also raised by Carney (2012) and Kuttner & Posen (2012) who, in light of the recent global

[18] In the early days of IT, "this distinction may have been a useful one, as a number of IT central banks talked the language of *strict* IT and one or two came close to actually practicing it" (Bernanke, 2003).

recession and financial crisis, pointed out that not only flexible IT is the best-practice MP, but also that IT central banks reacted more flexibly to the contractionary effects of the crisis. This relative higher flexibility of IT in the face of the crisis lies on the discretion this MP framework provides the central bankers to deal with temporary shocks without jeopardizing their credibility (as pointed out in the definition of IT, above). In the same line, another terminology is employed in the literature to characterize this flexibility of the regime, namely the so-called "soft" IT (Vega & Winkelried, 2005). According to these authors, for the sake of limiting output fluctuations, the central bank reaction, following a deviation of inflation from its targeted level, is slower compared to its reaction under an explicit or strict IT.[19] With respect to the rule-based definition of IT, this flexibility of IT is materialized in the modeling of the central bank's loss function. Indeed, under flexible (or soft) IT, the loss function contains two arguments, namely the variability of the inflation rate around its target and the variability of output around its potential, reflecting that the central bank aims at achieving its inflation target but do so in a way that would not result in excessive fluctuations in output and unemployment (Svensson, 1997a; 1997b).

Full-fledged IT versus Partial IT…

A second distinction is made between "Full-Fledged" IT (FFIT) and "Partial" IT, and stems from the fact that the implementation of IT regimes occurs gradually, particularly in developing countries where some central banks implemented first a "partial" version of IT before moving gradually to Full-Fledged IT. In the implementation process, Partial IT refers to the stage in which the central bank commitment to the IT regime is incomplete, as it "maintains an additional nominal anchor (typically an exchange rate band or a money growth target), did not satisfy key preconditions for IT, and did not put in place formal features of IT such as formalizing MP decisions or publishing an inflation report with inflation forecasts" (Mishkin & Schmidt-Hebbel, 2007). Once the inflation target becomes the only nominal anchor (although exchange rate interventions could be present)[20], and that the formal key features and preconditions of IT are fulfilled, then the regime is termed FFIT. For instance,

[19] It is however worth noting that opponents of IT rather argue that IT constrains the discretion of policymakers inappropriately and that its ability to achieve price stability comes at the cost of output volatility and/or contraction (Epstein, 2006; Brito & Bystedt, 2010). Consequently, they support the "conservative window-dressing view" of IT (due to Anna Schwartz in the literature, see Romer, 2006, p. 532).

[20] Indeed, even though IT goes hand in hand with floating exchange rate regimes (Amato & Gerlach, 2002), IT central banks should nevertheless limit temporally exchange rate fluctuations insofar as they affect the outlook for inflation and output (Roger, 2009).

Chile adopted first a "partial" version of IT in 1991, consisting of a mixture of IT and a crawling exchange rate regime, before switching to a full-fledged version of IT in 1999. Israel also implemented IT together with a widening exchange rate band in 1992 before abandoning the exchange rate target in 1997 and to commit explicitly to FFIT. Mexico also first experienced a mixture of IT and monetary targeting in 1999 before committing to FFIT in 2001. It is worth noting that in the literature, other terminologies have been employed to characterize to some extent, this distinction (FFIT *versus* Partial IT) of the different forms of IT, namely "Formal" IT *versus* "Informal" IT (Truman, 2003; and Pétursson, 2005) and "de facto" IT *versus* "de jure" IT (Miao, 2009).

Relying on this finding that IT is implemented gradually over time in some countries, Carare & Stone (2006) suggest classifying the ITers on the basis of their degree of progress in the implementation of the IT regime. They subdivide the group of ITers into three classes, based on the scores assigned to each ITer regarding the extent to which it meets the following two key features of IT, namely the clarity and credibility of the central bank's commitment to the IT regime. The clarity is captured through the public announcement of the inflation target and the institutional arrangements in support of the accountability to the target, while credibility is measured by actual inflation performances and by market ratings of long-term local currency government debt. These three classes are as follows: i) countries practicing full-fledged IT (FFIT); ii) countries operating under Eclectic IT (EIT); and iii) countries that implement Inflation Targeting Lite (ITL).[21]

In the same vein, Miao (2009) also recognizes this diversity in the practice of IT around the world. However, unlike previous studies, he suggests taking into account this diversity by measuring IT with a continuous variable (instead of a simple binary variable for the presence of IT). To this end, he constructs three sub-indices representing three of the key dimensions of IT, namely flexibility, transparency, and explicitness of the central bank's commitment to the inflation target. Although very attractive, this attempt to measuring IT with a composite index

[21] Full-Fledged ITers have a medium to high level of credibility, clearly commit to their inflation target and institutionalize this commitment in the form of a transparent MP framework that fosters accountability of the central bank to the inflation target. Eclectic ITers have so much credibility that they can maintain low and stable inflation without high transparency and accountability with respect to the inflation target. These include notably Singapore, Switzerland, Japan, the EMU and the US (before the very explicit announcement of the Fed to target inflation). Finally, countries practicing ITL announce a broad inflation objective but owing to their relatively low credibility, are not able to maintain inflation as the foremost policy objective. Simply put, ITL can be viewed as a transitory regime aimed at buying time for the implementation of the structural reforms needed for a single credible nominal anchor (Stone, 2003; and Carare & Stone, 2006).

resulting from an aggregation of sub-indices capturing some of the key features of IT, has however a major limit, namely that the assignment of scores to each ITer remains somewhere subjective.

1.2.3. Institutional parameters of the inflation target[22]

The effectiveness of IT in achieving price stability strongly depends on the design of key parameters surrounding the organization of the IT framework (Roger & Stone, 2005; Freedman & Laxton, 2009; and Roger, 2009). These vary by country and include notably: i) the definition of the target variable; ii) the use of a point target (with or without a band) or a range target; iii) the target horizon; and iv) the definition of mechanisms ensuring accountability and transparency in the conduct of MP. The design of all these parameters is country-specific, but most of the time results from a trade-off between the width of the target band, the target horizon, the escape clauses and the target variable (Bernanke & Mishkin, 1997; and Mishkin & Schmidt-Hebbel, 2002).

Defining the target variable…

Almost all ITers specify the target in terms of the 12-month change in the CPI, reflecting the familiarity of the public with the CPI comparatively to a broader measure such as the GDP deflator, the importance of the CPI in the formation of inflation expectations and wage determination, and the fact that it is more frequently available. One exception is the Fed which targets a measure of Personal Consumption Expenditure (PCE) price index.[23] Another noticeable fact is that even with the CPI, two options are available: the "headline" CPI and the "underlying" (or "core") CPI. Headline CPI refers to the total CPI while the underlying inflation refers to a measure of headline inflation, excluding certain components such as food prices, energy prices, fresh fruits and vegetables, non-market-determined or administered prices (Roger & Stone, 2005; Freedman & Laxton, 2009; and Roger, 2009). Consequently,

[22] For a detailed description of institutional parameters of inflation targets on a country-by-country base, see *e.g.*, Mishkin & Schmidt-Hebbel (2002), Freedman & Laxton (2009) and Roger (2009). See also Gemayel et *al.* (2011) for recent LICs' experiences.

[23] PCE is a measure of inflation based on price index calculated using weights that are constantly changing in response to relative price changes, simulating consumer substitution among item categories. There are four main reasons on which the differences between the CPI and the PCE lies: i) the formula effect (different methods of combining the price components); ii) the weight effect (CPI uses consumer surveys, PCE uses business surveys); iii) the scope effect (some items are missing from the PCE that are included in the CPI and vice-versa); and iv) an assortment of seasonal adjustments and other differences.

underlying inflation is a measure which reflects the changes in inflation that are likely to be sustained over the medium term. The use of underlying (or core) inflation as measure of official target therefore aims at filtering out the effect of aforementioned short-term fluctuations in the CPI, leaving therefore the central bank with a measure of inflation that is directly under its control. To some extent, this use of headline inflation measure is a part of the *discretion* component of the IT framework. Nevertheless, this approach has the disadvantage of excluding from the calculation of the CPI, a large portion of the poorest households, which could undermine the legitimacy of the central bank in pursuing the IT regime. This may justifies that in practice only one country is currently setting its target in term of core inflation, namely Thailand (Roger, 2009).[24]

Point Target, Point Target with Band, and Range Target…

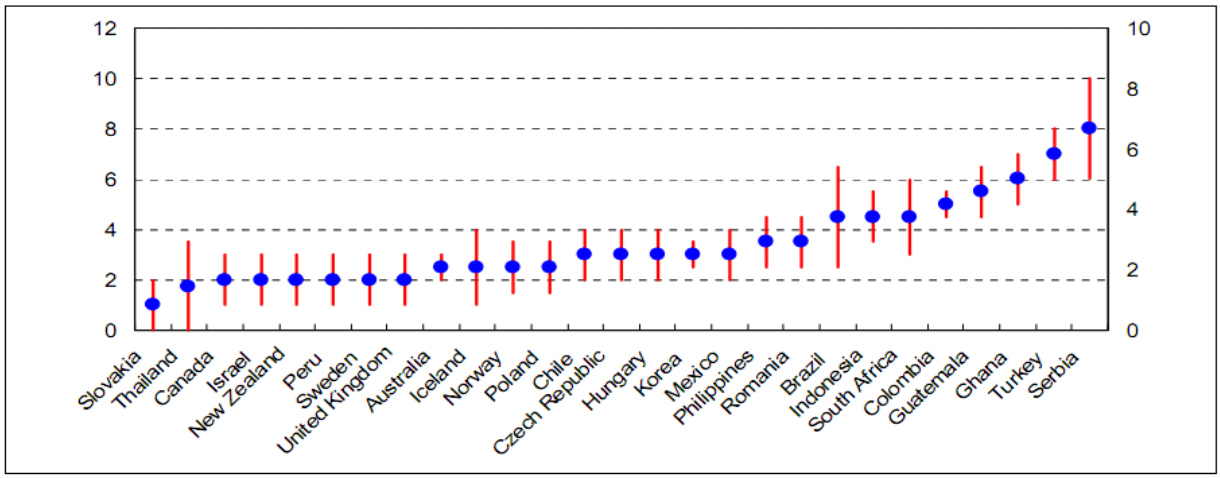
While announcing their medium-term numerical target for inflation, the ITers face generally three options: i) a "point target without a band", consisting of a single quantitative number (*e.g.*, 2%); ii) a "point target with a band", consisting of a number plus or minus an uncertainty interval (*e.g.,* 2% +/- 1%); and iii) a "range target" consisting of an interval without a single quantitative central number (e.g., 1% to 3%) (See Freedman & Laxton, 2009). The choice of the target width is country-specific, and results from a compromise between credibility and flexibility: on the one hand, the wider the target band, the higher the room the central bank has to hit its inflation target without entailing excessive fluctuations in output and unemployment. But on the other hand, the wider the target band, the lower the credibility of MP announcements, as wide target bands may be interpreted by private agents and markets as a lack of actual commitment of the central bank in favor of the inflation target. Consequently, while designing the target width, the ITers aim at striking the right balance between flexibility and credibility. In practice, the second option is most used, namely that the ITers set their target in terms of a point target with a band (Roger, 2009).

Regarding the level of the target, it is not constant, but rather evolves over time, especially in countries having adopted IT while they were in disinflation stages, as it is a common knowledge that inflation volatility goes hand in hand with the level of inflation rate. Chile for example begins with a target band between 15 and 20 percent in 1991, but has a point target

[24] Czech Republic and Korea set targets initially in terms of core inflation but both have subsequently switched to headline inflation.

with band set to 3+/-1 percent in 2012. Above all, it turns out that although inflation targets differed hugely across the ITers in the early days of IT, they have converged over time, with target midpoints and ranges being similar for most countries nowadays. This is illustrated by the following figure (*Figure 1.1*), borrowed from Roger (2009), which displays inflation target levels and bands throughout the world in 2008.

Figure 1.1: Inflation Target Levels and Bands in 2008



Source: Roger (2009)

It appears that inflation targets are tendentiously higher in developing IT countries than in developed IT countries. Industrialized IT countries have target around 2% (with or without a band, where the band is most commonly +/- 1%) or a 1% to 3% target range, while in developing IT countries, on average target band lies between 3% and 6%.[25]

Target horizon…

"The target horizon is the period over which the central bank and/or the government specify the target path for inflation" (Freedman & Laxton, 2009). It differs considerably across countries and most of the time obeys to the following scheme. During disinflation, it is advisable for central banks to have a multi-year target horizon rather than setting too short horizons, as this have often been the case in some EMEs. Once countries reach stable inflation levels, namely at their equilibrium situation, central banks have much to gain in lengthening the target horizon, even by setting an indefinitely long target horizon, as this is the case in industrialized IT countries. Recall however that the setting of the target horizon results in

[25] For an extensive discussion on the main reasons underlying the choice of the long term equilibrium inflation target, see Mishkin & Schmidt-Hebbel (2002) or Freedman & Laxton (2009).

some cases from a compromise with the choices of the target width, the target variable and the escape clauses (as discussed above in the point related to the choice of the target width).

Accountability and Transparency mechanisms…

As pointed out by Mishkin (2000) and Mishkin & Schmidt-Hebbel (2002), accountability and transparency are two pillars of the IT framework. They constitute the pedestal of the communication strategy that should accompany the implementation of IT and as such, are often overlapping and mutually reinforcing (Bernanke et *al.*, 1999).

On the one hand, with regard to accountability, the mechanisms used to hold the central bank accountable for its performances in meeting its inflation target are diverse, encompassing more or less formal arrangements between countries (Roger, 2009). These include notably: i) the publication of special reports or open letters in the event of significant misses of the target. In the United Kingdom (UK) for instance, the Bank of England needs to send an open letter to the Chancellor of the Exchequer to explain all target breaches, along with the policy actions (and the time horizon) taken to return to the target. Such a scheme has also been adopted in Brazil. ii) Parliamentary testimony by the central bank governor and/or officials. In some countries such as New Zealand, the UK, Norway and Sweden, MP is even subject to extensive reports by independent experts. iii) Use of "escape" clauses to limit central bank accountability in exceptional circumstances (that must however be identified ex-ante), as well as to indicate, in advance, how policy will react to certain kinds of shocks (major changes in terms of trade, changes in indirect taxes likely to affect the general level of prices, supply shocks such as drought, agricultural shock and epidemics affecting livestock). iv) Undoubtedly, the extreme form of accountability is the establishment of a contract between the governor of the central bank and the government, stipulating that maintaining the governor's position is conditioned by the achievement of the inflation target, consistently with Persson & Tabellini (1993) and Walsh (1995) conclusions.

On the other hand, regarding transparency mechanisms, it appears that they also take several forms, including among others: i) the regular publication of inflation reports and forecasts in the Press or in the central bank's website; ii) the publication of minutes of meetings of the MP committee within a reasonable time frame of MP calendar and forecasts of interest rate paths; and iii) Press conferences and analyst briefings following release of policy decisions and MP reports.

1.2.4. Motivations for adopting Inflation Targeting

Several motivations are behind the decision of countries to adopt IT. But before going any further in identifying the specific factors having motivated the shift of countries toward IT, it is worth recalling that from an historical viewpoint, the growing popularity of IT lies on the lack of alternative credible nominal anchors (Roger & Stone, 2005). Indeed, historically, six standard candidates for nominal anchors (or MP frameworks), of which IT, existed (Frankel, 2011). Two have been used in the past in many countries but have been abandoned. These are: i) the "price of gold", employed as a nominal anchor during the pre-1914 gold standard, but abandoned owing to the large monetary fluctuations resulting from the large shifts in the world demand and supply for gold; ii) the growth rate of money supply (M1) put at the forefront of MP by the monetarists and experienced in largest industrialized countries in the early 1980s. But financial innovations which render unstable the demand for money led to the ongoing decline of money growth targeting.[26] Then two other candidates for nominal anchors were put on the table by economists, emanating from an attempt to improve the two previous ones. Keynes (1938) and Hall (1984) suggested that targeting the price of a broader basket of commodities would have been more stable than targeting the price of gold alone. Other economists, including McKibbin & Singh (2003), also argue that targeting the Nominal Income may help avoiding the instability of money velocity. But none of these two candidates for nominal anchors has been put into practice. This consequently left central bankers with the remaining two candidates for nominal anchors, as widely used currently by central banks, namely Exchange Rate Targeting and Inflation Targeting, chronologically. Exchange rate targeting is mostly used in small open countries and Middle income countries, the first group often preferring to fix their exchange rates or joining a monetary union, while the second group rather follows a target zone or some other intermediate regimes. But the currency crises of the 1990s, reflecting the difficulty of running an autonomous MP under a context of fixed exchange rates and growing globalization of financial markets – the so-called "impossible trinity problem" -, have curbed the appetite for exchange rate targeting. Hence, IT which consists of targeting directly the expected inflation rate, turned out to be the remaining credible alternative framework for conducting MP. Accordingly, the first factor explaining the growing popularity and/or resilience of IT lies on the lack of alternative credible framework.

[26] According to the last IMF's classification of exchange rate arrangements and MP frameworks, it appears that only around 25 central banks operate under money growth targeting, several of which are preparing to switch to IT in a near future.

Besides, findings drawn from a review of existing experiences of IT adoption and/or questionnaires to central bankers, allow highlighting key other specific factors underlying countries' motivations for introducing IT. These reasons can be categorized according to the geographic regions in which IT is established. Indeed, Roger (2009) points out that the collapse of the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) played a major role in the spread of IT in Europe. Regarding Latin America, episodes of widespread adoption of FFIT occurs in the late 1990s and early 2000s, following the 1998 financial crisis. In the transition economies of Central and Eastern Europe (CEE), IT began in the late 1990s as part of their comprehensive economic reforms, while in East Asia IT began to be adopted in the early 2000s, when countries emerged from monetary targeting under Fund-supported programs following the 1997 Asian financial crisis. Recent waves of IT adoption in the transitions economies of the CEE as well as in Africa, notably since 2005, result from the good performances recorded by the pioneering ITers (Roger, 2009; and Freedman & Ötker-Robe, 2009). To some extent, these recent episodes of shifts toward IT may have much to do with phenomena of "imitation" or "fashion". Undoubtedly, the extent to which the IT framework will be perceived to have coped with the recent global crisis and oil price shocks will be a key determinant of future IT adoption.

In the literature, several empirical studies also highlight the main determinants of IT adoption (see *e.g.*, Hu, 2006; Leyva, 2008; Schmidt-Hebbel, 2009; and Samaryna & de Haan, 2011). Of particular relevance, country's past macroeconomic performances, its fiscal discipline, exchange rate regimes, as well as the structure and development of its financial system have been found to be significantly correlated with countries' decision to adopt IT. With respect to macroeconomic performances, it appears that low inflation rates are conducive to IT adoption, indicating that countries adopt IT to "maintain" their already low inflation rate or to "converge" to a lower rate, rather than to "squeeze" very high inflation rates down (Hu, 2006). In this regard, it is worth recalling that Truman (2003) classified the ITers into three groups, depending on their pre-IT inflation rates: the "*maintainers*", the "*convergers*" and the "*squeezers*".[27] Low GDP growth rates and high interest rates also turned out to be positive determinants of IT adoption, suggesting that IT adoption may signal dissatisfaction with past poor economic performances. Fiscal discipline, as captured either by fiscal balances or debt ratio is also found to be positively associated with IT adoption. Also, countries experiencing

[27] The "*maintainers*" are ITers whose pre-IT inflation rates are less than five percent but above zero; the "*convergers*" have pre-IT inflation rates more than five percent but less than 10 percent; and the pre-IT inflation rates for the "*squeezers*" are 10 percent or higher.

higher exchange rates volatility, as well as those with more flexible exchange rate arrangements are more likely to adopt IT. Another noticeable finding is that the motivations for introducing IT differ between developed and developing countries: for instance, low trade openness and higher degree of central bank's *instrument* independence are found to determine IT adoption in the developing world while they are not in the developed one.

Besides, it is worth emphasizing that some of these determinants have been identified as key preconditions for a successful implementation of IT, a point that we now address.

Preconditions for IT adoption…

As for any MP framework, IT needs the achievement of some key prerequisites to be credible with regard to private agents and financial markets. These include notably: i) the absence of fiscal dominance and/or the presence of sound fiscal policies; ii) a sufficient degree of central bank operational[28] (or *instrument*) independence; iii) a sound financial system; iv) a resilience to changes in exchange and interest rates; v) absence of dollarization; vi) absence of price regulation; and vii) the availability of a developed technical infrastructure for forecasting the inflation process and the transmission mechanism (see, *e.g.*, Masson et *al.*, 1997; Debelle et *al.*, 1998; Agénor, 2000; Mishkin, 2000; Amato & Gerlach, 2002; Sims, 2004; Bernanke & Woodford, 2004; Batini & Laxton, 2007; and Freedman & Ötker-Robe, 2009).

In practice, Amato & Gerlach (2002) or Batini & Laxton (2007) however found evidence showing that the ITers did not meet the aforementioned prerequisites at the *starting* date of their IT, mainly in developing IT countries. In this regard, Mishkin (2000) and Calvo & Mishkin (2003) stressed out that the developing countries present fundamental specific institutional differences with respect to the developed countries that need to be taken carefully into account when it comes to considering the prospect for switching to IT.

Specificities of developing countries…

Developing countries do have specific characteristics, including: i) weak fiscal institutions; ii) importance of seignoriage revenue, as a proportion of government total revenue; iii) weak

[28] In this regard, note that only *operational* independence, which relates to the scope for the central bankers to set autonomously the policy instrument (namely the short-term nominal interest rate), is necessary for a credible IT adoption. The independence of *goal*, which relates to the autonomy for choosing the main objective of the MP along with the fixation of the level of the inflation target, is not found to be essential for a credible adoption of IT. Indeed, since the precise numerical specification of the inflation target may be controversial, it may be preferable not to have the central bank setting it (see *e.g.*, Mishkin, 2000 or Amato & Gerlach, 2002).

financial institutions including government prudential regulation and supervision; iv) low credibility of monetary institutions; v) currency substitution and liability dollarization; Vulnerability to sudden stops (of capital inflows).

As pointed out by Freedman & Ötker-Robe (2009), the main concerns related to these institutional weaknesses can be grouped into two main points, both rendering less credible any commitment of the central banks to price stability as their overriding nominal anchor in these countries. First, with regard to the weakness of fiscal institutions for instance, these authors note that it reinforces the doubts of financial markets regarding the probability of pressures from the government on monetary authorities for monetizing the public debt, which would prevent them from hitting the inflation target. The main reason for such expectations lies on the short-term nature of public debt in many developing economies, which could raise concerns in the financial markets about debt sustainability and, hence, bringing up the risk premium on the country's debt. This in turn could lead to a depreciation of the currency (rather than the appreciation normally associated with a rise in the policy interest rate), which would tend to put upward pressure on inflation, both directly and indirectly. One ultimate outcome of such scenario is potentially the loose of the control over inflation dynamics by central bankers, consistently with the so-called unpleasant monetarist arithmetic (Sargent & Wallace, 1981). Second, the vulnerability of developing countries to large swings in external capital flows makes it harder for their central bank from limiting interventions in the foreign exchange markets, which are however incompatible with a credible IT adoption, as emphasized by Amato & Gerlach (2002). This explains why several developing ITers like Chile, Mexico, Israel or Hungary implemented first a version of "IT Lite", in which they keep on limiting fluctuations in exchange rates in parallel of IT, before moving to FFIT subsequently. Nevertheless, note that such attempts to stabilize exchange rates while targeting inflation are not necessarily irrelevant, provided that they occur when these fluctuations in foreign exchange threaten the outlook for inflation and output (Roger, 2009). This desire to care about the role of exchange rate in the effectiveness of IT in these countries led to the suggestion of a version of IT, termed "hybrid IT" (Garcia et *al.*, 2011).

1.2.5. Macroeconomic performances under Inflation Targeting: a literature review

After having laid the conceptual framework of IT, this section now wonders about the effectiveness of this MP framework: does it really make a difference? Throughout this

section, we make a survey of the existing literature regarding the macroeconomic consequences of IT. Then, on the basis of this existing evidence on the effects of IT, the next chapters of the thesis will explore new evidence of IT.

Effects on inflation dynamics…

An abundant literature analyzed the effects of IT on inflation, its volatility its persistence and expectations, in industrialized countries as well as in developing countries. Overall, it appears that IT is more effective in developing countries than in developed countries.

On the one hand, a strand of the literature finds evidence showing that IT adoption has beneficial effects on inflation dynamics. Pétursson (2005), with a sample of 21 developed and developing countries, but covering only ITers, find that IT reduces inflation, its volatility and its persistence. IMF (2005), Levin et *al.* (2004) and Truman (2003) also use a wide sample of both developed and developing countries and find that IT brings down average inflation, its volatility and its persistence. Using panels with country and time fixed effects, Wu (2004a) also find that the OECD ITers have reduced inflation, even when controlling for past inflation. Vega & Winkelried (2005) control for *self-selection* in IT adoption while assessing the effect of IT in a sample of developed and developing countries. For this purpose, they make use of a variety of *propensity scores-matching* methods and their results also support the view that IT adoption has been followed by a downward trend in average inflation, its volatility and its persistence. Employing the same methodology, but only on a sample of developing countries, Lin & Ye (2009) highlight that IT helped reducing average inflation and its volatility. They also emphasize that this inflation-reducing effect of IT increases with the time length since IT adoption, the country's willingness to meet the preconditions of IT adoption, the strength of the country's fiscal stance, but decrease with the country's attempts to limit the fluctuations of exchange rates. Most recently, de Mendonça & de Guimarães e Souza (2012) corroborate these results in developing countries using the same estimation methodology. Recognizing that there exists some persistence in the inflation dynamic, Wu (2004b) mobilizes dynamic panel methods and conclude that the beneficial effects of IT remain significant and reliable. On the contrary, Willard (2006), using also dynamic panel methods, rather conclude that the inflationary effects of IT are small and insignificant. Mishkin & Schmidt-Hebbel apply instrumental variable methods and find that IT is effective in lowering average inflation and its volatility in developing countries. With regard to

developing countries, it is worth underlining that Gonçalves & Salles (2008) is the pioneering evaluation study. They find that IT does reduce inflation and its volatility in these countries. Following them, Batini & Laxton (2007) and IMF (2006) find evidence supporting these favorable inflationary (inflation and its volatility) effects of IT in developing countries. Other studies focused on the effects of IT on inflation expectations. Johnson (2002) compares five developed ITers to six developed non-ITers and finds that IT reduces expected inflation but not the average absolute inflation forecast errors. Quite similar results showing that inflation persistence has decreased following IT adoption have been found by other studies (Corbo et *al.*, 2002; Levin et *al.*, 2004; and Levin & Piger, 2004). Most recently, for a first attempt to evaluating the inflationary performances of IT in LICs, Gemayel et *al.* (2011) find that IT appears to be associated with lower inflation and inflation volatility.

On the other hand, another strand of the literature rather casts doubts on the effectiveness of IT in tilting down inflation dynamics, by finding evidence showing that the ITers did not behave differently than the non-ITers following the introduction of IT. Neumann & Von Hagen (2002) compare six ITers against three non-ITers and find no significant difference between them in terms of average inflation. On a sample of developed countries, Ball & Sheridan (2005) find that the favorable effects ascribed to IT are actually the reflection of a "reversion to the mean" phenomenon, *i.e.* once they control for the pre-IT inflation rate, the inflation-reducing effect of IT ceases being statistically significant. The effect is also found not to be significant for the volatility and the persistence of inflation. Note however that Ball & Sheridan emphasize that this lack of a significant effect of IT is not synonymous of an irrelevance of IT, as they do not find significant negative effects of IT. Put differently, they simply show that on average, countries improved their inflationary performances in the 1990s, but there is no significant evidence that the ITers performed better than the non-ITers. Hyovonen (2004) find the similar conclusion that in reality inflationary performances depends on past inflation rates. Mishkin & Schmidt-Hebbel (2007) and Lin& Ye (2007), using instrumental variables methods and *propensity scores-matching* methods respectively, also find that the developed ITers reduced average inflation and/or its volatility but not better than the best developed non-ITers. Most recently, Brito & Bystedt (2010), focusing on a sample of 46 developing countries over 1980-2006, use dynamic panel models and conclude that once they control for time fixed effects, the significance of the reducing-effect of IT on inflation and its volatility gets weakened.

Effects on the real economy…

Existing studies on the effects of IT on the real economy can also be categorized into two groups: those arguing for a favorable effect of IT and those defending an adverse influence of IT. Regarding the first strand of the literature, many studies emphasize that the favorable effects of IT on price stability does not come at the cost of output volatility or contraction. Corbo et *al.* (2002) compare ITers with potential ITers and find that the sacrifice ratios are weaker in the ITers' group than in the non-ITers' group, suggesting that the costs of disinflation decreased after IT adoption. A similar conclusion is reached by Gonçalves & Carvalho (2009) who show that the OECD ITers record lower sacrifice ratios than the OECD non-ITers. Neumann & von Hagen (2002), IMF (2006), Batini & Laxton (2007), Gonçalves & Salles (2008), Lin & Ye (2009) and Fang et *al.* (2011) also find evidence showing that IT adoption has been followed by a downward trend in output volatility, notably in developing countries, indicating that this MP framework provides central bankers with enough flexibility to cope with temporary shocks hitting the economy. Regarding the effects on output growth, Walsh (2009), employing the *Propensity scores-matching* methods, finds no significant harmful effects of IT on economic growth. Fang et *al.* (2011) use an adjusted version of these methods, allowing them to identify time-varying treatments effects, and find that no negative intertemporal treatment effect of IT on output growth is significant. The cumulative effect eventually becomes positive, although not significantly so. Naqvi & Rizvi (2009) and Gemayel et *al.* (2011) also find that there are no output costs accompanying the favorable effects of IT on price stability in Asian countries and in a set of LICs, respectively.

On the contrary, the opponents of IT support the view that IT constrains disproportionally the discretion of monetary authorities, resulting in considerable output losses. This is well reflected in the following skepticism regarding the relevance of IT: "Today, inflation targeting is being put to the test - and it will almost certainly fail" (Stiglitz, 2008). Regarding output volatility, the seminal paper by Ball & Sheridan (2005), suggests that in developed countries, the ITers decreased output volatility following IT adoption, but not significantly better than the non-ITers. Lin & Ye (2007) also find that IT is not significantly helpful for stabilizing the volatility of output growth in these countries. Most recently, Brito & Bystedt (2010), focusing on developing countries, use dynamic panel methods and find that once controlling for time and country effects, the significance of the stabilizing effect of IT on output growth disappears. Further, they find that IT affects negatively output growth, and that once

controlling for the short-run inflation-output tradeoff, the favorable effects of IT on price stability disappear, signaling that the disinflation costs have not fallen under IT.

Beside these effects on output growth and its volatility, it is worth noting that other studies highlighted the influence of IT on interest rates. Ball & Sheridan (2005) show that once controlling for "mean reversion", the OECD ITers do not reduce significantly more their average long-term interest rates than the OECD non-ITers. A similar result is found by Lin & Ye (2007). Ball & Sheridan (2005) also find that the ITers' short-term interest rates are higher than the non-ITers'. On the contrary, Neumann & von Hagen (2002) do find that IT reduces the volatility of both short-term and long-term interest rates in developed countries. Pétursson (2005) also find that IT helped decreasing average interest rates, suggesting that IT has raised the credibility of MP and reduced the inflation risk premium of nominal interest rates.

International effects of Inflation Targeting…

The effect of IT on variables measuring the influence of external factors has also been evaluated. Pétursson (2005) shows that on average, exchange rate fluctuations decreased following IT adoption. Mishkin & Schmidt-Hebbel (2007) also find that IT adoption helped reducing exchange rates pass-through, notably in the EMEs. Rose (2007) finds that the ITers experienced less nominal and exchange rate volatility than the non-ITers. The latter also points out that the ITers recorded close mean values for international reserves and current accounts than the non-ITers. Most recently, Lin (2010) corroborated this result, showing that IT increases nominal and real exchange rates stability and international reserves in developing countries. But the contrary is observed in developed countries.

Performances in achieving the inflation target…

Finally, a bourgeoning body of the existing literature paid attention to the effectiveness of the ITers in hitting their inflation targets. Roger & Stone (2005) and Roger (2009) stress out that a large proportion of IT countries have failed to respect their targets, either "undershooting" or "overshooting" these latter. On average, inflation targets are missed 40 percent of the time, sometimes with a large magnitude and over a long time period. Moreover, it appears that target breaches are more frequent in developing than in developed IT countries. Target violations also occur more likely during disinflation stages. Other studies, including Albagli

& Schmidt-Hebbel (2004), Gosselin (2007) and Lostumbo (2007) also find that inflation targets are frequently missed. They suggest that the main reasons underlying these target misses stem from the institutional and policy weakness (including low overall institutional quality, lack of central bank independence, and high country risk-premiums). Nevertheless, these authors do emphasize that despite these target misses, no ITer has abandoned IT yet. This resilience comes from the transparency mechanisms of the IT framework which help the central bankers explaining to the general public the reasons underlying the target misses along with the policy actions taken to return to the target.

1.3. Fiscal Rules

1.3.1. Definition

From a broad viewpoint, Fiscal rules (FRs) refer to the "sets of rules, procedures and practices according to which budgets are crafted" (Alesina et *al.*, 1999). A similar view is present in Ayuso-i-Casals et *al.* (2006) who define FRs as "all the legislative and procedural elements underpinning the making of budgetary policy". Most recently, Dabla-Norris et *al.* (2010) follows a similar definition, but rather use the expression "**Budget Institutions**" which they refer to "the structures, formal and informal rules, and procedures governing budget planning, approval and implementation". These authors also point out that the term "**public financial management**" (PFM) is often used synonymously with "budget institutions". Nevertheless, they carefully note that although the two terms are similar, "budget institutions" encompass larger dimensions, including wider socio-political economy factors shaping the budget process, whereas the PFM rather focuses on narrower aspects of the budget since technically put, it is associated with systems, procedures and processes related to the budget.

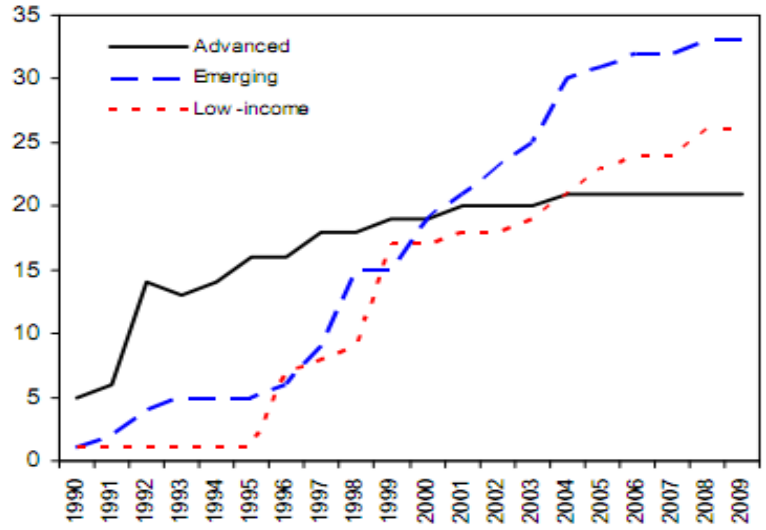
In the literature, the term "fiscal rule" is sometimes used in another understanding, to mean the "fiscal reaction function", *i.e.* the implicit rule followed by fiscal authorities when setting fiscal balances in response to relevant macroeconomic or fiscal variables (Ayuso-i-Casals et *al.*, 2006). The most conventional cited example is the fiscal rule proposed by Bohn (1998). He characterizes a country's compliance with its long term fiscal sustainability by an equation linking its primary fiscal balance to its past developments in public debt, business cycles fluctuations, a set of politico-institutional variables and shock variables (wars, disasters, etc).

Analogously to the definitions of IT in the previous sections, this latter terminology of FRs can be related to a *rule-based* definition of FRs, *i.e.* thinking of FRs in terms of policy rule for setting fiscal aggregates. In this regard, the broad view of FRs (above) therefore refers to a ***practical*** definition of FRs. In summary, we can therefore view FR as **a rule-based framework that uses institutional mechanisms to constrain permanently the discretion of fiscal authorities throughout the budget process**.

List of Countries experiencing FRs (FRers)…

As recalled in the General Introduction of the thesis, the very recent fiscal rules database collected by the IMF's Fiscal Affairs Department (IMF, 2009) estimates the number of countries having a FR to 80 in early 2009, including 21 Advanced Economies (AEs), 33 EMEs and 26 LICs. For a detailed and comprehensive overview of these FR experiences along with their *starting* dates, see IMF (2009), Appendix Table 1 (p. 59-68). *Figure 1.2* below provides an overview of the evolution of FR experiences by type of country group.

Figure 1.2: Number of countries with FRs by type of Country Group



Sources: IMF (2009)

It appears that the appetite for FRs has converged between countries group, the developing countries group (EMEs and LICs) having caught up the AEs around the mid-2000s. Moreover, the trend seems to have stabilized for the AEs from this date, whereas it is upward for the other two groups, suggesting that the wave of FRs adoption will likely continue in these countries, all the more that the current global recession and financial crisis has renewed the interest for FRs as a device for restoring fiscal sustainability.

1.3.2. Typology of fiscal rules

The implementation of FRs takes many forms that we now describe in this section.

Numerical fiscal rules versus procedural fiscal rules…

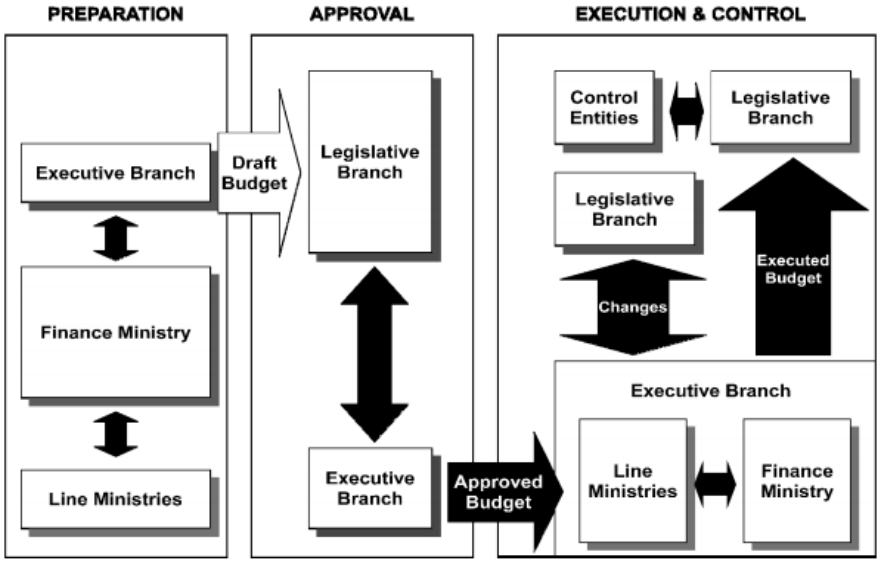
In general, two sets of rules are considered: i) **numerical fiscal rules**, and ii) **procedural rules** (Von Hagen & Harden, 1995).

On the one hand, numerical FR consists of "a permanent constraint on fiscal policy, expressed in terms of a summary indicator of fiscal performance" (Kopits & Symansky, 1998, p.2). The summary indicator needs to be as simple as possible, to be readily operationalized, communicated to the public, and monitored. These numerical limits should not be subject to frequent revisions. They need to be set durably, if not permanently. In this regard, it is worth noting that semantically, there is a shade between a numerical FR and a simple fiscal "target", the first being embodied in a legal framework, and hence very costly to violate, owing to the reputation losses that this would entail, while the second can be breached without significant sanctions and/or reputation losses (Kopits & Symansky, 1998). If well designed and effectively enforced, numerical FRs should therefore be conducive to more fiscal discipline. However, they are frequently hard to enforce, as governments can circumvent them through creative accounting practices (Milesi-Ferretti, 2003). To avoid such practices, optimal introduction of FRs needs to be as comprehensive as possible. But more comprehensive rules may also turn out to be more complicated, and hence less easily enforceable.

In practice, there are four types of numerical FRs: i) **budget rule** (*e.g.*, balanced budget rule); ii) **expenditure rule** (*e.g.*, ceiling on certain types of public spending and/or the growth rate of public spending); iii) **revenue rule** (*e.g.*, a target for revenue-to-GDP ratio); and iv) **debt** rule (*e.g.*, ceiling for the Government debt in level or as a percentage of GDP). According to IMF (2009), the choice of the appropriate fiscal variable to be constrained depends on three main considerations, namely its closeness to the ultimate goal variable (*e.g.*, debt ratio), its controllability and the extent to which it provides clear operational guidance for fiscal policy, and transparency as well as the easiness for monitoring it. In this regard, overall budget balance rules (in percentage of GDP) and debt rules appear to be the most comprehensive and therefore the most used throughout the sample period covered by the IMF's FRs dataset, whereas revenue rules are the least employed.

On the other hand, procedural FRs consist of all the procedures governing each of the three stages of the budget process, as summarized by the following figure (*Figure 1.3*):

Figure 1.3: The budget process



Source: Dabla-Norris et *al.* (2010)

In this regard, Von Hagen (2002) classifies procedural FRs in more *versus* less "**centralized**" rules, with the effectiveness of the rules increasing with the degree of centralization in the budget process, consistently with a desire to tackling the so-called *common-pool* problem. Alesina & Perotti (1999) adopt a similar classification but use rather the following terminology: **"hierarchical**" *versus* "**collegial**" rules. The rules governing the budget process are considered as hierarchical if they allow less representation of the different interest groups in the budgetary process. In the drafting stage of the budget for instance, more hierarchical rules limit the power of spending ministers and centralize drafting power on the treasury minister. At the voting stage, the hierarchical feature of the rules consists of limiting the legislature's abilities to modify the budget size proposed by the government. Finally, at the implementation stage, more hierarchical FRs involve for instance limits on the Congress's ability to impose ex-post amendments on the size of the budget. In the same vein, Hallerberg & von Hagen (1999), Hallerberg et *al.* (2007) and Ljungman (2009) propose categorizing FRs over two approaches in planning the budget: the "**delegation**" or "**top-down"** decision making approach and the "**cooperative bargaining**" or "**contract**" approach. The first consists of creating a clear authority by assigning budgetary powers to a strong central player (the ministry of finance). This approach needs strong accountability mechanisms to be effective. On the contrary, the second approach favors a cooperative approach, with the goal

of ensuring sufficient consensus among different players throughout the budget process, and strongly needs transparency mechanisms to be effective in delivering fiscal discipline. As pointed out by Dabla-Norris et *al.* (2010), the choice between these two approaches is country-specific and depends on the political system. But in practice, the two approaches are typically combined.

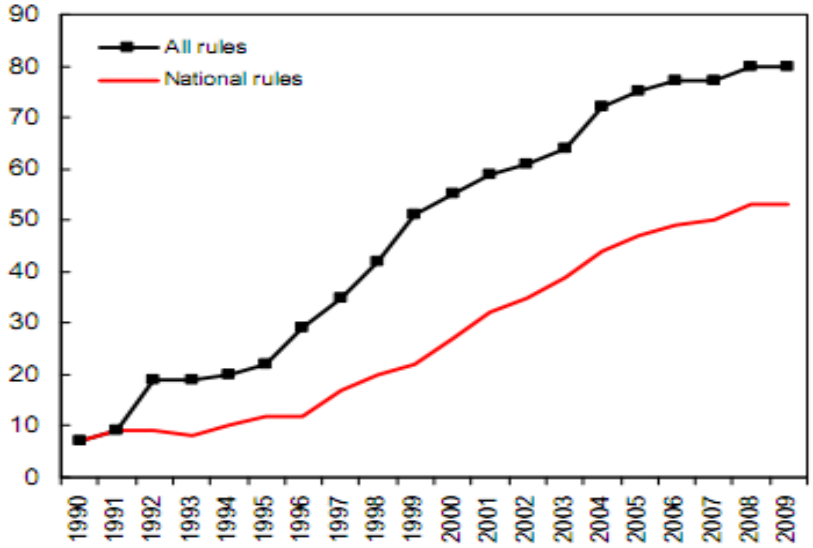
National versus supranational fiscal rules…

In some countries, FRs introduction results from a political commitment at the national-level, *i.e.* they are designed and implemented domestically by national policymakers and/or legislatures, in which case they are considered as "**National**" FRs. It is worth noting that even at the national level there exist several forms of rules, depending on the level of the government to which they are applied. Rules applied at the general and/or central government level are termed as National FRs while those applied on the local and regional government or individual sectors are termed as "**Sub-national**" FRs. However, the FRs dataset collected by IMF (2009), on which the present thesis is widely based, covers at the national-level, FRs established at least at the central or general government level. Accordingly, throughout the thesis, we mean exclusively those rules when we refer to national FRs.

In other countries, FRs establishment results from treaties or rules designed and implemented by officials of supranational organizations to frame the conduct of fiscal policy in all member States. In these cases, FRs are termed "**Supranational**" FRs.

From the FRs dataset (IM, 2009), it emerges that in recent years, national FRs are more likely introduced in Europe and Latin America while supranational ones are established more likely in the LICs. More precisely, in 2009, 53 out of the 80 countries enacted national FRs (of which 20 had them jointly with supranational FRs). About 52 percent of the rules in operation consist of national FRs, as depicted in *Figure 1.4* below. The remainder results from treaties framing the functioning of four supranational organizations: the SGP in Europe; the West African Economic and Monetary Union (WAEMU); the Central African Economic and Monetary Community (CEMAC); and the Eastern Caribbean Currency Union (ECCU).

Figure 1.4: Number of countries with fiscal rules



Sources: IMF (2009)

1.3.3. Institutional parameters of fiscal rules

The credibility and/or effectiveness of FRs require several qualitative characteristics to support their institutional infrastructure (Bohn & Inman, 1996). These include notably the *coverage* of the rule, as captured by the fiscal variable targeted, the share of government finances covered by the rule and the policy horizon of the rule; the *strength* features of the rules, encompassing the statutory basis, the enforcement procedures, the transparency and accountability mechanisms, and the *flexibility* feature of the rule. With respect to these institutional parameters of FRs, it is worth recalling that they are often aggregated into synthetic indices measuring the quality of the rules, which are then used to assess the discipline-enhancing role of FRs (see, *e.g.*, Von Hagen, 1992; Alesina & Bayoumi, 1996; Sutherland et *al.*, 2005; Deroose et *al.*, 2006; Debrun et *al.*, 2007a; Debrun et *al.*, 2008; Dabla-Norris et *al.*, 2010; and Gollwitzer, 2011).

The targeted fiscal variable…

As introduced above, numerical constraints are typically placed on four types of fiscal variables: budget balance, government debt, public spending and public revenue. But for each of these fiscal aggregates, several options are available to policymakers. With regard to budget balance rules (BBR), they consist *inter alia* of a balanced budget rule, a target on a specific budget balance in nominal terms, a specific budget balance as a percentage of GDP, a *Golden* BBR (a rule that sets a specific target for the budget balance, excluding public

investment spending, as they contribute to long term growth)[29] or a specific budget balance as a percentage of GDP in cyclically-adjusted or structural terms. The latter are designed with the aim to constraining the discretion of policymakers while providing them with some flexibility to cope with temporary shocks by allowing the full operation of automatic stabilizers. Even though such an attempt is relevant theoretically, in practice, they are difficult to implement, due to the difficulties surrounding their calculations, namely when it comes to compute a measure of output gap which is however crucial for deriving elasticities of each components of the budget with respect to business cycle fluctuations.

For Debt Rules (DR), most of the time they consist of debt ceilings in nominal terms or as a percentage of GDP, or debt ceilings related to repayment capacity. Regarding Expenditure Rules (ER), they are in majority expressed as nominal or real expenditure ceilings, or cap on nominal or real expenditure growth. Finally, Revenue Rules (RR) may take the forms of desired developments of the tax base, a target for revenue-to-GDP ratio, a ceiling on the use of oil revenue and the design of a rule for the allocation of extra revenue. Whatever the target option considered, it is worth noting that its appropriateness is country-specific and depends on the political system and on the way its is combined with the other options for designing the target variable.

Share of government finances covered by the rule…

For a credible introduction, the design of FRs should carefully determine the level of government to which the rule should be applied. Indeed, this latter, in addition to the number of rules in place, gives an idea on the "*intensity*" in using the rules (Ayuso-i-Casals et *al.*, 2006). Several options are available to policymakers: central government, sub-national governments, social security accounts, or public companies. To avoid creative account practices, comprehensiveness is desirable in the design of the rules, either regarding the targeted variables or the coverage of government levels. In this regard, the most comprehensive coverage of government level, namely the general government level is advisable. But in practice, this option is used mostly in countries with supranational rules,

[29] Such *Golden* rules are more frequent in the LICs, where in more than 30 percent of the countries the rules exclude public investment and other poverty-reduction spending aggregates (IMF, 2009). Note however that the use of *golden* rules is subject to controversies in that they may serve as a ground for creative accounting practices. They may also weaken the link with gross debt; moreover, all public investments are not productive. It is finally argued that human capital spending (health and education) may be even more conducive to higher productivity and then to long term growth (IMF, 2009).

given the higher status of the supranational legislation. In countries where rules at introduced only at the national level, FRs coverage is limited to the central government, with separate rules for sub-national governments (IMF, 2009).[30]

Time frame of the rule…

As for IT, the time frame of the rule refers to the period over which the compliance with the rule is required, and most of the time obeys to the desire to provide policymakers with the room to smooth economic activity by allowing them to deviate temporally from the targeted level of fiscal aggregates. Hence, the longer the time horizon of the rule, the more "cycle-friendly" is the rule, to paraphrase Ayuso-i-Casals et *al.* (2006). However, longer time horizon of the rule may be interpreted as a lack of actual commitment in favor of the rule, thus undermining its credibility. Consequently, as under IT, the appropriate time frame for FRs results from a judicious compromise between flexibility and credibility. In practice, the time frame ranges from one to several years; in some countries, they are squarely tailored over the business cycle, or over medium term, in which case they are embedded into medium term fiscal frameworks. In general, sub-national rules are designed yearly while the national ones are set on a multi-annual horizon basis (Ayuso-i-Casals et *al.*, 2006).

Statutory basis of the rule…

The statutory basis of the rule gives an idea on its institutional "power", as it refers to whether the rule is enshrined in the constitution (such as the German recent FR) or in Law (*e.g.*, Public finance Act, Fiscal Responsibility Law), results from a coalition agreement or an agreement by different general government tiers or simply from a political agreement. In general, the more the rule has a legal basis (enshrined in the Constitution or in Law), the stronger is the rule, as it is therefore difficult to modify, and hence enjoys higher credibility.[31] In this regard, it is worth noting that supranational rules, resulting from international treaties should be more credible, as they are difficult to modify. But in practice, these rules turned out to be less credible, as they are frequently violated without significant sanctions, for instance in the

[30] FRs coverage could be extended to nonfinancial public enterprises if they influence significantly fiscal policy functions, especially in countries where quasi-fiscal activities of these enterprises are large (IMF, 2009).
[31] Indeed, such rules need parliamentary "super-majorities" to be established and changed. This therefore tends to confer more stability to the rule framework. But in practice, only a few countries opted for embedding FRs in constitutional laws, including Germany, Poland, and Switzerland (IMF, 2009).

EMU, WAEMU or CEMAC (see, *e.g.*, Prakash & Cabezon, 2008). This therefore suggests that the credibility inherent to the statutory basis of the rules depends on the sanctions and/or enforcement mechanisms accompanying the implementation of the rules, a point that we now address.

Enforcement procedures…

Enforcement procedures are at the heart of the "*strength*" feature of FRs. They refer to the institutional mechanisms designed to ensure a full compliance with the rules. These include mainly the definition of ex-ante sanctions or corrective measures in the case of non-compliance with the rule. Their effectiveness also depends to some extent on the body in charge of applying them. In this regard, the *strength* of the rule is higher if the enforcement of the rule is under the responsibility of an independent fiscal authority (*fiscal council*, *fiscal agency* or any Court) or the national Parliament (See, *e.g.*, Debrun et *al.*, 2007b; or Debrun & Takahashi, 2011). Enforcement by Ministry of Finance or any other government body more generally is conducive to lower credibility associated with the rule. Close to this line, it is worth noting that the role of independent fiscal authorities (which are gaining a bourgeoning interest in the literature) also extends to monitoring the respect of the rule. Indeed, such bodies are more likely to yield realistic fiscal projections, grounded on reliable assumptions about future growth rate, interest rates, and then to avoid overly "optimistic" budgeting (Gollwitzer, 2011).

Transparency and Accountability mechanisms…

Similarly than under IT, credible introduction of FRs requires strong transparency and accountability supportive mechanisms, with the aim of guiding the regular communications with the general public and setting clearly the responsibility of policymakers in respecting the rules (Kopits & Craig, 1998).[32] Indeed, the deficit that arises from the opportunistic behavior of politicians depends on how transparent the budget is, as less transparency (or, more 'unobservability') is conducive to larger opportunistic deficits (Alt & Lassen, 2006; and Shi & Svensson, 2006). Recall that these two requirements are the bulk of the new wave of FRs, started in 1994 in New Zealand, just after the pioneering adoption of IT (Kopits, 2001). These

[32] Transparency standards on fiscal information are widely documented in the IMF Reports on the Observance of Standards and Codes, fiscal transparency module, namely the so-called "fiscal ROSC" (Dabla-Norris et *al.*, 2010).

procedures should help making it easier to monitor the compliance with the rules. To this end, the media visibility of the rule, the existence of independent fiscal agencies and external audits on the budget are key elements for associating higher transparency with FRs, which are in turn a key prerequisite for the accountability of the government in respecting those rules (IMF, 2009). For this purpose, fiscal transparency and fiscal accountability laws have been adopted widely in recent years to support the introduction of numerical FRs (Corbacho & Schwartz, 2007). These legal arrangements allow setting up transparent mechanisms by which private agents and financial markets can judge if the government is complying with the established FRs. For the sake of compromising between the desire of providing flexibility to policymakers and the desire to make them accountable in respecting FRs, escape clauses are often established, defining ex-ante the exceptional circumstances under which fiscal aggregates can deviate from their targeted levels.

The flexibility features of fiscal rules…

As for IT, opponents of FRs argue that they constrain disproportionately the discretion of policymakers, preventing them from reacting in the face of contractionary shocks hitting the economy. Consequently, they defend the view that FRs are conducive to more procyclical fiscal policies. On the contrary, the proponents of FRs rather reply that the design of best-practices of FRs carefully accounts for the necessity to cope with business cyclical fluctuations. From their viewpoint, best-practices of FRs, analogously with IT, result from a judicious mix of constraints and flexibility. The first aims to tackle the *deficit bias* while the second aims to preserving the stabilization function of fiscal policy. These flexibility features of FRs are embedded in some of their institutional parameters, including the use of cyclically-adjusted fiscal balances rules, the setting of target horizons over the business cycle and the definition of ex-ante escape clauses, as aforementioned. To paraphrase Bernanke & Mishkin (1997), we can say that FR is for fiscal policy what IT is for MP, *i.e.* FR can be viewed as a "constrained discretion framework" for conducting fiscal policy, not a mechanical fiscal policy rule. In the literature, this desire of taking into account the stabilization function of fiscal policy while designing FR is often reflected in the construction of indices measuring the flexibility or cyclicality of the rule (see, *e.g.*, Ayuso-i-Casals et *al.*, 2006). In this regard, these authors point out that budget balance rules and expenditure rules provide more flexibility than revenue and debt rules, as they are less likely to prevent the automatic stabilizers from operating.

1.3.4. Motivations for introducing Fiscal Rules

Several motivations underlie countries' decision to introduce FR. Before going any further, let start from an historical perspective. In this regard, it appears that FRs have existed for ages, but informally, as a matter of common sense with respect to the imperative of long term fiscal sustainability (Buchanan, 1997). The pioneering experience with formal or legal introduction of FRs goes back to the 19th century, notably in the federal countries, mostly motivated by the desire to gain reputation for fiscal discipline, with the ultimate goal of accessing market-based financing (Kopits, 2001). Thereafter, other countries, including Germany, Italy, Japan and the Netherlands enacted diverse forms of FRs, with the intention of supporting their post-war monetary stabilization programs (Ayuso-i-Casals et *al.*, 2006). Subsequently, FRs spread increasingly from the nineties in response to debt over-accumulation in several industrialized and Latin American countries. But in some countries, FRs flourished as the result of supranational decisions, establishing the respect of some criteria regarding their public finance management – hence FRs - as a precondition for adhering in a regional community Area. This was the case in Europe with the Maastricht treaty in 1992 and the SGP (1997), in Africa with the rules conditioning the entry in WAEMU and CEMAC and in East Caribbean and Pacific for the ECCU Area.

But from an analytical perspective, several reasons have been recognized to be determinant for countries' decision to enact FRs. From a broad viewpoint, FRs have been introduced to tackle policymakers' incentives for running fiscal deficits, as underlined in the General Introduction of the thesis, notably the *common-pool* problem, the *dynamic inconsistency* problem and the *agency* problem. In this regard, Ayuso-i-Casals et *al.* (2006), for European countries, point out that large countries with complex administrative structures are more likely to introduce FRs than small countries. They also point out that past macroeconomic performances are another relevant determinant of countries' decision to enact FRs. Put differently, countries with fiscal problems, either in terms of higher fiscal deficits and/or debt ratio more likely belong to the club of FRers. Politico-institutional factors also proved to be at work in the motivations for adopting FRs. Indeed, political instability and government fragmentation were found to be conducive to higher probability for adopting FRs. The presence of elections seems also to matter for countries' decision to enact FRs, as the probability for introducing FRs increases during election years, tending to signal the presence

of strategic use of the budget between successive governments. Finally, they highlight that the presence of supranational rules serves as a catalyst for the introduction of national rules.

Other studies, based on wider samples, including developed as well as developing countries, examined the motivations for adopting FRs and led to different conclusions in some points. IMF (2009) for instance finds that the likelihood of FRs adoption is higher in fiscally healthy countries, as the commitment to FRs needs to rely on sound fiscal stances to be credible to private agents and financial markets. But for debt ratio, the relationship is nonlinear, with the probability of adopting FRs decreasing with public debt up to a threshold, beyond which countries are forced to return to fiscal sustainability through a credible fiscal consolidation package, including *inter alia* the introduction of strong FRs. Other macroeconomic performances are also determinant for countries' decision to shift to FRs. Of particular relevance, high inflation, low and volatile economic growth and sharp exchange rate movements are less conducive to FRs adoption. Calderón & Schmidt-Hebbel (2008) also find evidence supportive of the previous findings. Nevertheless, they reach additional conclusions, suggesting that the likelihood of having FRs in place decrease with the dependency ratio (ratio of dependents to working-age population) and expenditure procyclicality, while it increases with countries' level of development.

Preconditions for adopting Fiscal Rules…

On the basis of country experiences with FRs and existing empirical regularities on the determinants of FRs adoption aforementioned, key prerequisites have been highlighted to be essential for a successful introduction of FRs (see, *e.g.*, IMF, 2009). These include notably i) the existence of adequate public financial management (PFM), consisting of the development of technical forecasting capacity to yield in-year and timely end-year fiscal reports and projections; ii) the establishment of bold fiscal reforms, including *inter alia*, the introduction of Fiscal Responsibility Laws and high transparency standards, through the creation of independent fiscal agencies and mandatory press releases of regular reports on multiyear fiscal projections and other pre-determined disclosures (such as tax expenditures, impact quantification for new policies, long-term sustainability analyses, etc.); iii) enabling political and institutional systems (less fragmentation of government).[33]

[33] It is also worth mentioning that presidential systems and majoritarian electoral rules have also been found to be conducive to more fiscal discipline (Persson & Tabellini, 2002; 2003; and Alesina et *al.*, 2006).

Specificities of Developing countries…

As well stressed out by Schick (1998), "the budgetary predicament of poor developing countries is fundamentally different from that of rich developed countries". Indeed, the budget process in developing countries has particular features that may render different the prerequisites needed to implement credibly FRs in these countries. In addition to the general sources of *deficit bias* (as highlighted in the General Introduction of the thesis), other typical elements have been found to be particular drivers of loose fiscal policies in the LICs (Schick, 1998; Allen & Radev, 2006; and Gollwitzer, 2011). These include notably i) *unrealistic budgeting*, where the approved budget is commonly known to be based on overly optimistic forecasts and unreliable data; *hidden budgeting*, where the actual budget is only known by a handful of selected; the prevalence of *extra-budgetary* funds and accounts, preventing from having an actual overview of the budget; the importance of *corruption*, owing to institutional weaknesses. Close to this line, it is worth noting that the embryonic state of democracy in the LICs may prevent FRs from exerting fully their discipline-enhancing virtues (Shi & Svensson, 2006; and Brender & Drazen, 2007). Another relevant feature, pointed out by Gupta et *al.* (2008) is that many LICs are heavily dependent on public aid, which is often not fully integrated with the budget. As a result, this contributes to reducing transparency and accountability, and creating parallel bargaining arenas separate from the budget process itself. Finally, the low level of education in the LICs may also constitute a serious impediment for the effectiveness of FRs, as voters' ability to understand the budget process and monitor efficiently fiscal policy is a key determinant for the success of FRs (Alt & Lassen, 2006; and Shi & Svensson, 2006). Accordingly, the design and the implementation of FRs in these countries should carefully be adapted to these particularities to allow their disciplinary properties to operate fully.

1.3.5. Macroeconomic performances under Fiscal rules: a literature review

The ability of FRs to promote fiscal discipline has been evaluated in the literature. Most studies built upon a synthetic index measuring the quality of budget institutions, to assess whether higher scores of these indices are conducive to more fiscal discipline. In general, it appears that the introduction of FRs have served as a good device for the implementation of more sound fiscal policies. Other studies also wondered about the influence of FRs on the

stabilization function of fiscal policy. Undoubtedly, as emphasized by Eslava (2011), better accounting for the endogeneity of FRs remains the key challenge faced by the empirical literature on FRs. Another element that should deserve more attention is the extent to which one may isolate the disciplinary effects actually attributable to FRs from those imputable to the politico-institutional system.

Fiscal rules and fiscal discipline…

Existing studies on the effects of FRs on fiscal discipline can be grouped into two broad categories: those focusing on numerical fiscal rules and those focusing on procedural rules. In the US States, several studies (Von Hagen, 1991; Alt & Lowry, 1994; Bayoumi & Eichengreen, 1994; Poterba, 1994; Bohn & Inman, 1996; and Canova & Pappa, 2006) find results suggesting that numerical rules do improve fiscal aggregates when attention is focused on the part of the budget subjected to those constraints. However, they do not rule out the fact that these better fiscal outcomes may also be the result of creative accounting practices (Von Hagen, 1991; Canova & Pappa, 2006). In addition, they emphasize that these results, supportive of a discipline-enhancing property of numerical rules, depend on the existence of an independent and elected state supreme court.

In the European countries, regarding numerical FRs, Von Hagen (2006) finds that those introduced in the EMU context were effective in reducing spending and deficits, but more in the small compared to the large countries, and in countries with good budgeting institutions. This tends to support the view by Von Hagen & Harden (1995), that informational asymmetries between different spending agencies are more important in larger countries, making it harder to define and enforce targets. As in the US States, Von Hagen & Wolff (2006) show that FRs in the EMU have generated incentives for creative accounting, with governments substituting deficits for stock-flow adjustments in order to comply with requirements to keep deficits under the 3% limit imposed by the SGP. This is also noted by Von Hagen (2006) and Fatas & Mihov (2003) who highlight that FRs in the EMU promoted fiscal discipline over the first few years following their adoption, but lost their effectiveness subsequently, indicating that governments might have learnt to circumvent the rules over the time. It is worth noting that this result is contrary to what has been found for IT, as aforementioned, in which case the inflation-reducing effect of IT was found to increase with the time length since IT adoption (Lin & Ye, 2009). With regard to procedural rules,

many existing studies find that more hierarchical and transparent institutions do promote more fiscal discipline in European countries (Von Hagen, 1992; de Haan & Sturm, 1994; Von Hagen & Harden, 1995; de Haan et *al.*, 1999; Ayuso-i-Casals et *al.*, 2006; and Hallerberg et *al.*, 2007).[34] Alt & Lassen (2006), relying on a wider sample of OECD economies, also find that greater transparency is conducive to lower deficits and debt. Interestingly, Von Hagen (2006) shows that in the European countries, strong procedural rules for the budget not only exert a direct favorable effect on fiscal balances, but also contribute to render more effective numerical FRs. More recent studies also find evidence supportive of a discipline-enhancing role of budget institutions in the European context (see, *e.g.*, Fabrizio & Mody, 2006; and Mulas-Granados et *al.*, 2009).

Regarding developing countries, Alesina et *al.* (1999) construct an index of the quality of budget institutions, summarizing the degree of hierarchy in the budget process, the extent of transparency of the budget process and the presence of numerical rules, for 20 Latin American and Caribbean countries. They relate this index to fiscal outcomes and conclude that higher scores of the index are positively associated with higher fiscal performances. A similar conclusion is reached by Stein et *al.* (1999). Still in Latin American countries, Filc & Scartascini (2005) show that higher quality of budget institutions is conducive to lower fiscal deficits, notably where strong enforcement mechanisms are implemented to support these numerical FRs. Most recently, Prakash & Cabezón (2008), Hallerberg et *al.* (2009), Dabla-Norris et *al.* (2010) and Gollwitzer (2011) confirmed that high quality of public financial management and/or budget institutions is strongly related to better fiscal performances in the LICs.

Fiscal rules and the cyclicality of fiscal policy…

Canova & Pappa (2006) and Fatas & Mihov (2006) evaluated the influence of FRs on the cyclicality of fiscal policy, and hence on macroeconomic variability in the context of the US States. The first authors find no significant link between FRs and the cyclical properties of fiscal policies while the second conclude that FRs reduce the responsiveness of policy to output shocks, a result also found by Bayoumi and Eichengreen (1994). Regarding the

[34] It is worth mentioning that Von Hagen (2006) finds little effectiveness of FRs in Japan, and argues that this could stem from the weakness of budgeting procedures, largely due to the political context.

European countries, Beetsma et *al.* (2009) find that well-enforced numerical fiscal rules reduce implementation errors and are conducive to more countercyclical policies. A similar result is found by Ayuso-i-Casals et *al.* (2006) in the context of the EMU, but such a "cycle-friendly" property of FRs proved to depend on the design of the institutional parameters of the rules. Finally, with regard to developing countries, Dabla-Norris et *al.* (2010) show that countries with stronger fiscal institutions have better scope to conduct countercyclical policies.

1.4. Concluding Remarks

This chapter has comprehensively provided a conceptual description of IT and FRs and reviewed their experiences around the world. It has also surveyed the existing empirical literature of both frameworks, encompassing *inter alia* the performance on inflation dynamics, the real economy, fiscal discipline and the cyclicality of fiscal policy. It emerged that IT and FRs do have many similarities with regard to the design of their institutional parameters, except on the recipient authorities to which their constraining features apply (namely central bankers and governments, respectively). Both frameworks also differ on the length of time during which their constraining feature applies to the policymakers: indeed, while it has been shown that the favorable inflationary effect of IT increases with the time length since its adoption, the disciplinary effect of FRs tends to vanish over time.[35] It also appeared that for a credible adoption of IT or FR, countries need to fulfill some key preconditions, notably in developing countries. In these countries, regarding IT for instance, policymakers need to account carefully for the fluctuations of exchange rates and ensure that all forms of fiscal dominance are removed. This aims at ruling out markets' expectations about possible public debt monetization, which would threaten the viability of the IT regime. It proved also desirable for developing countries to commit transitionally to IT, implementing first "soft" versions of IT, in which they limit the output costs of disinflations and undertake the necessary bold reforms to support the IT framework, and move to FFIT subsequently. Regarding FRs, it appeared that the full operation of their disciplinary virtues requires the parallel implementation of transparency, accountability and enforcement mechanisms. Of particular relevance, in the developing world, the deepening of the democratic process and the

[35] Another significant difference between IT and FR is that no ITers have abandoned IT due to economic duress patterns, whereas several FRers (including in the US from 2002 to now) have abandoned FRs due to socio-political and economic pressures.

development of independent fiscal councils should accompany the introduction of FRs. Last but not the least, the implementation of FRs should not inhibit the stabilization function of fiscal policy. In this regard, while designing FRs, policymakers should have in mind the concern of compromising judiciously between credibility and flexibility, by favoring longer term horizon for the target, and defining ex-ante escape clauses for instance.

The next three chapters of the thesis, relying on this conceptual and empirical background of IT and FRs will focus on highlighting new evidence on the macroeconomic effects of these two rules-based policy frameworks.

Chapter 2*

Does Inflation Targeting Matter for Attracting Foreign Direct Investment into Developing Countries?

*A version of this chapter is currently under review in the journal *World Development*.

2.1. Introduction

Does Inflation Targeting – IT hereafter - help attracting Foreign Direct Investment – FDI hereafter - into developing countries? This chapter aims to address this question on the basis of an empirical study on a sample of 53 developing countries over the period 1980-2007. As recalled in the General Introduction, since its first adoption by the Central Bank of New Zealand in 1990, the popularity of IT has grown considerably, to the point where around thirty central banks use it currently as their operational framework for the conduct of MP and many others, especially in Developing countries, are planning to move towards it.[36] According to the proponents of IT, this new MP framework, by increasing the transparency and the accountability of the central bank, enhances its credibility, allowing it to tackle the inflationary bias (Bernanke et *al.*, 1999) inherent to the time inconsistency problem (Kydland & Prescott, 1977; Calvo, 1978; and Barro & Gordon, 1983). Accordingly, IT adoption helps anchoring credibly inflation expectations and stabilizing the macroeconomic environment. However, Epstein (2007) challenged the merits of IT, namely its ability, *inter alia*, to attract more FDI. Attempting to answer the question whether or not IT has helped developing countries to attract more FDI, he pointed out the lack of direct studies evaluating the effect of IT on FDI. It is therefore important to fill this gap in the empirical literature by highlighting the effect of IT on FDI.

The classical FDI *push-pull* factors literature distinguishes two kinds of factors affecting the inflows of FDI: the external or *push* factors and the domestic or *pull* factors (Root & Ahmed, 1979; Schneider & Frey, 1985; Calvo et *al*., 1993; Calvo et *al.*, 1996; Fernandez-Arias, 1996; Gastanga et *al.*, 1998; Montiel & Reinhart, 1999; Kim, 2000; Ying & Kim, 2001; Asiedu, 2002, 2006; and Kinda, 2010a, 2010b). *Push* factors represent the economic conditions in the developed countries and reflect the opportunity cost in investing in these countries. *Pull* factors concern the macroeconomic conditions and the institutional environment in the recipient countries. With respect to this literature, IT may be related to the *pull* factors in that it affects the domestic macroeconomic conditions. Indeed, the increased credibility that IT gives the central bank makes it easier for the financial markets and the private sector to infer the central bank's intentions from MP announcements (Geraats et *al.*, 2006). IT therefore gives the financial markets and the private sector a transparent and predictable framework to

[36]According to Batini et *al.* (2006, p. 8) more than 35 developing countries explore the possibility of adopting an IT framework for the conduct of their MP. In addition, the only countries (Finland, Spain and Slovak Republic) having abandoned IT did it to join the Euro Area (See Roger, 2009).

plan their future investment decisions. This increased transparency and predictability lower policy uncertainty, which in turn decreases the transaction and the access to information costs. As a result, the expected return rates and the productivity prospects increase, making investment decisions easier, especially the longer-term ones since the cash-flows attached to them become less uncertain (Serven, 1998). Given that FDI requires long term investment decisions, such a sound macroeconomic environment induced by IT should be conducive to larger inflows of FDI into Developing countries. Indeed, due to the large sunk costs involved by FDI, their levels and their localization depend heavily on the confidence of the foreign investors regarding the soundness of the macroeconomic environment (Fischer, 1993).

A vast strand of the empirical literature also found evidence supporting the idea that IT allows creating a sound and stable macroeconomic environment, especially in Developing countries. IT adoption has been followed by a downward trend in inflation dynamics, interest rates levels and exchange rate pass-through, and this has been achieved without an increase in output volatility, particularly in Developing countries (IMF, 2005; Batini & Laxton, 2007; Mishkin & Schmidt-Hebbel, 2007; Gonçalves & Salles, 2008; and Lin & Ye, 2009).[37] By improving key macroeconomic variables, especially average inflation and its volatility, IT should help attracting more FDI into Developing countries since inflation is known to be negatively associated with FDI in the *pull* factors literature.

However, it is worth noting that some empirical studies challenged these macroeconomic benefits of IT. On a sample of developed countries, Ball & Sheridan (2005) find no significant difference between the IT countries and the non-IT countries in terms of inflationary performances. More recently, Brito & Bystedt (2010) show that in the emerging IT countries, the lower inflation levels recorded have been achieved at the cost of a lower real output growth rate. In other words, the sacrifice ratios associated with IT have not decreased in these emerging countries relatively to those induced by the alternative frameworks for MP. Accordingly, one could also assume that IT might lead to lower FDI into the emerging countries. Indeed, in line with the FDI *pull* factors literature, a lower real output growth rate may makes less optimistic the expectations of productivity gains and profit prospects, discouraging foreign investors to enter the economy.

Overall, it follows that the effect of IT on FDI into Developing countries is ambiguous *à priori* and needs to be addressed empirically. Using panel data of 53 Developing countries, of

[37] For further comprehensive literature review on the subject, see chapter 1 (*section 1.2.5.*) of the thesis.

which 20 that have adopted IT by the end of 2007, this chapter analyzes the relationship between IT and FDI over the period 1980-2007. Such an exercise is interesting in that it will not only shed light on the debate relative to the question raised by Epstein (2007), but might also reveal an additional ingredient helping developing countries to attract more FDI. Attracting FDI is especially important for developing countries because it is well-known that they are sometimes characterized by an insufficient mobilization of domestic resources, though essential to sustain economic growth and pursue the development agenda. In the current context of drying in aid inflows toward these countries, combined with their lesser access to financial markets, attracting more FDI may therefore be a solution to close the domestic saving gaps in these countries. In addition, FDI is not only the most stable external capital flowing into Developing countries, but also an excellent vehicle for the transfer of technology, knowledge and managerial skills into these countries.

The remainder of the chapter is organized as follows: section two presents the econometric methodology and introduces the dataset. Section 3 shows the estimation results while section 4 considers some robustness checks. Section 5 briefly concludes and draws some policy recommendations.

2.2. Methodology and Data

Our objective is to evaluate the *treatment* effect of IT on FDI in the countries having adopted IT (ITer hereafter), the so-called average treatment effect on the treated (*ATT*),

$$ATT = E[(Y_{i1} - Y_{i0})\big|IT_i = 1] = E[Y_{i1}\big|IT_i = 1] - E[Y_{i0}\big|IT_i = 1] \quad (2.1)$$

where IT_i is the IT dummy variable. Y_{i1} is the value of the outcome variable when the country i has adopted IT and Y_{i0} if not. $Y_{i0} / IT_i = 1$ is the outcome value that would have been observed if an ITer had not adopted IT regime, and $Y_{i1} / IT_i = 1$ the outcome value really observed on the same IT country. Equation (2.1) is telling us that a simple comparison between the outcome value (FDI in our case) observed in the *treatment* group (ITers) and the outcome value observed in the same countries if they had not adopted IT would give us an unbiased estimate of the *ATT*. Unfortunately, it is not possible to observe this latter outcome

value since we cannot observe the FDI flowing into an IT country had it not adopted IT. We face here, as it is common in non-experimental studies, an identification problem.

A common approach to circumvent this difficulty is to compare the sample mean FDI of the *treatment* group (ITers) with that of the *control* group (non ITers) if and only if assignment to the *treatment* is random. However, IT adoption may be non-random, as it may be correlated with a set of observable variables that also affects the outcome variable, leading to the so-called *self-selection* problem.[38] Simple comparison of the sample mean FDI between the two groups would then produce biased estimates of the *ATT*. As in Vega & Winkelried (2005), Lin & Ye (2007; 2009), Walsh (2009), Lin (2010) and Flood & Rose (2010), to address this problem of selection on observables, we make use of a variety of *propensity scores matching* methods recently developed in the *treatment* literature.

2.2.1. Matching on Propensity Scores

Propensity Scores Matching (*PSM* hereafter) consists of pairing the ITers with non-ITers that have similar observed characteristics so that the difference between the outcome of an ITer and that of a matched counterfactual is attributable to the *treatment* (IT adoption). A key assumption needed to apply the *PSM* is "conditional independence" $(Y_0, Y_1 \perp IT|X)$ which requires that conditional on the observables (*X*), the outcome be independent of the *treatment* variable. Under this assumption, equation (2.1) can be rewritten as

$$ATT = E[Y_{i1}|IT_i = 1, X_i] - E[Y_{i0}|IT_i = 0, X_i] \quad (2.2)$$

where we have replaced $E[Y_{i0}|IT_i = 1, X_i]$ with $E[Y_{i0}|IT_i = 0, X_i]$ which is observable. Yet, as the number of covariates in *X* increases, matching on *X* would be difficult to implement in practice. Rosenbaum & Rubin (1983) suggested overcoming this high dimension problem by basing the matching on the *propensity scores* instead of *X*. The *propensity score* is the probability of adopting the IT regime conditional on the observable covariates (*X)*:

[38] It is worth noting that the Propensity Scores-Matching method does not implicitly account for the unobservables; as a result, the issues it addresses differ from those related to selection on unobservables (omitted variables) as well as from a Heckman-type sample selection problem (see Heckman et *al.*, 1998; Dehejia & Wahba, 2002; and Caliendo & Kopeinig, 2008 for further details).

$$p(X_i) = E[IT_i \big| X_i] = \Pr(IT_i = 1 \big| X_i) \tag{2.3}$$

The validity of the *PSM* needs a further assumption, the so-called "common support" assumption ($p(X_i) < 1$), which requires the existence of some comparable *control* countries for each *treated* countries. Hence, the *ATT* can be estimated as

$$ATT = E[Y_{i1} \big| IT_i = 1, p(X_i)] - E[Y_{i0} \big| IT_i = 0, p(X_i)] \tag{2.4}$$

2.2.2. Data

Our dataset consists of 53 Developing countries examined over the period 1980-2007. This is an unbalanced panel because of missing data on some variables such as Central Bank Turnover rate, control of corruption, financial openness and financial reforms. The sample is composed of 20 Developing countries that have adopted IT by the end of 2007 (called ITers or *treatment group*) and 33 non-ITers (*control group*). For purpose of comparability, our sample relies on Lin and Ye (2009) and has been enriched thereafter in several aspects.[39] While the sample in Lin and Ye (2009) spanned from 1985 to 2005, ours covers a larger period, spanning from 1980 to 2007. Accordingly, some countries such as Guatemala, Romania, Slovak Republic and Turkey which adopted IT between 2005 and 2006 and were therefore in the *control group* in Lin & Ye (2009) are treated as ITers in our study. Furthermore, Serbia and Ghana that adopted IT respectively in 2006 and 2007 are included in our sample whereas they were absent in Lin & Ye (2009).

ITers along with their *starting* dates can be found at *Appendix 2.2*. Data on the *starting* dates come from Rose (2007) and have been supplemented with data from Roger (2009) regarding IT adoption between 2005 and 2007. An important issue in evaluating the *treatment* effect of IT is the sensitivity of the result regarding the chosen *starting* dates. Following Rose (2007), we consider two kinds of dates, the *default starting* dates and the *conservative starting* dates, with the goal of checking whether the effect of IT on FDI differs depending on the *starting* dates employed.[40]

[39] The country list can be found at *Appendix 2.3*. China Macao has been dropped because of lack of available data. The developing countries category considered here refers to the World Bank classification, and thus includes both the LICs and the EMEs.
[40] See chapter 1 of the thesis, *section 1.2.1,* for further details on this issue.

Data on FDI come from the World Development Indicators (WDI, 2009). These are the net inflows of FDI as GDP percentage and represent the net inflows of investments aiming to acquire a lasting management interest (10 percent or more of voting right) in an enterprise operating in an economy other than that of the investor. Descriptive statistics, definitions and sources of the other variables can be found in *Appendices 2.1* and *2.11* respectively.

2.3. Estimation results

2.3.1. Estimating the propensity scores (PS)

We estimate the *PS* using a *probit* model with the binary variable IT as the dependent variable.[41] The explanatory variables are twofold: on the one hand, we account for the fact that a country should reasonably adopt IT after having met some preconditions, and on the other hand, we consider the likelihood for a country to adopt an alternative framework for MP (exchange rate targeting and money growth targeting).[42]

As *precondition* variables we include the lagged inflation rate, central bank governors' turnover rates (reverse proxy for the independence of the central bank), public debt over GDP, Real per capita GDP growth rate, Domestic Credit to private sector as GDP percentage (proxy for financial development) institutional quality (proxied by the ICRG index for control of corruption), and financial openness. We expect a negative correlation between the probability of IT adoption and the first three variables.[43] We expect a negative correlation between the probability of IT adoption and the real per capita GDP growth rate. Indeed, a high GDP growth rate may be viewed as the result of successful macroeconomic policies, which implies no need to adopt an alternative MP framework. Regarding financial development and financial openness, we expect them to be correlated positively with the probability of IT

[41] *Logit* model does not change the results significantly.

[42] According to the *conditional independence* assumption, omitting in the *probit* model, variables that systematically affect the targeting probability but do not affect FDI, has little influence on results (Persson, 2001). In other words, an estimate bias occurs only if we omit an explanatory variable that simultaneously affect FDI and the probability of adopting IT. We give much attention to this issue when selecting variables in the *probit* model.

[43] Indeed, a country should adopt IT when its inflation rate is at reasonably low level, preferably after a successful disinflation (Masson et *al.*, 1997). Moreover, a high debt ratio should determine negatively IT adoption since this may be interpreted by the financial markets as the sign of a future pressure of the government on the central bank for monetizing the public debt, which will prevents it from hitting its inflation target. Finally, Operational independence – and not necessarily independence of goal - of the central bank is a desirable precondition for IT adoption (Mishkin, 2000). It is therefore reasonable to expect a negative correlation between the reverse proxy for central bank independence – turnover rate - and the probability of IT adoption.

adoption. Indeed, a well developed financial system gives the central bank a higher capacity to implement MP more effectively. Financial development should therefore be correlated positively with IT adoption. Moreover, for some countries, namely Central and Eastern European Countries (CEEC), IT has been adopted simultaneously with a wave of other reforms, including financial openness (Roger, 2009). Consequently, one should expect a positive correlation between financial openness and the probability of IT adoption. The expected sign on institutional quality is ambiguous *à priori*. On the one hand, a high institutional quality may reflect a better capacity to implement IT credibly. Indeed such a high quality of institutions will be viewed by financial markets as a signal that the central bank will be supported by the government to hit its inflation target. As a result, a higher institutional quality should affect the probability of adopting IT positively. But on the other hand, it may be assumed that a country chooses to adopt IT as a tool to "tie its own hand" and to improve the quality of its institutions. In this sense, the expected sign of the effect of institutional quality on the probability of IT adoption should be negative. With regard to the *second* set of controls, we choose trade openness and exchange rate flexibility. We expect them to be correlated negatively with the probability of IT adoption (see Lin & Ye, 2009).

Table 2.1 below reports the *probit* estimates of the *PS*.[44] The benchmark model [1] based on the *conservative starting* dates of IT supports our intuition, as most coefficients are significant and have the expected sign (except that of real per capita GDP growth rate). Lagged inflation, central bank governors' turnover rate, debt ratio, control of corruption and trade openness are correlated negatively with IT adoption, while real per capita GDP growth rate, domestic credit to the private sector and exchange rate flexibility enhance the targeting probability. The overall fit of the regression is also quite reasonable, with the pseudo-R-squared around 0.432.

2.3.2. Results from matching

Based on the *PS* estimated above, we employ four commonly used methods to match each ITer with non-ITers, depending on the closeness of their scores to that of the ITer.[45]

[44] It is worth noting that we check the balancing properties of the *matches* using the standardized bias suggested by Rosenbaum & Rubin (1985). The results clearly reveal that the standardized biases for the matched data are all below the 3% or 5% rule of thumb (see Lechner, 1999; Sianesi, 2004; or Caliendo & Kopeinig, 2008), indicating that within the matched data, there is no significant difference between the ITers' observable characteristics and the non-ITers' observable characteristics (see *Appendix 2.4*).

[45] While matching the ITers to the non-ITers, we employ the "common support" option. With this option, we exclude the *treated* countries whose the *PS* is higher than the maximum or less than the minimum *PS* of the *untreated* countries.

Table 2. 1: Probit estimates of the propensity scores (using the Conservative *Starting* Dates)

Dependent Variable	IT (Conservative *Starting* Dates)							
	[1]	[2] Post-1990	[3] No CEEC	[4] No New ITers	[5] No hyper-inflation	[6]	[7]	[8]
Inflation lagged one year	-0.125***	-0.123***	-0.174***	-0.125***	-0.125***	-0.127***	-0.129***	-0.147***
	(0.023)	(0.023)	(0.032)	(0.023)	(0.023)	(0.025)	(0.023)	(0.029)
Governors' turnover rate	-1.785***	-1.147**	-3.146***	-1.785***	-1.771***	-1.864***	-2.425***	-1.237**
	(0.534)	(0.566)	(0.766)	(0.534)	(0.542)	(0.630)	(0.610)	(0.587)
Debt ratio	-0.015***	-0.017***	-0.020***	-0.015***	-0.016***	-0.013***	-0.008**	-0.009*
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)
Real per capita GDP growth rate	0.016	0.010	0.005	0.016	0.010	0.00004	0.001	0.026
	(0.023)	(0.024)	(0.028)	(0.023)	(0.024)	(0.025)	(0.022)	(0.025)
Domestic credit to private sector	0.001	-0.001	0.003	0.001	0.001	-0.004	-0.001	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Financial openness	0.154**	0.086	0.1498*	0.154***	0.156**	0.159**	0.062	-0.289**
	(0.075)	(0.079)	(0.088)	(0.075)	(0.075)	(0.070)	(0.072)	(0.113)
Control of corruption	-0.260**	-0.297***	-0.455***	-0.260***	-0.283***	-0.204**	-0.469***	-0.380***
	(0.102)	(0.110)	(0.129)	(0.102)	(0.104)	(0.101)	(0.114)	(0.124)
Trade openness	-0.004*	-0.004*	-0.007***	-0.004*	-0.004*	-0.002	-0.001***	-0.006***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Exchange rate flexibility	0.360***	0.372***	0.414***	0.360***	0.368***	0.337***	0.337***	0.360***
	(0.051)	(0.053)	(0.064)	(0.051)	(0.052)	(0.047)	(0.045)	(0.048)
Log of Real GDP						0.468***		
						(0.082)		
Log of real per capita GDP							1.368***	
							(0.254)	
Financial reforms								0.278***
								(0.053)
No of observations	663	506	575	663	564	663	665	589
Pseudo R^2	0.432	0.434	0.526	0.432	0.410	0.489	0.506	0.579

Note: Robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant are included (not reported).

Table 2. 2: Matching results (Using the Conservative *Starting* Dates)

Dependent Variable : FDI over GDP	1-Nearest-Neighbor Matching	2-Nearest-Neighbor Matching	3-Nearest Neighbor Matching	Radius Matching r=0.005	Radius Matching r=0.01	Radius Matching r=0.05	Local Linear Regression Matching	Kernel Matching
Treatment Effect of IT on FDI: using the conservative *starting* Dates								
[1] : ATT	1.985***	1.721***	1.782***	1.404*	1.805***	1.493***	1.509***	1.568***
	(0.734)	(0.605)	(0.638)	(0.808)	(0.652)	(0.523)	(0.474)	(0.479)
Number of Treated Obs.	42	42	42	28	35	42	42	42
Number of Controls Obs.	607	607	607	607	607	607	607	607
Total Observations (Obs.)	649	649	649	635	642	649	649	649
Robustness Checks								
[2] : Post-1990 Period	1.894***	1.836***	2.047***	1.641**	1.711***	1.733***	1.738***	1.678***
	(0.655)	(0.620)	(0.535)	(0.718)	(0.630)	(0.535)	(0.441)	(0.435)
[3] : Excluding CEEC	1.502**	1.446**	1.430**	1.327*	1.393**	1.630***	1.678***	1.642***
	(0.749)	(0.603)	(0.607)	(0.802)	(0.632)	(0.570)	(0.474)	(0.516)
[4] : Excluding New ITers	1.985***	1.721***	1.782***	1.404*	1.805***	1.493***	1.509***	1.568***
	(0.757)	(0.661)	(0.601)	(0.754)	(0.622)	(0.497)	(0.445)	(0.466)
[5] : Excluding hyperinflation episodes	1.211*	1.424**	1.400**	0.944	1.305**	1.572***	1.398***	1.511***
	(0.706)	(0.655)	(0.610)	(0.757)	(0.639)	(0.522)	(0.484)	(0.501)
[6] : Adding Log of real GDP	1.829**	1.909**	1.867***	1.828**	1.694**	1.668***	1.789***	1.875***
	(0.787)	(0.766)	(0.679)	(0.929)	(0.763)	(0.598)	(0.492)	(0.602)
[7] : Adding log of real per capita GDP	1.403*	1.545**	1.396**	0.694	1.234*	1.353**	1.360***	1.426***
	(0.835)	(0.699)	(0.632)	(0.883)	(0.722)	(0.574)	(0.503)	(0.531)
[8] : Adding Financial reforms	1.228*	1.106*	1.382**	1.619**	1.762***	1.245**	1.135**	1.190**
	(0.689)	(0.630)	(0.574)	(0.807)	(0.674)	(0.536)	(0.487)	(0.542)

Note: in brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

First, the *nearest neighbor matching* with replacement, which matches each *treated* country to the N *control* countries that have the closest *PS* (we use $N=1$, $N=2$ and $N=3$). Second, the *radius matching*, which performs the matching based on *PS* falling within a certain *radius* or "caliper" R (we use a small radius *R=0.005*, a medium radius *R=0.01* and a wide radius *R=0.05*).[46] The third method is the *regression-adjusted local linear matching* developed by Heckman et *al.* (1998). Fourth, we consider the *kernel matching*, which matches an ITer to all non-ITers weighted proportionally to their closeness to the *treated* country. As the matching estimator presents no analytical variance, we compute standard errors by bootstrapping (*i.e.* by re-sampling the observations of the *control* group, see Dehejia & Wahba, 2002).

The upper panel of *Table 2.2* above reports the estimated *ATT* of IT on FDI based on the *conservative starting* dates. Irrespective of the matching method, the estimation results show that IT adoption enhances FDI inflows, as the estimated *ATT* is positive and statistically significant. Given the average value of FDI (2.798 percentage points of GDP, see *Appendix 1.1*) the contribution of IT to FDI attraction can be rather important, as it enhances the inflows of FDI into developing countries by at least 1.404 (*radius* matching R=0.005) and up to 1.985 (*1-Nearest-neighbor*) percentage points of GDP.

2.4. Robustness checks

Now we test the sensitivity of the results above to a set of alternative specifications. First, we perform regressions on different sub-samples. We restrict the regressions to the post-1990 period (*column* [2], *Table 2.1*) and exclude Central and Eastern European Countries (CEEC) (*column* [3] in *Table 2.1*).[47] Also, we exclude the New ITers (*column* [4] in *Table 2.1*) from the *treatment* group. New ITers consist of the countries having adopted IT only since 2005 (Slovak Republic, Guatemala, Indonesia, Romania, Turkey, Serbia and Ghana) and were

[46] As in Lin (2010), the medium radius is set equal to the standard deviation of the estimated propensity scores while the large radius and the small radius are set equal to the double and the half of the medium radius, respectively.

[47] As IT starts in 1990, performing the regression on the post-1990 period allows focusing more on the cross-countries differences in FDI (ITers *versus* non-ITers) rather than on time-differences (pre-IT *versus* post-IT period). Also, carrying out matching only on the post-1990 period allows us checking whether or not the benchmark matching results are not driven by a possible common-time trend effect. Regarding the exclusion of the CEEC, it allows testing whether the results above are not sensitive to the fact that the majority of the CEEC were created after 1990 whereas our sample spans from 1980 to 2007.

therefore not included in the *treatment group* in Lin & Ye (2009).[48] Accordingly, excluding them from the analysis make our sample comparable to Lin & Ye (2009). As depicted by *columns* [2], [3] and [4] of *Table 2.1* and the first three lines in the bottom panel of *Table 2.2*, the *probit* results and their corresponding results for the *ATT* are qualitatively similar to the ones from the benchmark model.

Second, we discard the hyperinflation episodes (*column* [5] in *Table 2.1*).[49] The *probit* results and their corresponding results for the *ATT* (fourth line in the bottom panel of *Table* 2.2) remain almost identical to the benchmark.

The third set of robustness checks consists of considering the *default starting* dates of IT rather than the *conservative* dates of IT, in order to make sure that our previous results are not driven by the chosen *starting* dates. *Columns* [1] to [8] of *Appendix 2.5* report the *probit* estimates of the propensity scores using this time the *default starting* dates. Except the coefficient on real GDP growth rate which becomes statistically significant, the *probit* results do not change significantly compared to those found previously with the *conservative starting* dates of IT. The matching results corresponding to these *default starting* dates are reported in *Appendix 2.6.* Irrespective of the matching estimator used, the results are almost similar to those found with the *conservative starting* dates of IT. The *ATT* of IT on FDI in Developing countries still is positive and statistically significant.

Fourth, to make sure that we filter out sufficiently any possible polluting effect resulting from observables known to affect both FDI and the targeting probability, we augment the *probit* model by controlling respectively for country's economic size (logarithm of total GDP), country's stage of development (logarithm of real GDP per capita) and for macroeconomic financial reforms (financial reform index, Abiad et *al.* (2008)). *Columns* [6], [7] and [8] of *Table 2.1* show the *probit* results for the *conservative starting* dates of IT while their corresponding results for the *ATT* are depicted in *Table 2.2* (lines [6] to [8]). The results remain robust to these new specifications: the *probit* results and the estimated *ATT* do not change qualitatively and quantitatively. Note however that because of missing observations, the inclusion of *financial reform* reduced considerably the sample size.

[48] Note that Slovak Republic ceased IT to join the Euro area in 2009. But as our sample ends in 2007, this does not affect our results.

[49] We discard observations for inflation higher than 40 percent (proxy for hyperinflation episodes) to check whether our results are not sensitive to these outliers.

Finally, for the sake of further robustness check, we follow Vega & Winkelried (2005) and apply matching to cross-sectional *pretreatment* observations instead of panel observations. This approach enables us to make sure that the results found previously with matching to panels do not skew our conclusions. Indeed, applying matching to panels means that one allows each IT country to be matched to a country that may vary each year during the entire time period of the sample, while with cross-sections matching, one needs to identify a (unique) non time-varying *control* country (on the basis of similarity in *pretreatment* observable covariates) to match each IT country. Concretely, we define the *pretreatment* observations as the average value of the five years prior to the *starting* date of IT. For the non-IT countries, we take the five years prior to 1999 and 2002 for the *conservative starting* dates and the *default starting* dates respectively (1999 and 2002 are the mid-date between the first IT *starting* date and the last one in the sample, using the *conservative starting* dates and the *default starting* dates respectively). The main results do not change significantly with respect to this approach (see *Appendices 2.7* and *2.8* for the *probit* results when using *conservative* and *default starting* dates respectively, and *Appendices 2.9* and *2.10* for their corresponding *ATT* results).

To summarize, our empirical investigation suggests that IT adoption really enhances FDI inflows into developing countries. According to the FDI *pull* factors literature, this result could stem from the fact that IT adoption stabilizes the macroeconomic environment by lowering average inflation, its volatility and output growth volatility. As a result, even though IT is not directly concerned with FDI, it may contribute to attract FDI through a side effect, by making the macroeconomic environment more sound and stable. Of course, one might keep in mind that these favorable effects on FDI will be delivered provided that IT is well implemented, namely by fulfilling the necessary prerequisites for its credible adoption. These include *inter alia*, the lack of fiscal dominance, a sufficient degree of central bank operational independence, a sound financial system, resilience to changes in exchange and interest rates, absence of dollarization, absence of price regulation, and the availability of a developed technical infrastructure for forecasting the inflation process and the transmission mechanism (see chapter 1, *section 1.2.4*).

2.5. Concluding remarks and Policy implications

This chapter has highlighted the effect of Inflation Targeting (IT) on Foreign Direct Investment (FDI) inflows into developing countries. Based on panel data of 53 Developing countries over the period 1980-2007, this chapter is the first study, to the best of our knowledge, to evaluate directly the effect of IT on FDI. Relying on the FDI *pull* factors literature and using a variety of *propensity scores* matching methods allowing us to control for *self-selection* in policy adoption, we find that the Average Treatment effect (*ATT*) of IT on FDI is positive and statistically significant. The magnitude of the contribution of IT to FDI inflows is rather important, as IT enhances FDI inflows by at least 1.404 (*radius* matching *r=0.005*) and up to 1.985 percentage points of GDP (*1-Nearest-neighbor*), and the result is found to be robust to several robustness checks (alternative *starting* dates of IT adoption, different specifications for the *probit* selection model, different sub-samples, controlling for hyperinflation episodes, or when carrying out the matching on cross-sectional instead of panel *pretreatment* observations).

Regarding the question raised by Epstein (2007), this chapter fills the gap in the literature by shedding light on the debate relative to the effect of IT on FDI: IT does help attracting more FDI inflows into Developing countries. Consequently, in terms of policy recommendations, this chapter suggests that if well implemented, namely by fulfilling the necessary prerequisites for a credible adoption, IT can be, in addition to the traditional pull factors, another legitimate part of the policy toolkit available to policymakers in developing countries in their competition to attract more FDI flows. This result is particularly important, since not only it is well-known that FDI is the most stable external capital flowing into Developing countries, allowing them to close their domestic savings gaps and finance the development agenda, but also exhibit growth-promoting effects through the transfers of technology, knowledge and managerial skills. However, it is worth noting that we are not suggesting that IT is the best framework for MP in Developing countries. We are just suggesting that in these countries, when it comes to the competition for FDI attraction, IT seems to be more appropriate.

The next chapter of the thesis will focus on one of the ingredient (*pull* factor) through which this FDI-conducive effect of IT may be channeled, namely the quality of institutions.

Appendices

Appendix 2.1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FDI (percentage of GDP)	1 239	2.798	3.767	-2.758	36.617
Full-Fledged IT	1 483	0.086	0.280	0	1
Soft IT	1 483	0.096	0.294	0	1
Inflation rate	1 253	59.929	338.275	-3.959	7 481.664
Central bank governor turnover rate	1 039	0.292	0.259	0	1.2
Real per capita GDP growth rate	1 268	2.297	5.945	-43.388	49.863
Trade openness (percentage of GDP)	1 282	79.276	54.644	6.320	456.936
Financial openness	1 008	-0.267	1.471	-1.831	2.5
Exchange rate Flexibility	1 259	9.294	3.633	1	15
Public Debt (percentage of GDP)	1 156	53.190	36.555	0.971	289.554
Domestic credit to private sector (percentage of GDP)	1 253	58.608	37.202	-4.645	233.265
Control of Corruption	1 016	2.924	1.087	0	6
Log of Real GDP	1 322	24.221	1.541	19.179	28.849
Log of Real per capita GDP	1 282	8.872	0.601	7.033	10.706
Financial reforms	930	11.233	5.585	0	21

Appendix 2.2: Developing Inflation Targeters along with their *starting* dates

Countries	Soft IT: default starting dates	Full-Fledged IT: conservative starting dates
Chile	January 1991	August 1999
Israel	January 1992	June 1997
Czech Republic	January 1998	January 1998
South Korea	April 1998	April 1998
Poland	September 1998	September 1998
Mexico	January 1999	January 2001
Brazil	June 1999	June 1999
Colombia	September 1999	October 1999
Philippines	January 2002	January 2002
South Africa	February 2000	February 2000
Thailand	May 2000	May 2000
Hungary	June 2001	August 2001
Peru	January 2002	January 2002
Slovakia	January 2005	January 2005
Guatemala	January 2005	January 2005
Indonesia	July 2005	July 2005
Romania	August 2005	August 2005
Turkey	January 2006	January 2006
Serbia	September 2006	September 2006
Ghana	January 2007	January 2007

Source: Rose (2007) and Roger (2009). Note that Slovakia abandoned IT in 2009 and joined the euro Area.

Appendix 2.3: Country List

Treatment Group		Control group		
Brazil	Poland	Algeria	Georgia	Morocco
Chile	Romania*	Argentina	Hong Kong, China	Paraguay
Colombia	Slovakia*	Belarus	Iran	Russia
Czech Republic	South Africa	Bulgaria	Jamaica	Singapore
Guatemala*	South Korea	Cape Verde	Jordan	Slovenia
Hungary	Thailand	China	Kazakhstan	Syria
Indonesia*	Turkey*	Costa Rica	Latvia	Trinidad & Tobago
Israel	Serbia^{++}	Croatia	Lebanon	Tunisia
Mexico	Ghana^{++}	Dominican Republic	Lithuania	Ukraine
Peru		Egypt	Macedonia	Uruguay
Philippines		Estonia	Mauritius	Venezuela

*: ITer that was not *ITer* in Lin and Ye (2009) yet; ++: countries absent in Lin and Ye (2009)' sample.

Appendix 2.4: The balancing properties of the matched data

Variables	**Sample**	**Mean**		**Standardized bias**	**t-test**	
		Treated	**Control**	**% bias**	**t**	**p>t**
Lagged inflation rate	Unmatched	7,0277	81,818	-23,8	-1,37	0,172
	Matched	7,8949	9,4007	-0,5	-1,03	0,305
Governors' turnover rate	Unmatched	0,21303	0,32372	-48	-3,27	0,001
	Matched	0,24039	0,28608	-5	-0,94	0,348
Debt-to-GDP	Unmatched	42,634	58,84	-55,8	-3,48	0,001
	Matched	45,05	44,764	1	0,07	0,942
Real per capita GDP growth rate	Unmatched	2,3683	1,8335	12,2	0,84	0,4
	Matched	2,2859	1,8246	4,6	0,49	0,625
Domestic credit to the private sector	Unmatched	76,901	55,048	58	4,76	0
	Matched	69,407	66,352	4,1	0,37	0,715
Financial openness	Unmatched	-0,25477	-0,28431	2,2	0,16	0,874
	Matched	-0,22146	0,02501	-4,9	-0,95	0,343
Control of corruption	Unmatched	2,9015	3,0067	-10,8	-0,76	0,446
	Matched	2,9641	2,9641	0	0	1
Trade openness	Unmatched	63,293	67,442	-9,4	-0,6	0,546
	Matched	64,664	64,527	0,3	0,02	0,986
Flexibility of exchange rate	Unmatched	10,727	9,3193	48,5	3,03	0,003
	Matched	10,333	10,098	3,1	0,36	0,718
Log of real per capita GDP	Unmatched	9,1929	8,7135	97,9	6,69	0
	Matched	9,1231	9,0872	2,3	0,5	0,62
Financial reforms	Unmatched	16,148	10,428	141,2	8,87	0
	Matched	15,779	15,412	4,1	0,76	0,451
Total GDP	Unmatched	25,724	24,438	108,3	7,29	0
	Matched	25,522	25,555	-2,8	-0,17	0,862

Appendix 2.5: Probit estimates of the propensity scores (using the Default *Starting* Dates)

Dependent Variable	IT (Default *Starting* Dates)							
	[1]	[2] Post-1990	[3] No CEEC	[4] No New ITers	[5] No hyper-inflation	[6]	[7]	[8]
Inflation lagged one year	-0.072***	-0.074***	-0.073***	-0.072***	-0.070***	-0.068***	-0.075***	-0.094***
	(0.015)	(0.015)	(0.017)	(0.015)	(0.016)	(0.018)	(0.019)	(0.023)
Governors' turnover rate	-1.177**	-0.483	-1.657***	-1.177***	-1.106**	-1.001**	-1.903***	-0.625
	(0.458)	(0.491)	(0.533)	(0.458)	(0.464)	(0.464)	(0.532)	(0.508)
Debt ratio	-0.013***	-0.014***	-0.014***	-0.013***	-0.013***	-0.009***	-0.004	-0.008**
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.0046)
Real per capita GDP growth rate	0.043**	0.036***	0.039*	0.043**	0.038*	0.0343*	0.022	0.054**
	(0.021)	(0.022)	(0.022)	(0.021)	(0.021)	(0.021)	(0.020)	(0.024)
Domestic credit to private sector	0.004	0.002	0.005**	0.004	0.003	-0.0002	0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Financial openness	0.085	0.011	0.045	0.085	0.084	0.068	-0.025	-0.395***
	(0.067)	(0.071)	(0.073)	(0.067)	(0.067)	(0.066)	(0.073)	(0.103)
Control of corruption	-0.235***	-0.254***	-0.340***	-0.235***	-0.252***	-0.184**	-0.492***	-0.362***
	(0.091)	(0.098)	(0.103)	(0.091)	(0.092)	(0.078)	(0.098)	(0.109)
Trade openness	-0.003*	-0.004***	-0.004*	-0.003*	-0.003	-0.002	-0.010***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Exchange rate flexibility	0.290***	0.311***	0.283***	0.290***	0.295***	0.267***	0.263***	0.295***
	(0.041)	(0.043)	(0.046)	(0.041)	(0.042)	(0.040)	(0.041)	(0.044)
Log of Real GDP						0.343***		
						(0.068)		
Log of real per capita GDP							1.688***	
							(0.284)	
Financial reforms								0.325***
								(0.054)
No of observations	663	506	575	663	564	663	665	589
Pseudo R^2	0.354	0.367	0.381	0.354	0.325	0.393	0.468	0.562

Note: Robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant are included (not reported).

Appendix 2.6: Matching results (Using the Default *Starting* Dates)

Dependent Variable :	1-Nearest-Neighbor	2-Nearest-Neighbor	3-Nearest Neighbor	Radius Matching			Local Linear Regression	Kernel Matching
FDI over GDP	Matching	Matching	Matching	r=0.005	r=0.01	r=0.05	Matching	
Treatment Effect of IT on FDI: using the Default *starting* Dates								
[1] : ATT	1.624***	1.467**	1.500***	1.329**	1.459***	1.679***	1.778***	1.814***
	(0.565)	(0.577)	(0.493)	(0.617)	(0.506)	(0.410)	(0.368)	(0.373)
Number of Treated Obs.	60	60	60	41	47	59	60	60
Number of Controls Obs.	597	597	597	597	597	597	597	597
Total Observations (Obs.)	657	657	657	638	644	656	657	657
Robustness Checks								
[2] : Post-1990 Period	2.039***	1.727***	1.670***	1.521**	1.844***	1.873***	1.433***	1.660***
	(0.544)	(0.507)	(0.459)	(0.670)	(0.524)	(0.421)	(0.365)	(0.386)
[3] : Excluding CEEC	1.855***	1.830***	1.735***	1.239*	1.498***	1.786***	1.752***	1.824***
	(0.582)	(0.555)	(0.483)	(0.651)	(0.542)	(0.403)	(0.375)	(0.371)
[4] : Excluding New ITers	1.624***	1.467***	1.500***	1.329**	1.459***	1.679***	1.778***	1.814***
	(0.623)	(0.552)	(0.496)	(0.599)	(0.526)	(0.402)	(0.373)	(0.390)
[5] : Excluding hyperinflation episodes	2.056***	1.887***	2.070***	1.815***	2.054***	1.844***	1.907***	1.833***
	(0.700)	(0.563)	(0.530)	(0.613)	(0.526)	(0.403)	(0.396)	(0.372)
[6] : Adding Log of real GDP	1.878***	1.865***	1.979***	1.791***	1.912***	2.107***	1.972***	2.061***
	(0.665)	(0.552)	(0.553)	(0.694)	(0.551)	(0.424)	(0.375)	(0.407)
[7] :Including Log of real per capita GDP	2.112***	1.674**	1.551**	1.534**	1.741***	1.463***	1.324***	1.505***
	(0.768)	(0.694)	(0.667)	(0.736)	(0.591)	(0.493)	(0.465)	(0.453)
[8] : Adding Financial reforms	2.123***	1.834***	1.723***	1.773**	1.833***	1.766***	1.560***	1.771***
	(0.566)	(0.526)	(0.517)	(0.888)	(0.671)	(0.487)	(0.402)	(0.444)

Note: in brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 2.7: Cross-sections-based Probit estimates of the propensity scores

Dependent Variable	IT (Conservative *Starting* Dates)						
	[1]	[2] No CEEC	[3] No New ITers	[4] No hyper-inflation	[5]	[6]	[7]
Inflation	-0.003***	-0.003**	-0.001	-0.071***	-0.003***	-0.003***	-0.0004
	(0.001)	(0.002)	(0.001)	(0.019)	(0.001)	(0.001)	(0.001)
Governors' turnover rates	1.490**	2.739***	0.768	1.791**	1.063*	1.808***	1.036
	(0.62)	(0.941)	(0.748)	(0.827)	(0.634)	(0.652)	(0.850)
Debt Ratio	-0.006*	-0.007	-0.016***	-0.010**	-0.003	-0.011***	-0.007
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)
Real per capita GDP growth rate	0.055	-0.004	0.018	-0.065	0.049	0.065*	0.247***
	(0.037)	(0.055)	(0.045)	(0.046)	(0.036)	(0.037)	(0.078)
Domestic credit to private sector	0.017***	0.018***	0.043***	0.008*	0.011***	0.021***	0.017***
	(0.004)	(0.005)	(0.007)	(0.005)	(0.003)	(0.004)	(0.005)
Financial openness	0.044	0.044	0.420***	-0.042	0.056	0.164	-0.770***
	(0.106)	(0.109)	(0.141)	(0.103)	(0.110)	(0.103)	(0.209)
Control of corruption	0.003	-0.547***	0.527***	0.023	0.024	0.193	-0.553***
	(0.127)	(0.169)	(0.174)	(0.148)	(0.129)	(0.125)	(0.169)
Trade openness	-0.009***	-0.009***	-0.015***	-0.010***	-0.007***	-0.008***	-0.010***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Exchange rate flexibility	0.182***	0.247***	0.308***	0.396***	0.140***	0.237***	0.093**
	(0.039)	(0.046)	(0.055)	(0.065)	(0.041)	(0.039)	(0.047)
Log of Real GDP					0.256***		
					(0.076)		
Log of per capita Real GDP						-0.723**	
						(0.281)	
Financial reforms							0.450***
							(0.081)
Observations	45	34	45	38	45	45	39
Pseudo R^2	0.256	0.331	0.411	0.338	0.283	0.280	0.466

Note: Robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant are included (not reported).

Appendix 2.8: Cross-sections-based Probit estimates of the propensity scores

Dependent Variable	IT (Default *starting* Dates)						
	[1]	[2] No CEEC	[3] No New ITers	[4] No hyper-inflation	[5]	[6]	[7]
Inflation	0.004***	0.061***	0.006***	0.039***	0.003**	0.004***	0.004***
	(0.001)	(0.017)	(0.002)	(0.013)	(0.001)	(0.001)	(0.001)
Governors' turnover rates	-0.224	1.405**	-0.549	0.117	-0.043	0.295	-1.380**
	(0.570)	(0.712)	(0.792)	(0.631)	(0.548)	(0.671)	(0.621)
Debt Ratio	0.00003	-0.001	-0.007*	-0.001	0.003	-0.009**	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Real per capita GDP growth rate	-0.055	0.051	-0.088*	0.004	-0.047	-0.047	-0.113**
	(0.041)	(0.049)	(0.048)	(0.043)	(0.042)	(0.047)	(0.051)
Domestic credit to private sector	0.018***	0.013***	0.036***	0.019***	0.013***	0.024***	0.018***
	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Financial openness	0.101	0.089	0.196	0.131	0.122	0.243***	-0.139
	(0.087)	(0.077)	(0.120)	(0.082)	(0.091)	(0.092)	(0.111)
Control of corruption	0.329***	-0.127	1.019***	0.303***	0.362***	0.685***	0.486***
	(0.114)	(0.137)	(0.156)	(0.113)	(0.118)	(0.130)	(0.114)
Trade openness	-0.010***	-0.006***	-0.016***	-0.008***	-0.008***	-0.008***	-0.012***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Exchange rate flexibility	0.245***	0.233***	0.285***	0.218***	0.218***	0.331***	0.314***
	(0.046)	(0.052)	(0.062)	(0.058)	(0.043)	(0.054)	(0.052)
Log of Real GDP					0.242***		
					(0.082)		
Log of per capita Real GDP						-1.299***	
						(0.287)	
Financial reforms							0.079*
							(0.043)
Observations	42	31	42	39	42	42	37
Pseudo R^2	0.286	0.330	0.503	0.290	0.307	0.349	0.382

Note: Robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant are included (not reported).

Appendix 2.9: Matching results (Using the Conservative *Starting* Dates and cross-sections-based Propensity scores)

Dependent Variable :	1-Nearest-Neighbor	2-Nearest-Neighbor	3-Nearest Neighbor	Radius Matching			Local Linear Regression	Kernel Matching
FDI over GDP	Matching	Matching	Matching	r=0.005	r=0.01	r=0.05	Matching	
	Treatment Effect of IT on FDI: using the conservative *starting* Dates							
[a] : ATT	3.465***	3.365***	3.256***	3.465***	2.387***	2.324***	2.477***	2.346***
	(0.522)	(0.421)	(0.362)	(0.497)	(0.329)	(0.355)	(0.321)	(0.321)
Number of Treated Obs.	42	42	42	28	35	42	42	42
Number of Controls Obs.	607	607	607	607	607	607	607	607
Total Observations (Obs.)	649	649	649	635	642	649	649	649
	Robustness Checks							
[b] : Excluding CEEC	2.617***	2.499***	2.462***	2.617***	1.724***	1.649***	1.820***	1.672***
	(0.365)	(0.346)	(0.310)	(0.427)	(0.175)	(0.225)	(0.219)	(0.219)
[c] : Excluding New ITers	3.581***	3.471***	3.346***	3.581***	2.573***	2.777***	2.674***	2.681***
	(0.571)	(0.429)	(0.364)	(0.538)	(0.330)	(0.368)	(0.385)	(0.352)
[d] : Excluding hyperinflation episodes	2.998***	2.845***	2.791***	2.998***	2.087***	2.163***	2.047***	2.232***
	(0.533)	(0.435)	(0.392)	(0.488)	(0.353)	(0.361)	(0.406)	(0.314)
[e] : Adding Log of real GDP	3.465***	3.365***	3.256***	3.465***	2.661***	2.582***	2.483***	2.541***
	(0.502)	(0.415)	(0.362)	(0.537)	(0.351)	(0.355)	(0.332)	(0.360)
[f] : Adding Log of real per capita GDP	3.465***	3.365***	3.256***	3.465***	2.234***	2.453***	2.385***	2.590***
	(0.485)	(0.427)	(0.390)	(0.519)	(0.310)	(0.342)	(0.330)	(0.337)
[g] : Adding Financial reforms	3.446***	3.343***	3.253***	3.446***	2.339***	2.352***	2.412***	2.324***
	(0.455)	(0.396)	(0.338)	(0.474)	(0.291)	(0.322)	(0.304)	(0.308)

Note: in brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 2.10: Matching results (Using the Conservative *Starting* Dates and cross-sections-based Propensity scores)

Dependent Variable :	1-Nearest-Neighbor	2-Nearest-Neighbor	3-Nearest Neighbor	Radius Matching			Local Linear Regression	Kernel Matching
FDI over GDP	Matching	Matching	Matching	r=0.005	r=0.01	r=0.05	Matching	
Treatment Effect of IT on FDI: using the Default *starting* Dates								
[a] : ATT	3.438***	3.332***	3.217***	3.438***	2.559***	2.690***	2.601***	2.732***
	(0.497)	(0.399)	(0.376)	(0.484)	(0.297)	(0.339)	(0.324)	(0.327)
Number of Treated Obs.	60	60	60	41	47	59	60	60
Number of Controls Obs.	597	597	597	597	597	597	597	597
Total Observations (Obs.)	657	657	657	638	644	656	657	657
Robustness Checks								
[b] : Excluding CEEC	2.676***	2.551***	2.499***	2.676***	1.798***	1.813***	2.053***	1.766***
	(0.379)	(0.350)	(0.302)	(0.429)	(0.290)	(0.266)	(0.229)	(0.297)
[c] : Excluding New ITers	3.542***	3.426***	3.296***	3.542***	2.454***	2.658***	2.858***	2.658***
	(0.512)	(0.370)	(0.406)	(0.475)	(0.322)	(0.354)	(0.295)	(0.368)
[d] : Excluding hyperinflation episodes	3.111***	2.831***	2.710***	3.111***	1.950***	1.934***	1.734***	2.025***
	(0.834)	(0.574)	(0.447)	(0.794)	(0.359)	(0.354)	(0.363)	(0.387)
[e] : Adding Log of real GDP	3.438***	3.332***	3.217***	3.438***	2.487***	2.507***	2.622***	2.684***
	(0.494)	(0.411)	(0.359)	(0.490)	(0.306)	(0.310)	(0.306)	(0.319)
[f] : Adding Log of real per capita GDP	3.438***	3.332***	3.217***	3.438***	2.685***	2.656***	2.603***	2.626***
	(0.498)	(0.385)	(0.354)	(0.481)	(0.299)	(0.319)	(0.310)	(0.324)
[g] : Adding Financial reforms	3.325***	3.216***	3.126***	3.325***	2.523***	2.515***	2.581***	2.489***
	(0.400)	(0.398)	(0.301)	(0.506)	(0.287)	(0.245)	(0.272)	(0.283)

Note: in brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 2.11: Sources and definitions of data

Variables	Definition	Sources
FDI over GDP	Net Inflows of Foreign Direct Investments, as GDP per cent	World Development Indicators (WDI, 2009), World Bank
Domestic credit to private sector (GDP percent)	Proxy of the financial development: credit offered by the banks to the private sector, as GDP per cent.	
Total GDP	Gross Domestic Product (constant 2000US$). Proxy for a country's economic size.	
Fully Fledged IT	Dummy Variable taking the value 1 if in a given year the country practices *IT*, the starting dates considered being the *conservative* ones.	Rose (2007) and Roger (2009)
Soft IT	Dummy Variable taking the value 1 if in a given year the country practices IT, the starting dates considered being the *default* ones.	
Inflation	Annual growth rate of average CPI	World Economic Outlook (WEO, 2009)
Corruption	Index ranged from 0 to 6, assessing the corruption in the political system. The higher the index, the less corrupt the political system is.	International Country Risk Guide (ICRG, 2009)
Real per capita output growth rate	Annual growth rate of the real output per capita	Penn World Table (PWT 6.3)
Real GDP per capita	Real GDP per capita, constant prices. Proxy for a country's stage of development.	
Trade Openness (GDP percent)	Sum of imports and exports divided by GDP	
Exchange rate Flexibility	Fine classification codes for exchange rates regimes, ranging from 1 (no separate legal tender) to 15 (Dual markets in which parallel market data is missing). The higher the code value, the more flexible the exchange rate regime.	Reinhart and Rogoff (2004), updated
Debt (GDP percent)	Gross General government debt, in percentage of GDP	Ali Abbas et al. (2010)
Turnover Rates	Central Banks' governors turnover rates	Ghosh et al. (2003), updated
Financial Openness	Index measuring the extent of openness in external account transactions, with respect to four aspects: i) presence of multiple exchange rates; ii) restrictions on current account transactions; iii) restrictions on capital account transactions; and iv) requirement of the surrender of export proceeds. The higher the index, the more open the external accounts.	Chinn and Ito (2008)
Financial reforms	Multi-faceted measure of reforms, covering seven aspects of financial sector policy: i) credit controls and reserves requirements; ii) interest rate controls; iii) entry barriers; iv) state ownership in the banking sector; v) capital account restrictions; vi) prudential regulations and supervision of the banking sector; and vii) security market policies. The higher the index, the better the reforms in the financial sector.	Abiad et al. (2008)

Chapter 3*

Can Inflation Targeting Promote Institutional Quality in Developing Countries?

*A version of this chapter, co-authored with A. Minea and P. Villieu, is currently under review in *Journal of International Economics*.

3.1. Introduction

Institutional reforms were often emphasized in order to improve economic performances of developing or emerging countries: according to some of the most influential papers of the late 90's (see, for example, Easterly et *al.*, 1997), reforms accelerated growth in Latin America by as high as 2.2 percentage points. However, subsequent work (Loayza et *al.*, 2005) concluded that these positive effects might have been only temporary, a view shared by Velasco (2005). This pessimism was reinforced by several studies which, as a reaction to the "Washington Consensus", have outlined similarly poor performances of such reforms concerning poverty reduction or economic growth enhancement in Sub-Saharan Africa (see the Van der Walle's, 2001; and Stliglitz's, 2002, books). In an impressive attempt to clarify the mechanism underlying these conflicting findings, Acemoglu et *al.* (2008) study the relation between central bank independence and inflation performances, and show in particular the existence of threshold effects, depending on the "political context". Their results indicate that the inflation rate is negatively linked to the degree of independence of the central bank exclusively for "average" levels of the political and institutional context, with no clear-cut relation when this context is "good" (as in most of developed countries) or "bad". The intuition is that economies enjoying a good political context have already good institutions and low inflation rates, while, in countries with no mechanism of control of government activity, inflation is established outside the central bank, irrespective of its degree of independence. In these two extreme cases, institutional reforms would thus be inefficient, but they could become extremely useful in countries with "average" institutional quality, which dispose already of rather good institutions that could be further enhanced.

If the question of when and how policy reforms are successful in terms of reducing inflation is a crucial one, the largest majority of studies assume that institutions are exogenous and mainly focus on the influence of institutional reforms on economic performances. In this chapter, we adopt the opposite view,[50] and explore the relation between the monetary regime and "institutional quality", measured as the capacity to fight corruption or fiscal evasion. This chapter builds upon two strands of literature, one emphasizing an important role of seigniorage revenue in terms of public budget resources (Cukierman et *al.*, 1992; and Catao &

[50] For an early discussion about the endogeneity of policy reforms, and particularly regarding Central Bank independence, see Alesina & Summers (1993).

Terrones, 2005), and the other outlining a positive link between corruption and high inflation in developing countries (Al Marhubi, 2000; and Blackburn et *al.*, 2008).

We run our analysis in two steps. In the first step, we develop a theoretical model to account for the interaction between the monetary regime and the quality of institutions. We show in particular that an inflation targeting (IT hereafter) regime (or, equivalently, a more conservative central banker) can enhance the quality of institutions, because governments are induced to fight corruption, in order to offset the losses of seigniorage revenue associated with strict monetary regimes.

Moreover, this result depends on the cost of institutional reforms, which may correspond to the political context in which reforms are undertaken. Thus, we derive a threshold effect generated by the political context: first, if the cost of reforms is extremely high, governments have no incentive to enhance the quality of institutions, independently of the monetary regime. Institutions then remain at their initial level, which may reproduce an "institutional trap". Second, if the cost of reforms is relatively low, the quality of institutions is already (very) good, and the monetary regime has, yet again, no effect on institutions. Third, as in Acemoglu et *al.* (2008), only countries with average institutional quality find an incentive to run institutional reforms, as a response to a strict monetary regime (such as IT or a conservative central banker).

However, our results go along with a more optimistic view. Indeed, in our model, the thresholds defining the lower and upper values for the cost of reforms (namely the level below and, respectively, above which the monetary regime is useless) are endogenous and depend upon the value of the inflation target. Our model shows that a more stringent inflation target reduces the interval over which economies are stuck in the "institutional trap" and extends the interval over which the monetary regime is efficient. Thus, even in the two extreme cases the monetary regime remains effective in enhancing institutional quality.

The second step of the analysis aims at evaluating the pertinence of our theoretical findings. Using data for developing countries over the 1984-2007 period, we investigate if the adoption of IT leads to an improvement in the quality of institutions. As stated previously, one of the main issues is that the adoption of IT is likely not to be an exogenous monetary reform. To deal with such an endogeneity problem of IT adoption, we draw upon recently-used

econometric techniques (see, *e.g.*, Lin & Ye, 2007, 2009; or Lin, 2010), based on *propensity scores-matching*. We find that IT adoption does indeed improve the quality of institutions in developing countries, a result that remains robust to a set of alternative specifications (alternative *starting* dates of IT adoption, different specifications for the *probit* selection model, different sub-samples, or when controlling for hyper-inflation episodes).

In section two we present our basic setup, section three illustrates the commitment regime, while section four considers the discretionary solution with IT. Section five develops an econometric analysis confirming our theoretical findings and section six concludes.

3.2. The model

Our model is based on the setup coined by Barro & Gordon (1983), and developed by Alesina & Tabellini (1987) to account for the effect of fiscal policy. We consider a supply Lucas function, in which unanticipated inflation can stimulate output, while distortive fiscal policy exerts a negative effect on supply

$$y = a\left(\pi - \pi^{e}\right) - b\tau . \tag{3.1}$$

π and π^{e} stand for inflation and expected inflation respectively, with τ the tax rate, y the logarithm of output, and a and b positive parameters.[51]

The government finances public spending (g) with taxes (τ) and seigniorage(π). In addition, we introduce tax collecting costs. Fragile fiscal institutions are often associated with an inefficient fiscal system, with important collecting costs and tax evasion, due to corruption for example. We define the quality of fiscal institutions by the coefficient $\mu \in [0;1]$: when private agents pay an amount τ, the government retrieves only $\mu\tau$. Therefore, we can write the government budget constraint as[52]

[51] This function comes from a maximization behavior of profit (net of taxes) by firms in a competitive environment with nominal wages indexed on the expected inflation rate, for example.

[52] We derive this relation as Alesina & Tabellini (1987). The government budget constraint can be written in level $M_{t+1} - M_t = PG - \mu T$, with M the money supply, P the price index, G nominal public spending and T taxes. Defining $g = G/PY$ and $\tau = T/PY$ as the share of public spending and taxes in output

$$g = \mu\tau + \pi \,. \tag{3.2}$$

In studying the effect of the monetary regime on the quality of institutions, we will treat μ as an endogenous parameter.

The government loss function depends on inflation, output and public spending

$$L^g(\pi,\tau,e) = -\frac{1}{2}\left[\pi^2 + \lambda y^2 + \theta(g-\overline{g})^2\right] - \gamma^g e \,, \tag{3.3}$$

with λ and θ the weights of the deviations of output and public spending relative to inflation in the objective function.[53] Besides, the government can improve institutions by choosing the appropriate level of "effort" $\left(e \in [\underline{e}, \overline{e}]\right)$, and we suppose a simple relation between the effort and the quality of institutions: $\mu = \mu_0 f(e)$, with $f'(e) > 0$, $f''(e) < 0$, $f(\underline{e}) = 1$ and $f(\overline{e}) = 1/\mu_0$, such as $\mu \in [\mu_0, 1]$, with μ_0 the initial quality of institutions. A simple way to fulfill these constraints is to assume $f(e) = e^{\varepsilon}$, with $\varepsilon \in (0,1)$,[54] which simplifies calculations for finding the minimal effort $(\underline{e} = 1)$ and the maximal effort $\left(\overline{e} = 1/\mu_0^{1/\varepsilon}\right)$. γ^g stands for the cost per unit of effort for a government that aims at improving institutions, and it can correspond, for example, to the political context in which the reforms are implemented.

In addition to the government loss function, we introduce a social welfare function, which can differ from (3.3). Indeed, governments in place often take advantage of existing institutions, and have few incentives to change them, compared to what would be desirable from a social welfare perspective. In other words, governments face lobbies and electoral issues, and thus have little incentives to change the "rules of the game" (to improve institutions). To take this fact into account, we assume that the cost of reforms $\left(\gamma^w\right)$ may be lower for the society than for the government, which overestimates the difficulties of the "political context" to improve

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respectively, leads to $M_{t+1} - M_t = PY(g - \mu\tau)$, and moreover to $g - \mu\tau = (M_{t+1} - M_t)/(M_t) = \pi$, where π stands for either the seigniorage rate or the inflation rate.

[53] As shown by Alesina & Tabellini (1987), a positive public spending target $\overline{g}$ is sufficient to generate an inflationary bias; consequently, we suppose that social targets for inflation and output are zero.

[54] For example, in our computations below we choose $\varepsilon = 1/2$.

institutions compared to the society. Consequently, we suppose the following social welfare function[55]

$$L^w(\pi,\tau,e) = -\frac{1}{2}\left[\pi^2 + \lambda y^2 + \theta(g-\bar{g})^2\right] - \gamma^w e\,, \qquad \text{with } \gamma^w \le \gamma^g\,. \tag{3.4}$$

We imagine a strategic game between the government, who chooses both the tax rate and the effort that maximize L^g, and the central bank, who chooses the inflation rate that maximizes L^g (or equivalently L^w). In general, such a game leads to a sub-optimal equilibrium, because the central bank has incentives to cheat through its choice of the inflation rate. As in principal-agent models of monetary policy (see, *e.g.*, Walsh, 1995), we solve this issue by introducing a supra-authority (a social planner, acting as the principal), which can modify the loss function of the central bank (the agent), by using an IT regime,[56] in order to maximize the social welfare L^w. We distinguish in the following the *commitment* regime, in which the central bank credibly commits to the inflation rate by dropping down inflation surprises ($\pi^e = \pi$ *ex-ante*), and the discretionary regime, in which the commitment is unfeasible (in the absence of stochastic disturbances, inflation expectations will be fulfilled in equilibrium only: $\pi^e = \pi$ *ex-post*).

3.3. The commitment regime

In the commitment regime, the central bank internalizes the effect of its choice of the inflation rate over the agents' expectations $\left(\pi^e = \pi\right)$; thus the equilibrium output is simply $y = -\beta\tau$. First order condition (hereafter FOC) for the central bank $\left(\partial L^g / \partial\pi = 0\right)$ is

$$\pi + \theta(\mu\tau + \pi - \bar{g}) = 0\,. \tag{3.5}$$

Since the government is not subject to the time inconsistency problem (it has no incentives to generate fiscal surprises), FOCs for the tax rate $\left(\partial L^g / \partial\tau = 0\right)$ and for the level of effort $\left(\partial L^g / \partial e = 0\right)$ are identical in the commitment and discretionary regimes

[55] All our results are unchanged if $L^w = L^g$ (namely, if the two costs are identical $\gamma^g = \gamma^w$).

[56] Such a targeting can be obtained by anchoring the exchange rate on a foreign currency or by creating a monetary union, for example. Given the degree of generality of our model, we do not need to detail the mechanism through which the inflation is targeted.

$$b^2\lambda\tau+\mu\theta\left(\mu\tau+\pi-\overline{g}\right)=0, \tag{3.6}$$

$$\theta\mu_0 f'(e)\tau\left(\mu\tau+\pi-\overline{g}\right)+\gamma^g=0. \tag{3.7}$$

We first describe the solution for exogenous institutions (without equation (3.7)); then, we consider endogenous institutions, with the level of effort to be computed in (3.7).

3.3.1. The commitment regime with exogenous institutions

With *exogenous* institutions, the commitment solution (exponent *c*) for inflation and taxes comes from (3.5) and (3.6): $\pi^c=x^c b^2\lambda\theta\overline{g}$ and $\tau^c=x^c\theta\mu\overline{g}$, with: $x^c\equiv\left[\theta\mu^2+(1+\theta)\lambda b^2\right]^{-1}$. These results show that an exogenous increase in institutional quality (an upwards jump of μ) reduces the equilibrium inflation rate in the commitment regime: $\pi^c\left(\underset{-}{\mu}\right)$. Indeed, the extra tax collection ensured by the fight against corruption can be substituted to the inflation tax in the government budget constraint. However, the impact of institutional quality on the equilibrium tax rate is ambiguous: $\tau^c\left(\underset{?}{\mu}\right)$. Effectively, better institutions induce the government to increase this rate (a substitution effect, because of a better return); but, simultaneously, the return of fiscal collection increases, which allows the government reducing taxes (a revenue effect).

3.3.2. The commitment regime with endogenous institutions

With *endogenous* institutions, the solution comes from equations (3.5)-(3.6)-(3.7), namely, abstracting from corner solutions,[57]

$$e^c=\frac{b}{\mu_0^2}\left[\mu_1\overline{g}-\left(\frac{1+\theta}{\theta}\right)\lambda b\right], \text{ where } \mu_1\equiv\mu_0\sqrt{\lambda/2\gamma^g} \text{ and } \varepsilon=1/2. \tag{3.8}$$

Notice that, the level of effort chosen by the government is not necessarily optimal for society, because the government's objective can differ from social welfare (if $\gamma^w\neq\gamma^g$), even in the commitment solution.

[57] We examine corner solutions with IT in the next section.

With endogenous institutional quality, FOCs (3.6) and (3.7) of the government program can by themselves determine the value of equilibrium public spending, independently of monetary policy: $g^c = \bar{g} - \lambda b / \theta\mu_1$. The inflation rate comes from the FOC of the central bank (3.5): $\pi = -\theta\left(g^c - \bar{g}\right)$. Thus, the commitment solution with endogenous institutions is

$$\begin{cases} \pi^c = \lambda b / \mu_1 \\ \tau^c = \left(e^c\right)^{0.5} \mu_0 / (\mu_1 b) \end{cases} \text{ and } \quad \begin{cases} y^c = -\left(e^c\right)^{0.5} \mu_0 / \mu_1 \\ g^c = \bar{g} - \lambda b / (\theta\mu_1) \end{cases}. \tag{3.9}$$

Therefore, under commitment, the equilibrium inflation rate increases with the cost of institutional reform: $\pi^c\left(\underset{+}{\gamma^g}\right)$, while the equilibrium tax rate decreases: $\tau^c\left(\underset{-}{\gamma^g}\right)$. Intuitively, higher costs of institutional reform discourage government's effort in enhancing institutions, and poor institutions cause a leakage in tax collection. Since the return on taxes (the tax collection) decreases, it is optimal for the government to decrease the equilibrium tax rate and for the central bank to increase the inflation rate in order to increase seigniorage resources.

3.4. The discretionary regime with inflation targeting

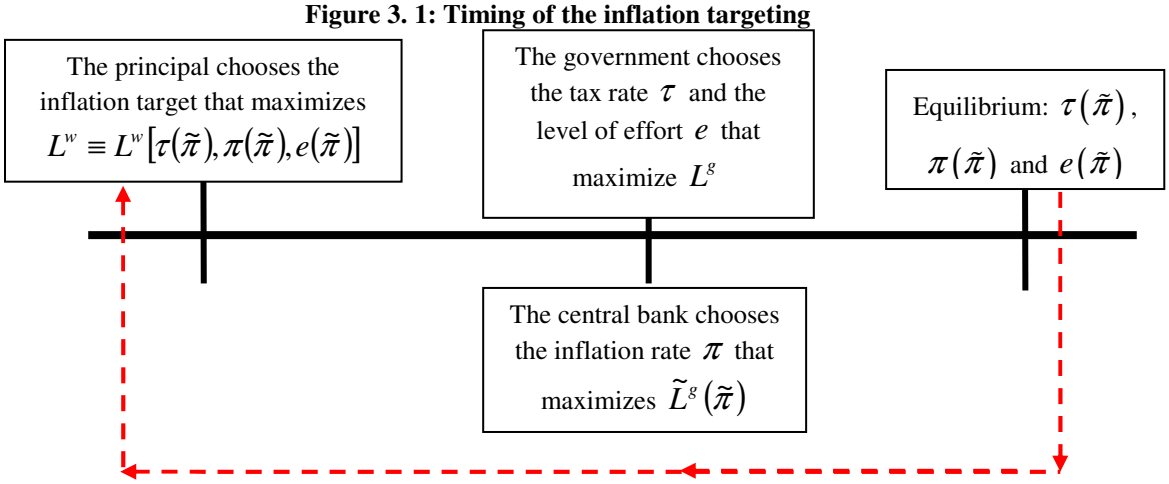
In the discretionary regime (exponent *d*), the government still maximizes L^g, with unchanged FOCs (3.5) and (3.6), since fiscal policy is not subject to time inconsistency. The central bank maximizes L^g (or equivalently L^w), taking expectations as given. As it has been shown by Alesina & Tabellini (1987), compared to the commitment regime, such a regime yields an inflationary bias due to the time-inconsistency of the monetary policy $\left(\pi^d \geq \pi^c\right)$.[58] In this chapter, we study a possible solution to this problem, namely the delegation of the monetary policy to a supra-authority (the principal), which imposes an inflation target to the central bank.[59]

[58] Besides, in such a regime, taxes $\left(\tau^d \leq \tau^c\right)$ and welfare $\left(L^d \leq L^c\right)$ decline.

[59] The literature emphasizes several solutions for the time inconsistency problem for the monetary policy. Rogoff (1985) suggests appointing a conservative central banker (namely who gives more interest than the society to the stabilization of inflation), while Walsh (1995) discusses an optimal contract for the central bank, a strategy which is formally equivalent to inflation targeting (see Svensson, 1997c). In a deterministic setup as ours, targeting inflation leads to the same result as for the case of a conservative central banker (see *Appendix 3.1*). However, in a stochastic setup the two strategies would be different, since appointing a conservative central

The structure of the inflation targeting game is depicted in *Figure 3.1*. We consider a game in two stages. In the first stage, the principal chooses the inflation target $(\tilde{\pi})$ that maximizes the social welfare. In the second stage, the central bank computes the inflation rate, by considering the inflation goal assigned by the principal $\pi(\tilde{\pi})$, and the government computes the tax rate $\tau(\tilde{\pi})$ and the level of effort $e(\tilde{\pi})$. This procedure allows exploring the influence of the monetary regime on the determination of the quality of institutions, since the principal can, in the first stage of the game, choose the optimal inflation target that will provide an incentive for the government to enhance institutions in the second stage.[60]

Figure 3. 1: Timing of the inflation targeting



As usual in the literature, we use a "backward-looking" procedure to solve the game: we first compute the levels of inflation, taxes and effort, and then the "principal", acting as a leader in the Stackelberg equilibrium, decides of the optimal inflation target.

We assume that a social planner (the "principal") assigns the central bank (the "agent") the following goal

$$\tilde{V}(\pi,\tau,e) = -\frac{1}{2}\left[(\pi-\tilde{\pi})^2 + \lambda y^2 + \theta(g-\bar{g})^2\right] - \gamma^g e, \qquad (3.10)$$

with $\tilde{\pi}$ the inflation target, established by the "principal", and that the government and the central bank take as given. In the discretionary regime, the FOC (3.5) becomes

banker deforms the response of the monetary policy to stochastic shocks and gives rise to a "credibility *versus* flexibility" trade-off, while the inflation targeting scheme allows reproducing the first best solution, as does the contractual approach of Walsh (1995).

[60] Formally, the inflation targeting solution illustrated in *Figure 3.1* is strictly equivalent to an exchange rate pegging on an external currency (the inflation rate equals the inflation rate of the anchor currency), and the "principal" is then the anchor monetary authority. For countries in a monetary union, the "principal" is the MP Committee of the Common Central Bank, which establishes the inflation goals of the common central bank.

$$\pi - \tilde{\pi} - ab\lambda\tau + \theta(\mu\tau + \pi - \bar{g}) = 0. \tag{3.11}$$

The discretionary regime gives rise to an inflationary bias, since the central bank attempts to stimulate the activity, while the equilibrium output $(y = -b\tau)$ is independent of the inflation rate. This credibility bias is depicted by the term $ab\lambda\tau$.

3.4.1. The discretionary regime with exogenous institutions

As for the commitment regime, we focus first on the solution with *exogenous* institutions. Using (3.11) and (3.6), we compute the inflation and the tax rate for a given level of institutions[61]

$$\pi^d = x^d\left[\lambda\theta b(a\mu + b)\bar{g} + (\lambda b^2 + \theta\mu^2)\tilde{\pi}\right], \tag{3.12}$$

$$\tau^d = x^d\theta\mu(\bar{g} - \tilde{\pi}), \tag{3.13}$$

where $x^d \equiv \left[\theta\mu^2 + (1+\theta)\lambda b^2 + ab\lambda\theta\mu\right]^{-1}$. The optimal inflation target that matches the commitment solution (at *given* institutional quality) is

$$\tilde{\pi}^c = -ab\lambda\tau^c = -x^c ab\lambda\theta\mu\bar{g}, \tag{3.14}$$

such as $\tau^d = \tau^c$ and $\pi^d = \pi^c$.

A number of observations can be made. First, the inflation target $\tilde{\pi}^c$ is negative,[62] due to the positive inflation bias in discretionary monetary policy. Thus, the equilibrium inflation rate (3.12) is lower in the presence of IT. Second, the equilibrium tax rate (3.13) is higher in the presence of IT, since the discretionary tax-rate is too low, compared to the commitment one. Third, the inflation target is not linearly related to the quality of institutions. Indeed, $d\tilde{\pi}^c / d\mu > 0$ if $\mu > \bar{\mu} \equiv \sqrt{(1+\theta)b^2\lambda/\theta}$ and $d\tilde{\pi}^c / d\mu < 0$ if $\mu < \bar{\mu}$. This property comes from the effect of institutional quality on τ. In (3.11), we can see that the incentive to generate inflation surprises depends on the equilibrium level of output $(-b\tau)$. A higher level of institutional quality improves the return of tax collection, allowing government using lower

[61] We find the discretionary solution of Alesina & Tabellini (1987) for $\mu = 1$ and a zero inflation target.

[62] This will also be the case for the optimal target with endogenous institutional quality in the next section.

rates of output taxation, for a given level of public expenditure. Simultaneously, higher institutional quality induces government to increase public expenditure. If the latter effect dominates the former $(\mu < \overline{\mu})$, taxes increase, so does the incentive to generate inflation surprises $(-b\tau)$ in absolute value. Consequently, the inflation target must be increased (in absolute value) in (3.14): monetary policy must be more restrictive to offset the higher inflation bias. In the opposite case $(\mu > \overline{\mu})$, the inflation target must be released.

3.4.2. The discretionary regime with endogenous institutions

Let us consider in the following *endogenous* institutions (relation (3.7)). When institutional quality is endogenous, the inflation target $\tilde{\pi}^c$ in (3.14) is no longer optimal, since one should take into account the influence of the target on the choice of effort by the government. Using (3.11), (3.6) and (3.7), we compute the optimal degree of institutional quality from the implicit relation

$$\theta b\mu_1(\overline{g} - \tilde{\pi}) = \theta\mu^2 + (1+\theta)\lambda b^2 + ab\lambda\theta\mu. \tag{3.15}$$

(3.15) is a second degree polynomial $\mu^2 + A\mu + B = 0$, with $A \equiv ab\lambda > 0$ and $B \equiv -b\mu_1(\overline{g} - \tilde{\pi}) + (1+\theta)b^2\lambda/\theta \leq 0$.

In the following, we distinguish between interior and corner solutions. Recall that the level of effort is bounded by lower and upper limits, namely $(e \in [\underline{e}, \overline{e}])$. Consequently, we find corner solutions when $e = \underline{e}$ or $e = \overline{e}$, and interior solutions when $e \in]\underline{e}, \overline{e}[$.

An *interior* solution arises if the cost of reforms is such as $\gamma \in]\underline{\gamma}, \overline{\gamma}]$, with the two thresholds to be defined below. In this case, we can show that the polynomial (3.15) has only one positive solution[63]

$$\mu^d = \frac{1}{2}\left[-A + (A^2 - 4B)^{0.5}\right], \tag{3.16}$$

and the level of effort is: $e^d = (\mu^d)^2 / \mu_0^2$. Based on (3.16), notice that the effort in improving the quality of institutions negatively depends on the inflation target

[63] Since $A > 0$; besides, to have a positive solution $(\mu > 0)$, B must be negative since $\mu^2 + A\mu = -B$.

$$\frac{d\mu^d}{d\tilde{\pi}} = -\frac{dB}{d\tilde{\pi}}\left(A^2 - 4B\right)^{-0.5} = -\frac{b\mu_1}{A + 2\mu^d} < 0 \Rightarrow \frac{de^d}{d\tilde{\pi}} < 0. \tag{3.17}$$

Consequently, the lower the inflation target, the higher the effort in improving the quality of institutions. Therefore, by the way of IT, tight monetary policies induce the government to increase institutional quality: with a more stringent inflation target (a lower $\tilde{\pi}$), the government must find another way of government finance, and is encouraged to increase efforts in order to augment tax collection, including institutional reforms. Observe that our result does not rely on IT strictly speaking, but also works in a different setup, with a conservative central banker, for example: the higher the degree of central bank conservatism, the higher the government's effort in improving the quality of institutions (see *Appendix 3.1*).

Let us now discuss *corner* solutions. Since, in this case, the effort is bounded by its minimum or maximum level, the monetary regime has, apparently, no effect on the quality of institutions. However, this assertion is misleading, because the monetary regime influences the endogenous frontier that separates interior from corner solutions. Effectively, since the level of effort lies between two extreme values $\left(\underline{e} \le e \le \overline{e}\right)$, we compute in (3.15) the thresholds for the cost $\overline{\gamma}$ (such as $e = \underline{e} = 1$) and $\underline{\gamma}$ (such as $e = \overline{e} = 1/\mu_0^2$), which depend on the inflation target

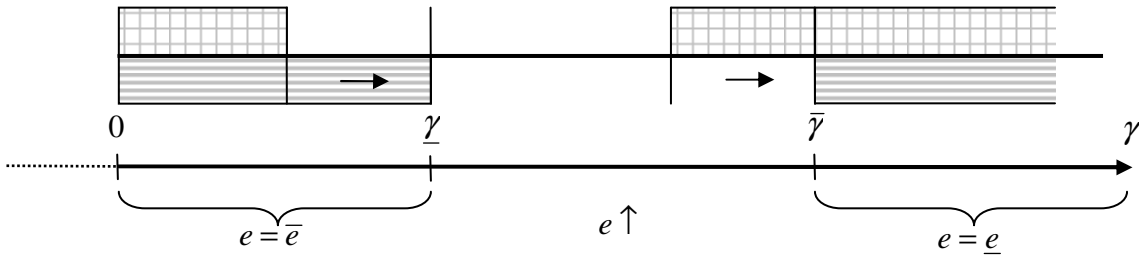
$$\begin{cases} \overline{\gamma} = \dfrac{\lambda}{2}\left[\dfrac{\left(\overline{g} - \tilde{\pi}\right) b\theta\mu_0}{(1+\theta)b^2\lambda + \theta\mu_0\left(\mu_0 + ab\lambda\right)}\right]^2 = \overline{\gamma}\left(\tilde{\pi}\right) \\ \underline{\gamma} = \dfrac{\lambda}{2}\left[\dfrac{\left(\overline{g} - \tilde{\pi}\right) b\theta\mu_0}{(1+\theta)b^2\lambda + \theta(1+ab\lambda)}\right]^2 = \underline{\gamma}\left(\tilde{\pi}\right) \end{cases}. \tag{3.18}$$

If $\gamma^g \ge \overline{\gamma}$, government has no incentive to improve institutional quality, since the cost of reforms is too high. The effort takes its minimal value $\left(e = 1\right)$, so does the quality of institutions $\left(\mu = \mu_0\right)$. If $\gamma^g \le \underline{\gamma}$, on the contrary, institutions become "perfect" $\left(\mu = 1\right)$, whatever the monetary regime is. Thus, we emphasize the presence of threshold effects for the cost γ, since above $\overline{\gamma}$ (or below $\underline{\gamma}$) the monetary regime is irrelevant for the quality of institutions. This joins empirical evidence from Acemoglu et *al.* (2008), showing the

existence of threshold effects between the monetary regime and economic performances, which would correspond to institutional performances in our model.

However, one can remark in (3.18) that the two thresholds depend negatively upon the inflation target. If the inflation target is more rigorous ($\tilde{\pi}$ is lower), the two thresholds increase, which shrinks the interval over which the effort is minimum $\left(e = \underline{e}\right)$ and extends the interval over which the effort is maximum $\left(e = \overline{e}\right)$, as depicted by *Figure 3.2*. Consequently, our model shows that a more restrictive inflation target *i*) reduces the "institutional trap" interval for which the government has no incentive for institutional reforms (namely $\left[\bar{\gamma}, +\infty\right)$), *ii*) extends the interval for which the quality of institutions is at its highest level (namely $\left[0, \underline{\gamma}\right]$), and *iii*) gives an incentive to government for increasing its effort to enhance institutions over the interval $\left[\underline{\gamma}, \bar{\gamma}\right]$, since for any interior solution $d\mu^d / d\tilde{\pi} < 0$.

Figure 3. 2: Impact of a more rigorous inflation target (a lower $\tilde{\pi}$)



3.4.3. The optimal inflation target

Finally, we compute the optimal inflation target that is chosen by the "principal". To do so, we find the equilibrium values for output, inflation and public spending (all depending on the inflation target) in the discretionary regime by reintroducing (3.15) in (3.12) and (3.13), namely: $y^d = -\mu^d / \mu_1$, $\pi^d = \tilde{\pi} + \lambda\left(a\mu^d + b\right)/\mu_1$ and $g^d = \overline{g} - b\lambda / \theta\mu_1$. The level of institutional quality $\left(\phi^d\right)$ comes from equation (3.16) in the discretionary regime.[64] We compute the value of the social welfare in this regime by injecting these values in (3.4)

$$L^w(\tilde{\pi}) = -\frac{\gamma^g}{\lambda\mu_0^2}\left[\left[\mu_1\tilde{\pi} + \lambda\left(a\mu^d + b\right)\right]^2 + \left(\frac{\gamma^g + \gamma^w}{\gamma^g}\right)\lambda\left(\mu^d\right)^2 + \frac{b^2\lambda^2}{\theta}\right]. \tag{3.19}$$

[64] We focus exclusively on interior solutions.

The optimal inflation target, which we denote by $\tilde{\pi}^*$, maximizes $L^w(\tilde{\pi})$; thus, $\tilde{\pi}^*$ is the solution of $\frac{dL^w}{d\tilde{\pi}}(\tilde{\pi}^*)=0$, with $\frac{d^2L^w}{d\tilde{\pi}^2}(\tilde{\pi}^*)<0$, namely[65]

$$\tilde{\pi}^* = -\frac{\lambda}{\mu_1}\left[a\mu^d + b\left(\frac{\gamma^g-\gamma^w}{2\gamma^g}\right)\right], \tag{3.20}$$

and the associated inflation rate is $\pi^d = b\lambda(\gamma^g+\gamma^w)/2\mu_1\gamma^g$.

If the social welfare is identical to the government welfare function $(\gamma^g=\gamma^w)$, the optimal inflation target is simply $\tilde{\pi}^* = a\lambda y^d$, such as the inflation rate equals its commitment value $\pi^d = b\lambda/\mu_1 = \pi^c$.[66] In this case, the commitment regime from the previous section is also optimal from a social welfare perspective.

On the contrary, if the government overestimates the cost of reforms compared to the society $\gamma^g > \gamma^w$, the inflation target in (3.20) must be more restrictive: $\tilde{\pi}^* < a\lambda y^d$, and the associated inflation rate is lower: $\pi^d = \frac{b\lambda}{\mu_1}\left(\frac{\gamma^g+\gamma^w}{2\gamma^g}\right) < \pi^c$. Indeed, the inflation target should be defined in order to provide an incentive for the government to increase its effort to enhance institutions, because the government overvalues the cost of institutional reforms, from a social welfare perspective.

Remark that relation (3.20) provides only an implicit relation for $\tilde{\pi}^*$, since μ^d depends on $\tilde{\pi}^*$ in (3.16). However, by reintroducing (3.20) in (3.15), we extract an implicit solution for the quality of institutions

$$(\mu^*)^2 = b\mu_1\bar{g} + \left[\left(\frac{\gamma^g-\gamma^w}{2\gamma^g}\right) - \left(\frac{1+\theta}{\theta}\right)\right]b^2\lambda, \tag{3.21}$$

and for the optimal effort (we focus on interior solutions exclusively)

---

[65] Remark that $\frac{dL^w}{d\tilde{\pi}} = -\frac{2\gamma^g}{\lambda\mu_0^2}\left[\left(\mu_1 + a\lambda\frac{d\mu^d}{d\tilde{\pi}}\right)\left[\mu_1\tilde{\pi} + \lambda(a\mu^d+b)\right] + \lambda\mu^d\left(\frac{\gamma^g+\gamma^w}{\gamma^g}\right)\frac{d\mu^d}{d\tilde{\pi}}\right]$.

[66] Taxes and output are also at their commitment values, namely $\tau^d = \tau^c$ and $y^d = y^c$.

$$e^* = \frac{b}{\mu_0^2}\left[\mu_1 \bar{g} + \left[\left(\frac{\gamma^g - \gamma^w}{2\gamma^g}\right) - \left(\frac{1+\theta}{\theta}\right)\right] b\lambda\right]. \quad (3.22)$$

By comparing (3.22) to (3.8), we can immediately observe that $e^* \geq e^c$ if $\gamma^g \geq \gamma^w$, with the same interpretation as above: if the government overvalues the difficulties of the "political context" to reform institutions, a more rigorous monetary regime should be adopted in order to create incentives for government to go further in institutional reform programs.

To summarize, our theoretical analysis of the relation between the monetary system and the quality of institutions displays two types of regimes, namely extreme and intermediate regimes. However, compared to the findings of Acemoglu et *al.* (2008), the fact that in our model the thresholds separating the two kinds of regimes are endogenous amplifies the role of the monetary system, which is found to be effective also for defining the frontier between the intermediate and the extreme regimes. Consequently, we emphasize conclusive support in favor of a positive effect of IT on the quality of institutions. The next section aims at testing this result on a group of developing countries.

3.5. Econometric analysis

According to our theoretical model, we aim at testing the influence of adopting IT on the quality of institutions (QI hereafter). We first outline the econometric strategy and the data, and then present and discuss our main results.

3.5.1. Econometric strategy and data

3.5.1.1. Methodology

To assess the influence of IT on the QI, we draw on the propensity scores-matching methodology (hereafter *PSM*), recently used by Lin & Ye (2007, 2009) and Lin (2010). *PSM* consists of pairing the IT countries (ITers hereafter) with non-ITers that have similar observed characteristics, so that the difference between an ITer outcome and that of a matched counterfactual is attributable to the treatment (IT adoption). Let us define the average treatment effect of the treated (*ATT*) as

$$ATT = E[(QI_i^1 - QI_i^0 \mid IT_i = 1)] = E[(QI_i^1 \mid IT_i = 1)] - E[(QI_i^0 \mid IT_i = 1)] \quad (3.23)$$

IT is a dummy variable for the presence of IT (i.e. $IT = 1$ if a country i is targeting inflation and $IT = 0$ if it does not). Accordingly, the *ATT* measures, for all the ITers, the change in the quality of their institutions, defined as the difference between the quality of institutions under IT ($QI_i^1 \mid IT_i = 1$) and the quality of institutions these countries would have had, had they not adopted IT ($QI_i^0 \mid IT_i = 1$). Unfortunately, it is not possible to observe the latter; as it is common in non-experimental studies, we face here an identification problem. To circumvent it, we compare the sample mean QI of the *treatment group* (the *ITers*, $IT = 1$) with that of the *control group* (the *non-ITers*, $IT = 0$), assuming that the assignment to the *treatment* is random. However, IT adoption can be non-random, since correlated with a set of observable variables that also affect the outcome variable (QI), leading to the so-called *self-selection* problem,[67] and simple comparison of the sample mean of the QI between the two groups would then produce biased estimates of the *ATT*. The *PSM* allows precisely addressing this "selection on observables" problem.

A key assumption needed to apply this matching method is the conditional independence assumption ($QI^0, QI^1 \perp X$), which requires, conditional on observables, that the outcome (QI) to be independent of the *treatment* variable. Under this assumption, equation (3.23) becomes

$$ATT = E[(QI_i^1 \mid IT_i = 1, X_i)] - E[(QI_i^0 \mid = 0, X_i)], \quad (3.24)$$

Where we replaced $E[(QI_i^0 \mid IT_i = 1, X_i)]$ by $E[(QI_i^0 \mid IT_i = 0, X_i)]$, which is observable. However, as the number of covariates (X) increases, such a matching on X would be difficult to implement in practice; to overcome this high dimension problem, we follow Rosenbaum & Rubin (1983) and base the matching on the *propensity scores* (instead of X). The *propensity score* (*PS* hereafter) is the probability of adopting the IT regime, conditional

[67] See Dehejia & Wahba (2002) and Heckman et *al.* (1998). Also, note that the selectivity problem here is neither the selection on unobservables (omitted variables), nor a Heckman-type sample selection problem. Indeed, matching on the *propensity scores* implicitly assumes that unobservables play no role in the *treatment* assignment.

to the observable covariates (X), namely $p(X_i) = E[IT_i | X_i] = \Pr(IT_i = 1 | X_i)$. Under a final assumption needed for the validity of the *PSM* (the so-called "common support assumption" $p(X_i) < 1$, namely the existence of some comparable *control* units for each *treated* unit), we estimate the *ATT* as

$$ATT = E[(QI_i^1 | IT_i = 1, p(X_i)] - E[(QI_i^0 | = 0, p(X_i)] \quad (3.25)$$

3.5.1.2. Data

According to our theoretical model, we use a dataset of 53 developing countries examined over the 1984-2007 period.[68] The sample is composed of 20 developing countries that have adopted IT by the end of 2007 (ITers or *treatment* group) and 33 non-ITers (*control* group). An important issue in evaluating any *treatment* effect of IT is the relevance of the counterfactual or *control* group. For purpose of comparability with the samples used in existing studies, our sample relies on Lin & Ye (2009) and has been extended thereafter in several aspects. Indeed, Guatemala, Romania, Slovak Republic and Turkey, which adopted IT between 2005 and 2006, were in the control group in Lin & Ye (2009). Since our sample covers a larger period (up to 2007), these countries are treated as ITers in our study. Furthermore, Serbia and Ghana, which adopted IT respectively in 2006 and 2007, are included in our sample, whereas absent from Lin & Ye (2009).[69]

ITers along with their *starting* dates can be found in *Appendix 3.2.2.* Data on the *starting* dates come from Rose (2007) and Roger (2009); following Rose (2007), we consider two kinds of dates: *default starting* dates and *conservative starting* dates.[70] To avoid for the estimated *treatment* effect of IT upon the QI not to be driven by the chosen *starting* dates of IT, we employ alternatively the two starting dates.

Data on Institutional Quality come from International Country Risk Guide (ICRG, 2009). As suggested by the Quality of Government Dataset Codebook (2007), we compute an aggregated index of the quality of institutions (QI) as the arithmetic mean of the three ICRG

[68] See *Appendix 3.2.1* for the country list. The *starting* year is 1984, as QI data are available only ever since.
[69] Note that Macao China has been dropped because of lack of data in the ICRG (2009) database on QI.
[70] See chapter 1 of the thesis (*section 1.2.1.*) for further discussions on this issue.

indicators which reflect best the concept of the QI: Control of Corruption, Quality of the Bureaucracy, and Law and Order. A higher value of the index stands for better QI.

3.5.2. The effect of inflation targeting on the quality of institutions

We proceed in two steps: we first estimate the *propensity scores*, then, based on these scores, we compute the *ATT*.

3.5.2.1. Estimation of the propensity scores (PS)

We estimate the *PS* using a *probit* model with the binary variable IT as the dependent variable.[71] We divide explanatory variables into two groups.[72]

Variables in the first group account for the fact that a country should reasonably adopt IT after having met some preconditions. The variables we include are: lagged quality of institutions, lagged inflation rate, lagged tax revenues, logarithm of real per capita GDP, educational level (completed primary schooling, as percentage of total population), an index of constraints on the executive and a dummy variable for English speaking country.

In the second group, we consider variables that allow controlling for the possibility of a country to adopt an alternative framework for monetary policy (exchange rate targeting or money growth targeting), namely trade openness and a dummy variable for fixed exchange rate regime.[73] *Appendix 3.A1* reports the sources and definitions of variables, while *Appendix 3.A2* illustrates descriptive statistics.

Table 3.1 below reports the *probit* estimates of the *PS* based on conservative *starting* dates. The benchmark model [1] supports our intuition, as most coefficients are significant and have

[71] *Appendix 3.C* shows that using a *logit* model to compute the *PSs* and the *ATTs* leads to similar conclusions.

[72] According to the conditional independence assumption, omitting from the *probit* model variables that systematically affect the targeting probability but do not affect the QI has little influence on results (Persson, 2001). In other words, an estimate bias occurs only if we omit an explanatory variable that simultaneously affects the QI and the probability of adopting IT.

[73] As stated above, most of these variables (including the level of economic development – proxied by real per capita GDP -, tax revenues, constraints on the executive, English speaking country – proxy for the legal origin -, educational level – primary schooling and trade openness) have been identified in the literature as traditional determinants of institutional quality (see, Easterly & Levine, 2003; or Rigobon & Rodrik, 2005). Given that they affect IT adoption as well as the QI, their inclusion in the *probit* aims at avoiding bias in estimating the *ATT* of IT on the QI.

the expected sign (see *Appendix 3.A1*): lagged inflation, lagged tax revenues, fixed exchange rate and trade openness are negatively correlated with IT adoption, while (the logarithm of) real per capita GDP increases the targeting probability. Moreover, observe that lagged QI has a negative influence on the probability of adopting IT, which is a crucial finding. Indeed, any positive link between IT and the QI (such as the one that we present below, based on the *ATTs*), might be criticized for not being immune to a causality problem, according to which IT might have been adopted by countries having the best QI (i.e. a "common package" reform). The fact that lagged QI *negatively* influences IT adoption, which in turn *positively* influences the QI (see the evidence below based on the *ATTs*), immunizes our econometric results to this critique.

Table 3. 1: *Probit* estimates of the Propensity Scores (Conservative *Starting* Dates)

	Dependent Variable : Inflation Targeting (Conservative *Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**Post-1990 [5]**	**Excluding CEEC [6]**	**Excluding New ITers [7]**	**No hyper-inflation [8]**
Lagged QI	-0.703***	-0.863***	-0.872***	-0.790***	-0.740***	-0.679***	-0.919***	-0.789***
	(0.142)	(0.158)	(0.158)	(0.165)	(0.170)	(0.169)	(0.180)	(0.165)
Lagged Inflation	-0.137***	-0.132***	-0.134***	-0.154***	-0.147***	-0.185***	-0.165***	-0.154***
	(0.018)	(0.019)	(0.020)	(0.022)	(0.023)	(0.027)	(0.024)	(0.022)
Lagged Tax Revenue	-0.005	-0.033***	-0.031**	-0.032**	-0.032**	-0.043**	-0.046***	-0.032**
	(0.010)	(0.013)	(0.013)	(0.014)	(0.014)	(0.018)	(0.016)	(0.014)
Log of Real per capita GDP	1.269***	0.971***	1.005***	0.804***	0.779***	1.197***	1.165***	0.803***
	(0.187)	(0.209)	(0.214)	(0.246)	(0.246)	(0.302)	(0.276)	(0.246)
Trade Openness	-0.008***	-0.007***	-0.008***	-0.006**	-0.006***	-0.009***	-0.007***	-0.006**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Fixed Exchange Rate	-1.414***	-1.658***	-1.668***	-1.569***	-1.565***	-1.376***	-1.688***	-1.570***
	(0.169)	(0.195)	(0.197)	(0.208)	(0.206)	(0.235)	(0.222)	(0.208)
Primary Schooling		0.435***	0.425***	0.2439**	0.231**	-0.275*	0.319****	0.244**
		(0.087)	(0.088)	(0.104)	(0.105)	(0.156)	(0.110)	(0.104)
English Language			0.193	0.099	0.102	0.646**	0.040	0.098
			(0.242)	(0.245)	(0.248)	(0.324)	(0.259)	(0.245)
Executive Constraints				0.403***	0.398***	0.520***	0.381***	0.402***
				(0.099)	(0.099)	(0.105)	(0.105)	(0.099)
Constant	-7.923***	-6.167***	-6.395***	-6.403***	-6.228***	-8.164***	-9.102***	-6.381***
	(1.426)	(1.551)	(1.582)	(1.884)	(1.871)	(2.186)	(2.160)	(1.884)
Number of observations	667	636	636	636	559	537	636	588
Pseudo R^2	0.446	0.504	0.505	0.546	0.527	0.568	0.580	0.531

Note: robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

3.5.2.2. Matching results

Based on the *PS* estimated above, we employ four commonly used methods to match each ITer with non-ITers, according to the closeness of their scores to that of the ITer.[74] First, the *nearest-neighbor matching* with replacement, which matches each *treated* country to the N *control* countries that have the closest *PSs* (we use $N=1$, $N=2$ and $N=3$). Second, the *radius matching*, which performs the matching based on *PS* falling within a certain radius or "caliper" R (we use a small radius $R=0.01$, a medium radius $R=0.05$ and a wide radius $R=0.1$). The third method is the *regression-adjusted local linear matching* developed by Heckman et *al.* (1998). Fourth, we consider the *kernel matching*, which matches an ITer to all non-ITers weighted proportionally to their closeness to the *treated* country. As the matching estimator presents no analytical variance, we compute standard errors by bootstrapping (*i.e.* by re-sampling the observations of the *control* group, see Dehejia & Wahba, 2002).

The upper panel of *Table 3.2* reports the estimated *ATTs* based on conservative *starting* dates. Irrespective of the matching method, the estimation results show that IT adoption improves the QI, as the estimated *ATT* is positive and statistically significant. Given the range of the QI index (between 0.56 and 5, see *Appendix 3.A2*), the contribution of IT adoption can be rather important, as it enhances the QI by at least 0.252 (radius matching, $R=0.01$) and up to 0.522 (local linear regression matching).

3.5.3. Robustness checks

We test now the sensitivity of our results to a set of alternative specifications. First, we consider changes in the *probit* specification. Compared to the benchmark model [1], in columns [2], [3] and [4] of *Table 3.1,* we add respectively Primary School completion rate, the English speaking country dummy variable and the Constraints on the Executive.[75] As depicted by the first three lines in the bottom panel of *Table 3.2*, results are qualitatively similar to the ones from the benchmark model.[76]

[74] While matching ITers to non-ITers, we employ a "common support" strategy, namely we eliminate *treated* countries whose *PS* is higher than the maximum, or lower than the minimum *PS* of the *untreated* countries.
[75] Their inclusion in our model stems from the willingness to avoid a possible simultaneity bias in the estimation of the *ATT*, given that these variables may affect simultaneously IT adoption and the QI.
[76] In an *Appendix* available upon request, we add the growth rate of real per capita GDP to the benchmark *probit* model. Its coefficient is not significant (as this is also the case in Lin & Ye, 2007, 2009; and Lin, 2010), and we report that there is no qualitative impact on the sign and the significance of the *ATT*.

Second, we perform regressions on different sub-samples. We restrict the regressions to the post-1990 period (column [5], *Table 3.1*), or we exclude the Central and Eastern European Countries (CEECs, column [6] in *Table 3.1*). This helps taking into account the fact that the majority of CEECs have suffered major changes after 1990, namely when IT adoption started. Also, we exclude the New ITers from the *treatment* group (column [7], *Table 3.1*),[77] and discard hyperinflation episodes (column [8], *Table 3.1*).[78] The *probit* equations [5]-[8] are qualitatively similar compared to the benchmark, while the magnitude and the statistical significance of the *ATT* are improved (see the last four lines of *Table 3.2*)

Our third set of robustness tests considers the *default starting* dates of IT adoption, rather than the *conservative* ones, to explore if results are not sensitive to the choice of the *starting* dates. *Appendices 3.B1* and *3.B2* illustrate respectively the *probit* models and the matching results based on *default* dates of IT. Irrespective of the matching method, results are still extremely robust, as IT adoption still exerts a positive and significant effect on the QI.

To summarize, our empirical investigation suggests that IT adoption improves the QI in developing countries. According to our theoretical predictions, this result could come from the fact that IT adoption constraints government discretion, when it comes to raising seigniorage revenue. As a result, adopting an IT regime could provide strong incentives, from a public finance stance viewpoint, for governments to undertake reforms designed to improve the QI.

[77] We design by New ITers, countries having adopted IT recently (since 2006), namely Turkey, Serbia and Ghana. Indeed, it may take some delay for IT to affect the QI, so that New ITers are not really different from the non-ITers. Excluding New ITers from the *treatment* group shows that our results are not driven by recent ITers.
[78] Excluding hyperinflation episodes, proxied by inflation rates above 40%, aims at showing that results are not sensitive to these outliers.

Table 3. 2: Matching Results using the Conservative *Starting* Dates

Dependent Variable : Quality of Institutions (QI)	Nearest- Neighbor Matching			Radius Matching			Local Linear Regression Matching	Kernel Matching
	$N=1$	$N=2$	$N=3$	$R=0.01$	$R=0.05$	$R=0.1$		
	Treatment Effect of IT on QI, using the *Conservative starting* dates							
[1]:ATT	**0.375***	**0.417****	**0.485*****	**0.252***	**0.391*****	**0.379****	**0.522*****	**0.382*****
	(0.203)	**(0.188)**	**(0.175)**	**(0.143)**	**(0.137)**	**(0.151)**	**(0.167)**	**(0.144)**
Number of Treated Obs.	101	101	101	56	71	96	101	75
Number of Controls Obs.	564	564	564	564	564	564	564	564
Total Observations (Obs.)	665	665	665	620	635	660	665	639
	Robustness Checks							
[2]:Adding Primary Schooling	0.540**	0.563**	0.489**	0.217	0.452***	0.402**	0.346**	0.509***
	(0.230)	(0.220)	(0.193)	(0.180)	(0.168)	(0.165)	(0.158)	(0.187)
[3]:Adding English Language	0.379*	0.409**	0.357*	0.249	0.347**	0.319**	0.348**	0.370**
	(0.218)	(0.193)	(0.192)	(0.172)	(0.158)	(0.140)	(0.145)	(0.169)
[4]:Adding Executive Constraints	0.632***	0.488**	0.430**	0.304*	0.473***	0.415***	0.444***	0.482***
	(0.220)	(0.203)	(0.190)	(0.184)	(0.183)	(0.147)	(0.149)	(0.173)
[5]:Post-1990 period	0.515**	0.442**	0.399**	0.288	0.461**	0.406**	0.440***	0.462**
	(0.228)	(0.203)	(0.191)	(0.190)	(0.182)	(0.158)	(0.160)	(0.183)
[6]:Excluding CEEC	0.839***	0.608**	0.597**	0.411*	0.535**	0.467**	0.494**	0.558***
	(0.283)	(0.255)	(0.245)	(0.239)	(0.219)	(0.205)	(0.208)	(0.209)
[7]:Excluding New ITers	0.623***	0.478**	0.444**	0.428**	0.545***	0.441***	0.446***	0.543***
	(0.236)	(0.215)	(0.203)	(0.208)	(0.188)	(0.157)	(0.154)	(0.194)
[8]:No hyperinflation episodes	0.612***	0.492**	0.443**	0.350**	0.481***	0.416***	0.445***	0.483***
	(0.222)	(0.209)	(0.194)	(0.178)	(0.169)	(0.159)	(0.146)	(0.170)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

3.6. Concluding Remarks and extensions

Against the general belief often emphasized in the 90's, recent empirical contributions, including Loayza et *al.* (2005), or Velasco (2005), concluded that the benefits of institutional reforms in terms of economic performances are not as clear-cut as one would have expected. One explanation for this lack of robustness is depicted in the influential paper of Acemoglu et *al.* (2008), outlining the presence of thresholds in the level of the political context, which is positively correlated with better performances only for average values, while no effect emerges for low and high levels of the political context.

In this chapter, we explore these issues by correcting for a fundamental caveat of the existing literature, namely the assumption that institutions are exogenous. To this end, we develop a theoretical model allowing accounting for the interaction between monetary regimes and the quality of institutions. On the one hand, we find that a tighter monetary regime, namely a stronger inflation target or a more conservative central banker, leads to an improvement of the quality of institutions, through the means of inducing governments to fight corruption. On the other hand, we emphasize the dependence of this result on the political context, proxied by the cost of reforms. Indeed, tighter monetary regimes improve the quality of institutions only when the cost of running such reforms is at some average level, while no effect appears for low and high levels. In addition, our results go beyond the conclusions of the empirical work of Acemoglu et *al.* (2008), since a more rigorous monetary regime is found to expand (shrink) the interval over which the quality of institutions is maximum (minimum), by affecting the two thresholds defining the levels of low and high costs of reforms, which are endogenous in our model. Consequently, we reveal strong proofs in favor of a positive effect of IT on institutional quality.

Our empirical study, based on recently-used econometric methods for assessing the performances of IT, confirms these theoretical results. Effectively, despite not acting as a precondition for IT adoption in the group of developing countries we considered, the quality of institutions is found to have significantly increased following IT adoption, a result which remains remarkably robust to numerous alternative specifications. Compared to the traditional view, our findings are against certain doubts regarding the capacity of monetary regimes, designed to lower inflation, to enforce institutions in emerging and developing countries.[79] For example, the IMF suggests waiting until

[79] For example, Huang & Wei (2006) "cast doubts on the notion that a low inflationary framework can induce governments to improve public institutions" (p.239). However, they express their doubts on an informal basis and

institutions are well established, before promoting policies that aim at fighting inflation. In our model, on the opposite, such inflation-fighting policies can generate incentives for the government to enforce institutions, in order to raise revenue other than seigniorage to finance public spending. This result finds empirical support in the work of Al-Marhubi (2000), or Blackburn et *al.* (2008), emphasizing a strong positive correlation between inflation and several corruption indices.

From a larger standpoint, the debate over the capacity of a monetary regime to enforce institutions in emerging or developing countries joins the discussions over the introduction of the Euro and the role of the unique currency in the convergence process of the European Monetary Union Countries. Back then, the dilemma consisted of exploring whether putting in place a monetary regime (the EMU) could lead to the convergence of institutions, or if a certain convergence was a prerequisite. Our results do not offer a single answer to this question: for the monetary regime to enforce institutions, economies must have some initial "institutional capital", and the costs of reform (or the "political context") should not be dissuasive. However, a more rigorous monetary regime can turn an existing political context less dissuasive for the government, and create incentives to start what needs to be done.

Nevertheless, these conclusions should be considered with caution, because several ignored variables can interfere in the link between the monetary regime and institutions, as for example public debt, market imperfections and/or expectations. Moreover, establishing an IT (or exchange rate pegging) mechanism probably requires a favorable "political-institutional context", and the determination of the optimal inflation rate can be subject to difficult negotiations with governments. This calls for the need of pursuing the analysis concerning the threshold effects exerted by the political context in a more sophisticated model, in which inflation would be determined by a bargaining game between the government and the central bank. In addition, future work should extend the mechanism through which an emerging or developing economy could anchor its exchange rate (through exchange rate pegs or currency boards, for example) in order to reach the desirable inflation rate.

The next chapter of the thesis concludes the exploration of new evidence of rules-based policy frameworks by focusing on FRs this time, the usefulness of which has been re-put at the forefront of the policy debate during the recent global recession and financial crisis.

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not as the result of a formal proof, and these doubts are based on a framework in which institutions are chosen before choosing the monetary policy; thus, monetary policy cannot retroact on institutions, contrary to our setup.

Appendices

Appendix 3.1: The impact of central bank conservatism on the quality of institutions

Following Rogoff (1985), the society can appoint a conservative central banker who maximizes

$$L^S(\pi,\tau,e) = -\frac{1}{2}\left[C\pi^2 + \lambda y^2 + \theta(g-\bar{g})^2\right] - \gamma^g e, \tag{3.A1}$$

where the appropriate degree of conservatism $C \geq 1$ is chosen *ex-ante* by a supra-authority in a simple principal-agent setting. In this case, only the FOC (11) changes

$$C\pi - ab\lambda\tau + \theta(\mu\tau + \pi - \bar{g}) = 0. \tag{3.A2}$$

Using (3.A2) and (3.6) we find $\mu C\pi = b\lambda(a\mu+b)\tau$, and the discretionary solution is $\tau^d = z^d\theta\mu C\bar{g}$ and $\pi^d = z^d b\lambda(a\mu+b)\bar{g}$, where $1/z^d = C(b^2\lambda+\theta\mu^2) + b\lambda\theta(a\mu+b)$. For a given value of effort (thus exogenous institutions), we have $\pi^d(\underline{C})$ and $\tau^d(\underset{?}{C})$. To determine the optimal value of effort, we still have the relation $b^2\lambda\tau^2 = 2\gamma^g e$, so that

$$b\mu_1\theta C\bar{g} = C(b^2\lambda+\theta\mu^2) + b\lambda\theta(a\mu+b). \tag{3.A3}$$

Equation (3.A3) is still a second order polynomial in μ (namely $\mu^2 + A\mu + B = 0$), with only one positive solution, namely $\mu^d = \frac{1}{2}\left[-A + (A^2-4B)^{0.5}\right]$, with $A \equiv ab\lambda/C > 0$ and $B \equiv -b\mu_1\bar{g} + b^2\lambda/\theta + b^2\lambda/C \leq 0$. We can check that institutional quality (or, equivalently, the effort to improve institutions) depends positively on the degree of central bank conservatism. Effectively, remark that $dA/dC < 0$ and $dB/dC < 0$, thus:

$$\frac{d\mu^d}{dC} = \frac{1}{2}\left[-\frac{dA}{dC} + \left(\frac{A\frac{dA}{dC} - 2\frac{dB}{dC}}{(A^2-4B)^{0.5}}\right)\right] = \frac{1}{2}\left[-\frac{dA}{dC} + \left(\frac{A\frac{dA}{dC} - 2\frac{dB}{dC}}{A+2\mu}\right)\right] = \frac{-1}{A+2\mu}\left[\mu\frac{dA}{dC} + \frac{dB}{dC}\right] > 0.$$

Consequently, the more conservative the central banker (the higher C), the higher the government's incentive to undertake institutional reforms (the higher μ^d).

Appendix 3.2

Appendix 3.2.1: Developing Countries Inflation Targeters along with their *starting* dates

Countries	**Soft IT:** ***Default starting* dates**	**Full-Fledged IT:** ***Conservative starting* dates**
Chile	January 1991	August 1999
Israel	January 1992	June 1997
Czech Republic	January 1998	January 1998
South Korea	April 1998	April 1998
Poland	September 1998	September 1998
Mexico	January 1999	January 2001
Brazil	June 1999	June 1999
Colombia	September 1999	October 1999
Philippines	January 2002	January 2002
South Africa	February 2000	February 2000
Thailand	May 2000	May 2000
Hungary	June 2001	August 2001
Peru	January 2002	January 2002
Slovak Republic	January 2005	January 2005
Guatemala	January 2005	January 2005
Indonesia	July 2005	July 2005
Romania	August 2005	August 2005
Turkey	January 2006	January 2006
Serbia	September 2006	September 2006
Ghana	January 2007	January 2007

Source: Rose (2007) and Roger (2009). Note that Slovak Republic abandoned IT in 2009 and joined the euro area.

Appendix 3.2.2: Country List

Treatment Group		**Control group**		
Brazil	Poland	Algeria	Georgia	Morocco
Chile	Romania*	Argentina	Hong Kong, China	Paraguay
Colombia	Slovak Republic*	Belarus	Iran	Russia
Czech Republic	South Africa	Bulgaria	Jamaica	Singapore
Guatemala*	South Korea	Cape Verde	Jordan	Slovenia
Hungary	Thailand	China	Kazakhstan	Syria
Indonesia*	Turkey*	Costa Rica	Latvia	Trinidad & Tobago
Israel	Serbia^{+}	Croatia	Lebanon	Tunisia
Mexico	Ghana^{+}	Dominican Republic	Lithuania	Ukraine
Peru		Egypt	Macedonia	Uruguay
Philippines		Estonia	Mauritius	Venezuela

* ITer that was not ITer in Lin & Ye (2009) yet; + countries absent in Lin & Ye (2009) sample.

Appendix 3.A

Appendix 3.A.1: Sources and definitions of data

Variables	Definition	Data sources	Characteristics		
			Role	**Expected sign**	**Explanations**
Quality of Institutions (QI)	Synthetic index of Institutional Quality: arithmetic mean of ICRG indices of Bureaucracy Quality, Law and Order, and Control of Corruption. The higher the index, the higher the institutional quality.	Authors' calculations based on International Country Risk Guide (ICRG, 2009) data.	Dependent Variable in the estimate of the *Treatment* effect		
Bureaucracy Quality	Index of the institutional strength and quality of the bureaucracy, ranging from 0 to 4. The higher the index, the stronger the quality of the bureaucracy.		Sub-components of the aggregate QI index		
Law and Order	Index assessing the strength and the impartiality of the legal system, as well as the popular observance of the law. The index ranges from 0 to 6, with a higher value of the index reflecting a higher institutional quality.				
Control of corruption	Index assessing the control of corruption within the political system. It ranges from 0 to 6, with a higher value of the index reflecting a better control of corruption				
Full-Fledged IT	Binary variable taking the value 1 if in a given year a country operates formally under IT, zero otherwise. When we use the conservative *starting* dates of IT, we refer to full-fledged IT.	Rose (2007) and Roger (2009)	*Treatment* Variable in the estimate of the *Treatment* effect	(+)	See the theoretical model
Soft IT	Binary variable taking the value 1 if in a given year a country operates informally under IT, zero otherwise. When we use the default *starting* dates of IT, we refer to soft IT.	Rose (2007) and Roger (2009)	*Treatment* Variable in the estimate of the *Treatment* effect	(+)	See the theoretical model

Lagged QI	Lagged value (one year) of the QI index	Authors' calculations	Covariates in the probit model for IT adoption	Ambiguous à priori	(+): a high lagged QI can reflect a better capacity to implement credibly IT. (-): a country can adopt IT to improve the quality of its institutions via a "tie its own hands" strategy.
Inflation Rate	Annual growth rate of average CPI	World Economic Outlook (WEO, 2010)		(-)	A country should adopt IT when its inflation rate is at reasonably low level.
Real per capita GDP	Real per capita output. Proxy for the level of economic development.	World Development Indicators (WDI, 2010)		(+)	Countries with higher per capita GDP (proxy for economic development) have a high initial credibility, so that they can more easily commit to IT.
Trade openness	(Imports + Exports) / GDP	Penn World Table (PWT.6.3)		(-)	It becomes more difficult to have an effective monetary policy with a higher degree of openness.
Tax revenues	Total general government revenue from taxes, as GDP %	IMF Government Financial Statistics (GFS, 2007)		Ambiguous à priori	(+): Higher tax revenue lead to a sound fiscal position, which should be a precondition for adopting IT credibly. (-): in the practice, it has been found that most Inflation Targeters did not meet the fiscal discipline precondition at the *starting* date of their IT.
Completed Primary Schooling, as % of total population	Percentage of total population having completed primary school.	Barro & Lee (2010)		(+)	IT success requires a well educated population, able to read the regular communications of the central bank on its website and on the press media.
English language	Binary Variable taking the value 1 if a country has English as its official language, zero otherwise.	Authors' compilation		(+)	Countries sharing the same language, due to the pairs or spillover effects, can very likely choose adopting IT.
Fixed Exchange rate	Dummy Variable taking the value 1 if a country is classified as having a de facto hard of soft peg (exchange rate).	Reinhart & Rogoff (2004), updated		(-)	Because IT is incompatible with a rigid exchange rate.
Executive Constraints	Index referring to the decisions rules, i.e. the institutionalized constraints on the decision-making power of chief executives, whether individuals or collectivities. The higher the index, the more constrained the decision-making power.	The QOG Institute Quality of Government (2007)		(+)	If policymakers are already experiencing constraints on their actions, it will be easier for them to conform to IT which implies hard constraints on the transparency and the accountability of the central bank.

Appendix 3.A.2: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Quality of Institutions	1016	2.863	0.853	0.556	5
Law and Order	1016	3.522	1.282	1	6
Quality of Bureaucracy	1016	2.143	0.902	0	4
Control of Corruption	1016	2.923	1.087	0	6
Full-Fledged IT	1483	0.086	0.280	0	1
Soft IT	1483	0.096	0.294	0	1
Inflation	1253	59.93	338.3	-3.959	7481.7
Real per Capita GDP	1282	8461.1	5261.9	1133.2	44618.9
Trade Openness	1282	77.82	54.07	10.09	456.6
Fixed Exchange Rate	1259	0.476	0.499	0	1
Tax Revenue	861	24.06	8.508	3	53.1
Primary Schooling (% of Population)	1259	4.408	1.724	0.697	8.997
English Language	1455	0.135	0.341	0	1
Executive Constraints	1253	2.535	13.97	-88	7

Appendix 3.B

Appendix 3.B.1: *Probit* estimates of the propensity scores (Default *Starting* Dates)

	Dependent Variable : Inflation Targeting (*Default Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**Post-1990 [5]**	**Excluding CEEC [6]**	**Excluding New ITers [7]**	**No hyper-inflation [8]**
Lagged QI	-0.535***	-0.681***	-0.684***	-0.608***	-0.505***	-0.524***	-0.707***	-0.606***
	(0.134)	(0.147)	(0.148)	(0.156)	(0.162)	(0.158)	(0.167)	(0.156)
Lagged Inflation	-0.103***	-0.094***	-0.095***	-0.106***	-0.097***	-0.115***	-0.111***	-0.106***
	(0.014)	(0.015)	(0.015)	(0.017)	(0.017)	(0.019)	(0.018)	(0.017)
Lagged Tax Revenue	-0.009	-0.037***	-0.037***	-0.040***	-0.041***	-0.037***	-0.058***	-0.040***
	(0.010)	(0.013)	(0.013)	(0.015)	(0.015)	(0.017)	(0.016)	(0.015)
Log of Real per capita GDP	1.432***	1.1388***	1.147***	1.006***	0.947***	1.204***	1.407***	1.002***
	(0.186)	(0.207)	(0.212)	(0.248)	(0.247)	(0.298)	(0.283)	(0.248)
Trade Openness	-0.010***	-0.009***	-0.009***	-0.007***	-0.007***	-0.008***	-0.007***	-0.007***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Fixed Exchange Rate	-1.488***	-1.746***	-1.748***	-1.653***	-1.660***	-1.385***	-1.785***	-1.654***
	(0.166)	(0.193)	(0.194)	(0.203)	(0.201)	(0.220)	(0.218)	(0.203)
Primary Schooling		0.435***	0.433***	0.258**	0.234**	-0.084	0.337***	0.258**
		(0.087)	(0.088)	(0.103)	(0.105)	(0.147)	(0.109)	(0.103)
English Language			0.045	-0.041	-0.015	0.168	-0.106	-0.043
			(0.229)	(0.233)	(0.238)	(0.282)	(0.245)	(0.233)
Executive Constraints				0.410***	0.415***	0.476***	0.408***	0.407***
				(0.099)	(0.099)	(0.101)	(0.109)	(0.099)
Constant	-9.708***	-8.039***	-8.100***	-8.709***	-8.364***	-9.618***	-11.95***	-8.678***
	(1.426)	(1.554)	(1.586)	(1.957)	(1.941)	(2.228)	(2.322)	(1.961)
Number of observations	667	636	636	636	559	537	636	588
Pseudo R^2	0.446	0.505	0.505	0.548	0.536	0.549	0.599	0.532

Note: robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 3.B.2: Matching Results using the *Default Starting* Dates

Dependent Variable : Quality of Institutions (QI)	Nearest- Neighbor Matching			Radius Matching			Local Linear Regression Matching	Kernel Matching
	$N=1$	$N=2$	$N=3$	$R=0.01$	$R=0.05$	$R=0.1$		
	Treatment Effect of IT on QI, using the Default starting dates							
[1]:ATT	**0.545*** **	**0.402*** **	**0.382*** **	**0.224***	**0.365*** **	**0.378*** **	**0.393*** **	**0.359*** **
	(0.182)	**(0.148)**	**(0.142)**	**(0.135)**	**(0.126)**	**(0.136)**	**(0.137)**	**(0.122)**
Number of Treated Obs.	109	109	109	63	82	109	109	85
Number of Controls Obs.	551	551	551	551	551	551	551	551
Total Observations (Obs.)	660	660	660	614	633	660	660	636
	Robustness Checks							
[2]:Adding Primary Schooling	0.418**	0.441**	0.331*	0.318*	0.283*	0.272*	0.244	0.273*
	(0.205)	(0.200)	(0.188)	(0.170)	(0.161)	(0.143)	(0.151)	(0.152)
[3]:Adding English Language	0.308	0.379*	0.307*	0.299*	0.280*	0.277**	0.247*	0.269*
	(0.212)	(0.211)	(0.183)	(0.166)	(0.154)	(0.140)	(0.147)	(0.148)
[4]:Adding Executive Constraints	0.449*	0.455**	0.511**	0.309*	0.541***	0.511***	0.492***	0.547***
	(0.232)	(0.216)	(0.217)	(0.187)	(0.190)	(0.169)	(0.158)	(0.202)
[5]:Post-1990 period	0.533**	0.561**	0.526**	0.293	0.503***	0.489***	0.475***	0.506**
	(0.260)	(0.225)	(0.222)	(0.193)	(0.195)	(0.182)	(0.172)	(0.198)
[6]:Excluding CEEC	0.489**	0.533**	0.454**	0.454**	0.458**	0.470***	0.407**	0.458**
	(0.240)	(0.240)	(0.222)	(0.209)	(0.188)	(0.173)	(0.194)	(0.192)
[7]:Excluding New ITers	0.498**	0.551**	0.555**	0.298	0.546***	0.524***	0.476***	0.541**
	(0.244)	(0.227)	(0.219)	(0.191)	(0.200)	(0.190)	(0.167)	(0.218)
[8]:No hyperinflation episodes	0.461**	0.450**	0.510**	0.298	0.540***	0.509***	0.496***	0.546***
	(0.235)	(0.220)	(0.212)	(0.194)	(0.192)	(0.167)	(0.167)	(0.193)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 3.C

Appendix 3.C.1: *Logit* estimates of the propensity scores

	Dependent Variable : Inflation Targeting (*Conservative Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**Post-1990 [5]**	**Excluding CEEC [6]**	**Excluding New ITers [7]**	**No hyper-inflation [8]**
Lagged QI	-1.311***	-1.580***	-1.581***	-1.463***	-1.382***	-1.242***	-1.646***	-1.461***
	(0.266)	(0.294)	(0.294)	(0.311)	(0.316)	(0.316)	(0.336)	(0.311)
Lagged Inflation	-0.259***	-0.248***	-0.249***	-0.277***	-0.264***	-0.333***	-0.294***	-0.276***
	(0.036)	(0.038)	(0.038)	(0.043)	(0.043)	(0.053)	(0.046)	(0.043)
Lagged Tax Revenues	-0.004	-0.052**	-0.052**	-0.054**	-0.053**	-0.078**	-0.070**	-0.054**
	(0.020)	(0.024)	(0.024)	(0.026)	(0.026)	(0.034)	(0.028)	(0.026)
Log of Real per capita GDP	2.605***	2.022***	2.024***	1.668***	1.615***	2.531***	2.101***	1.664***
	(0.378)	(0.414)	(0.415)	(0.478)	(0.474)	(0.616)	(0.520)	(0.477)
Trade Openness	-0.016***	-0.014***	-0.014***	-0.012***	-0.012***	-0.017***	-0.012***	-0.012***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Fixed Exchange Rate	-2.801***	-3.173***	-3.173***	-2.885***	-2.854***	-2.490***	-3.065***	-2.886***
	(0.340)	(0.391)	(0.391)	(0.398)	(0.394)	(0.439)	(0.424)	(0.398)
Primary Schooling		0.761***	0.760***	0.459**	0.436**	-0.588**	0.567***	0.459**
		(0.167)	(0.168)	(0.194)	(0.195)	(0.296)	(0.203)	(0.194)
English Language			0.031	-0.078	-0.074	1.020*	-0.162	-0.078
			(0.474)	(0.472)	(0.472)	(0.601)	(0.505)	(0.472)
Executive Constraints				0.711***	0.697***	0.956***	0.678***	0.709***
				(0.187)	(0.187)	(0.206)	(0.196)	(0.187)
Constant	-16.89***	-13.39***	-13.40***	-13.43***	-13.03***	-17.62***	-16.65***	-13.39***
	(2.860)	(3.072)	(3.074)	(3.722)	(3.671)	(4.563)	(4.111)	(3.722)
Number of observations	667	636	636	636	559	537	636	588
Pseudo R^2	0.470	0.517	0.517	0.554	0.534	0.575	0.581	0.539

Note: robust standard errors are reported in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 3.C.2: Matching Results using a *Logit* Model for Estimating the Propensity scores (*Conservative Starting* Dates)

Dependent Variable : Quality of Institutions (QI)	Nearest- Neighbor Matching			Radius Matching			Local Linear Regression Matching	Kernel Matching
	$N=1$	$N=2$	$N=3$	$R=0.01$	$R=0.05$	$R=0.1$		
	Treatment Effect of IT on QI, using the Conservative starting dates							
[1]:ATT	0.260	0.361*	0.447**	0.027	0.326**	0.397**	0.425**	0.375**
	(0.216)	(0.203)	(0.190)	(0.150)	(0.154)	(0.165)	(0.179)	(0.152)
Number of Treated Obs.	109	109	109	63	82	109	109	85
Number of Controls Obs.	551	551	551	551	551	551	551	551
Total Observations (Obs.)	660	660	660	614	633	660	660	636
	Robustness Checks							
[2]:Adding Primary Schooling	0.412*	0.430**	0.438**	0.051	0.398**	0.405**	0.333**	0.437**
	(0.247)	(0.217)	(0.220)	(0.172)	(0.178)	(0.183)	(0.157)	(0.193)
[3]:Adding English Language	0.422*	0.404*	0.368*	0.064	0.393**	0.403**	0.338**	0.429**
	(0.254)	(0.220)	(0.198)	(0.153)	(0.188)	(0.163)	(0.157)	(0.192)
[4]:Adding Executive Constraints	0.559**	0.534**	0.484**	0.181	0.598***	0.440***	0.441***	0.600***
	(0.246)	(0.253)	(0.219)	(0.186)	(0.190)	(0.158)	(0.131)	(0.184)
[5]:Post-1990 period	0.665***	0.574***	0.488***	0.235	0.585***	0.423**	0.455***	0.591***
	(0.221)	(0.219)	(0.186)	(0.197)	(0.205)	(0.192)	(0.164)	(0.189)
[6]:Excluding CEEC	0.633*	0.538**	0.579**	0.187	0.565**	0.508**	0.547***	0.565**
	(0.369)	(0.273)	(0.240)	(0.267)	(0.242)	(0.233)	(0.211)	(0.251)
[7]:Excluding New ITers	0.703***	0.562***	0.516**	0.339*	0.601***	0.452**	0.461***	0.607***
	(0.252)	(0.210)	(0.205)	(0.194)	(0.204)	(0.214)	(0.166)	(0.194)
[8]:No hyperinflation episodes	0.545**	0.547**	0.480**	0.182	0.603***	0.441***	0.442***	0.600***
	(0.225)	(0.218)	(0.219)	(0.192)	(0.175)	(0.170)	(0.142)	(0.206)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Chapter 4*

Do National Numerical Fiscal Rules Really Shape Fiscal Behaviors in Developing Countries?

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4.1. Introduction

The recent global recession and financial crisis, along with the policy actions taken to buffer their effects, have eroded fiscal positions in several countries, raising concerns about the sustainability of public finances. Policymakers are therefore urged to undertake appropriate measures to put back public finances on a sustainable path. To this end, the establishment of fiscal rules appears *inter alia*, as a good candidate. Indeed, if well designed and implemented, fiscal rules – FRs hereafter - can strengthen fiscal credibility and fiscal discipline, in that they place a durable constraint on the discretion of fiscal authorities (von Hagen, 1992; Alesina & Perotti, 1995; Inman, 1996; Poterba, 1996; Eichengreen & Wyplosz, 1998; and Debrun et *al*., 2007a).[80] First started in the developed countries, the new wave of FRs has gained the developing world.[81] To date, twenty-five low-income and middle-income countries have adopted FRs at the national level to frame the conduct of their fiscal policy (IMF, 2009).

Parallel to this growing appetite for FRs in developing countries, a few papers attempted to evaluate their effectiveness in shaping fiscal behaviors in these countries. Alesina et *al*. (1999) is the first study to assess the impact of FRs in developing countries, namely in Latin America and the Caribbean. Thereafter, Poter & Diamond (1999), Prakash & Cabezon (2008), Hallerberg et *al*. (2009), Dabla-Norris et *al*. (2010) and Gollwitzer (2011) analyzed the effect of FRs and found that they improve fiscal discipline in developing countries. But a drawback, common to all these existing studies, is that they ignore the *self-selection* problem in policy adoption, which might bias the estimate of the effect of FRs in these early studies. A more formal re-evaluation of the impact of FRs, taking into account the *self-selection* problem in policy adoption is therefore necessary.

The aim of this chapter is therefore to assess the effect of FRs on fiscal developments, by addressing carefully the issue of *self-selection* this time. To this end, we make use of a variety of *propensity scores-matching* and a wide panel of 74 developing countries, of which 22 have introduced rule-based fiscal policy frameworks by the end of 2007, to evaluate the *treatment* effect of FRs. In the literature related to monetary policy (MP), such methods have been used to evaluate the impact of IT, a MP framework where *self-selection* is potentially also at work

[80] See chapter 1, *section 1.3.5,* for further discussion on the effectiveness of FRs for delivering fiscal discipline.
[81] The new wave of FRs, whose implementation is accompanied by a greater transparency contrary to the older ones, started in New Zealand in 1994 (Kopits, 2001).

(Lin & Ye, 2007). But to the best of our knowledge, this chapter is the first study to take into account this *self-selection* problem while investigating the impact of FRs. More precisely, throughout the chapter, we aim to answer the following questions: do national numerical FRs improve fiscal discipline as measured by the cyclically-adjusted primary fiscal balance (CAPB), after controlling for *self-selection*? Does the *treatment* effect vary with the types of rules (Budget Balance Rules, Expenditure Rules and Debt rules)? Finally, is there heterogeneity in the *treatment* effect of FRs, depending on countries' structural characteristics? We explore five possible sources of heterogeneities: number of FRs in place, time length since FRs adoption, presence of supranational FRs, government fractionalization and government stability.

The rest of the chapter is organized as follows: the second section describes the econometric methodology and introduces the dataset. Section 3 shows the *propensity scores-matching* results while section 4 considers some robustness checks. In section 5, we explore the heterogeneity feature of the *treatment* effect of FRs using a control function regression approach. Section 6 briefly concludes and draws some policy recommendations.

4.2. The data

Our dataset consists of 74 developing countries examined over the period 1990-2007.[82] The panel is unbalanced because of missing observations. The time coverage of the sample is 1990-2007 because it is a common feature that reliable fiscal data exist only from early 1990s to 2007 at most, especially in developing countries. The sample is composed of 22 countries that have adopted FRs at the national level by the end of 2007 (called FRers) and 52 non-FRers. To make sure that the *control* group is a good counterfactual of the *treatment* group, that is the two groups are reasonably comparable, we include in the *control* group only non-FRers developing countries that have a real GDP per capita at least as large as that of the poorest FRer and with a population size at least as large as that of the smallest FRer.[83] The 22 *treated* countries and the 52 *control* countries that satisfy these criteria are listed in the first two columns and the last three columns of *Appendix 4.1*, respectively.

[82] The developing countries category considered here refers to the World Bank classification, thus including LICs as well as middle-income countries.

[83] The poorest FRer in our sample is Kenya with a real per capita GDP of 2025.179 in 2007 while the smallest FRer in terms of population size is Cape Verde (with 424395 inhabitants in 2007).

The FRers along with their *starting* dates have been taken from the new Fiscal Rules Database collected by the IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division (2009) which gives a comprehensive overview on FR experiences around the world at the national level as well as at the supranational level.[84] Nevertheless, we choose to focus on national FRs for two reasons. First, supranational rules generally suffer from a problem of insufficient enforcement and compliance so that the member countries frequently violate these rules without any sanctions. The most obvious examples are some countries from the European Union, the WAEMU and the CEMAC (Prakash & Cabezon, 2008).[85] These rules therefore look like simple ornaments. Accordingly, it seems better to focus on FR experiences at the national level which most of the time result from a real political commitment. Second, by distinguishing the national FRs from the supranational ones, as in Debrun et *al*. (2008) and IMF (2009), we are able to analyse in the *probit* estimates of the *propensity scores*, the influence of having supranational rules on the decision to introduce national FRs. Better, this allows us exploring whether or not the presence of rule-based fiscal policy frameworks at the supranational level influences the *treatment* effect of the national FRs.

It is worth noting that in the existing literature, the effectiveness of FRs is assessed using not only the presence of numerical targets or limits on fiscal aggregates, but also employing other aspects related to the strength or intensity of these rules. These include their statutory basis, the sanctions for breaking the rules, the procedures required to modify or amend the rules, the share of government finances covered by the rules, and fiscal transparency. However, the *propensity-scores matching* used in this chapter allows building a binary measure of FRs only, indicating the presence or not of rule, but not to build a synthetic FR index summarizing the other aspects aforementioned. Furthermore, even though it would be possible to analyze the importance of the strength of the rules when we will explore the heterogeneity feature of the *treatment* effect of FRs using a control function regression approach, most of these aspects related to the strength of FRs are missing for many countries in our sample. Attempting to analyze the influence of the strength of the rule on the *treatment* effect of FRs will imply a significant reduction in our sample size. Accordingly, we choose to use only the simple binary measure of FR.

[84] The database is available at www.imf.org/external/np/pp/eng/2009/121609.pdf.
[85] West African Monetary and Economic Union (WAEMU) involves eight countries of West Africa, while the Central African Economic and Monetary Community (CEMAC) is composed of six countries of Central Africa.

Table 4.1 below displays the 22 FRers along with their *starting* dates. Except Indonesia which has implemented FRs in 1967, most countries started at the end of 1990s or early 2000s. 60% of FRers have adopted Budget Balance Rules (*BBR*), 36% have adopted Expenditure Rules (*ER*) and 55% have opted for Debt Rules (*DR*). Only two countries, namely Kenya and Nigeria have enacted Revenue Rules (*RR*).[86]

Table 4. 1: Fiscal Rules countries along with their *starting* dates

Countries	***Starting* Dates**				
	National Numerical Fiscal Rule				
		BBR	*ER*	*RR*	*DR*
Angola	2005		2005		
Argentina	2000	2000	2000		2000
Bulgaria	2003				2003
Brazil	2000	2000	2000		2001
Botswana	2003		2003		
Cape Verde	1998	1998			1998
Chile	2000	2000			
Costa Rica	2001		2001		
Czech Republic	2005		2005		
Ecuador	2003	2003			2003
Estonia	1993	1993			
India	2004	2004			
Indonesia	1967	1967			2004
Israel	1992	1992	2005		
Kenya	1997			1997	1997
Lithuania	1997				1997
Nigeria	2004			2004	
Pakistan	2005	2005			2005
Panama	2002	2002			2002
Peru	2000	2000	2000		
Poland	1997				1997
Sri Lanka	2003	2003			2003

Source: Fiscal Affairs Department, IMF (2009), available at www.imf.org/external/np/pp/eng/2009/121609.pdf. BBR=Budget Balance Rule; ER=Expenditure Rule; RR=Revenue Rule; DR: Debt Rule.

In the econometric analysis below, FR is a dummy variable equaling one, if in a given country at a given year a numerical constraint exists on fiscal aggregates at the national level (budget balance, spending, revenue or debt). *BBR*, *ER*, *RR* and *DR* are dummy variables equaling one, if in a given country at a given year a numerical constraint is placed only on budget balance, expenditure, revenue and public debt, respectively.[87]

Fiscal data come from the IMF World Economic Outlook (2010). Our measure of fiscal discipline is the Structural or Cyclically-Adjusted Primary Fiscal Balance, as GDP percentage (CAPB). It is the difference between General Government revenues and expenditures

[86] Madagascar (2006), Mexico (2006), Equatorial Guinea (2007) and Mauritius (2008) adopted FRs, but given that our sample ends up in 2007, we still treat them as non-FRers. The Union of the Comoros (2001), Namibia (2001), Liberia (2004) and Timor-Leste (2005) also adopted FRs, but due to lack of available data on fiscal balances, they are not included in our sample.

[87] See chapter 1, *section 1.3.3* for further details on the different forms that these numerical constraints may take.

excluding interest payments, adjusted for the effect of business cycle fluctuations. This is a measure of discretionary fiscal behavior, that is fiscal policy changes really imputable to current fiscal policymakers, in that it not only excludes the effects of past fiscal policy decisions (interest payments) but also filters out the impact of automatic stabilizers on the primary balance. To compute the CAPB, in line with the so-called "residuals" approach (Fatás & Mihov, 2003; 2006) we estimate the following fiscal policy reaction function adapted from Fatás & Mihov (2003; 2006), on a country-by-country base:[88]

$$PB_t^i = \alpha + \beta PB_{t-1}^i + \lambda GAP_t^i + \delta W_t^i + \varepsilon_t^i, \quad \forall i \tag{4.1}$$

where PB_t^i is the primary fiscal balance, for country i at year t, GAP_t^i the output gap, and W_t^i a set of control variables. The output gap is calculated as the difference between the logarithm of real GDP and the logarithm of a Hodrick-Prescott filtered trend of real GDP (with 100 as smoothing parameter).[89] Control variables include inflation and a time trend. The λ coefficient measures the cyclical response of fiscal policy to business cycle fluctuations, and the error term ε_t^i measures the unsystematic component of fiscal policy. The estimated value of this latter catches the part of primary fiscal balance unexplained by economic conditions and is our measure of fiscal discipline (CAPB).[90] To correct for a potential endogeneity of output gap in equation (4.1), we use the two stages least squares (2SLS) method and instrument the output gap with its lagged value. The 2SLS results (see *Appendix 4.10*) indicate that in 69% of cases (51 of 74 countries), the *F-statistics* associated with the instrumentation equations are above the rule of thumb of 10 (Staiger & Stock, 1997), suggesting that the lagged output gap is reasonably a strong instrument. This result is reinforced by the analysis of the *Shea's Partial* R^2 statistics, which shows that in more than 85% of cases (63 of 74 countries), the *Partial* R^2 are above the rule of thumb of 20.

[88] In the literature, the CAPB is also calculated using a three-step procedure, especially in several international organizations (OECD, IMF or European Commission, see Girouard & André, 2005). First, they calculate a measure of potential GDP. Second, to estimate the budget balance that is due to business cycle fluctuations, they apply the elasticity of government revenues and expenditures, to the deviation between the effective GDP and the potential GDP. Third, they deduct the CAPB by subtracting the budget balance estimated in the second step, from the primary fiscal balance actually observed. Although very attractive, this methodology is very intensive in detailed data, namely in the estimation of revenue and expenditure elasticity. As such detailed information does not exist in developing countries, we rather focus on the "residuals" approach.

[89] We have also used 6.25 as smoothing parameter, but this does not change significantly the estimation results.

[90] Note that Fatás & Mihov (2003; 2006) rather took the standard deviation of the error term (and not the error term itself) because they were interested in the volatility of fiscal policy (and not fiscal policy itself).

We also use the same methodology displayed in (4.1) to calculate a measure of Cyclically-Adjusted-Primary Expenditure (CAPE). We use this latter to evaluate the impact of Expenditure Rule (*ER*) on a measure of government spending filtered out from the influence of economic conditions. Regarding the assessment of the impact of Debt Rule (*DR*) on government debt developments, we use a recent central government debt database collected by Ali Abbas et *al*. (2010). Descriptive statistics, definitions and sources of the other variables can be found in *Appendices 4.8* and *4.9*.

As depicted in *Figure 4.1* (see *Appendix 4.7*), the *treated* countries (FRers) improved their CAPB between the *pre-FR* period and the *post-FR* period, their CAPB passing from -0.8 (as GDP percentage) to 1 (as GDP percentage). Meanwhile, the CAPB in the *control* group (which is around 0, as GDP percentage) decreased slightly between the *pre-FR* period and the *post-FR* period.[91] This seems to give a first indication that FR adoption improves fiscal discipline. A similar finding can be viewed in *Figures 4.2* and *4.3* (see *Appendix 4.7*) where we use the CAPE and government debt as alternative measures of fiscal performances, respectively. Indeed, the CAPE decreased between the *pre-FR* period and the *post-FR* period in *treated* countries while it increased in the *control* group. Regarding public debt, it decreased between the *pre-FR* period and the *post-FR* in the *treated* countries as well as in the *control* group, but more in the first group. Nevertheless, are these naive correlations corroborated by a more rigorous econometric analysis? In the next section, we assess the impact of FRs more formally, by controlling for the *self-selection* problem in policy adoption.

4.3. Methodology

Our objective is to evaluate the *treatment* effect of FRs on fiscal discipline. To this end, we consider the adoption of FRs by a country as a *treatment*, just as in the program evaluation literature in microeconomic studies. Consistently with this literature, we refer to the countries having adopted *FRs* – FRers - as the *treated* group, and to the non-FRers as the *control* group. Then, the average effect of being a FRer on fiscal discipline, the so-called Average Treatment effect on the Treated (*ATT*), can be expressed as follows,

[91] Note that as this is done in the literature related to inflation targeting, the *post-FR* period for the non-FRers has been defined as the mid between the first FR adoption date in our sample (Indonesia started FRs in 1967, but given that our sample begins in 1990, this latter becomes therefore the *starting* date of FRs for Indonesia) and the ending date in our sample (2007), that is 1998.

$$ATT = E[(Y_{i1} - Y_{i0}) | FR_i = 1] = E[Y_{i1} | FR_i = 1] - E[Y_{i0} | FR_i = 1] \quad (4.2)$$

where FR_i is the FR dummy in country *i*. Y_{i1} is the value of the outcome variable when the country *i* has adopted FRs and Y_{i0} if not. $Y_{i0} / FR_i = 1$ is the outcome value that would have been observed if a FRer had not adopted FR policy, and $Y_{i1} / FR_i = 1$ the outcome value really observed on the same FRs country. Equation (4.2) is telling us that a simple comparison between the outcome value (fiscal discipline in our case) observed in the *treatment* group and the outcome value observed in the same countries if they had not adopted FRs would give us an unbiased estimate of the *ATT*. Unfortunately, it is not possible to observe this latter outcome value since we cannot observe the fiscal performance a FRer had it not adopted FRs. We face here, as it is common in non-experimental studies, an identification problem.

A common approach to circumvent this difficulty is to compare the sample mean budgetary outcome of the *treatment* group with that of the *control* group if and only if assignment to the *treatment* is random. However, FRs adoption may be non-random, as FRs may be correlated with a set of observable variables that also affects the outcome variable, leading to the so-called *self-selection* problem.[92] Simple comparison of the sample mean budgetary outcome between the two groups would then produce biased estimates of the *ATT*. As in Lin & Ye (2007), to address this problem of selection on observables, we make use of a variety of *propensity scores-matching* methods recently developed in the *treatment* literature.

4.3.1. Matching on Propensity-Scores

Propensity Scores-Matching (*PSM* hereafter) consists of pairing FRers with non-FRers which have similar observed characteristics, so that the difference between the outcome of a FRer and that of a matched counterfactual is attributable to the *treatment* (FRs adoption). A key assumption needed to apply *PSM* is "conditional independence" $(Y_0, Y_1 \perp FR | X)$ which requires that conditional on the observables (*X*), the outcome be independent of the *treatment* variable. Under this assumption, equation (2) can be rewritten as,

[92] It is worth noting that the *Propensity Scores-Matching* method does not implicitly account for the unobservables; as a result, the issues it addresses differ from those related to selection on observables (omitted variables) as well as from a Heckman-type sample selection problem (see Heckman et *al.*, 1998; and Dehejia & Wahba, 2002 for further details).

$$ATT = E[\,Y_{i1} \big| FR_i = 1, X_i\,] - E[\,Y_{i0} \big| FR_i = 0, X_i\,] \tag{4.3}$$

where we have replaced $E[\,Y_{i0} \big| FR_i = 1, X_i\,]$ with $E[\,Y_{i0} \big| FR_i = 0, X_i\,]$ which is observable. Yet, as the number of covariates in *X* increases, matching on *X* would be difficult to implement in practice; to overcome this high dimension problem, we follow Rosenbaum & Rubin (1983) and base the matching on the propensity scores (instead of *X*). The *propensity score* is the probability of adopting FRs, conditional to the observable covariates (*X*), namely

$$p(X_i) = E[\,FR_i \big| X_i\,] = Pr(FR_i = 1 \big| X_i) \tag{4.4}$$

Under a final assumption needed for the validity of the *PSM* (the so-called "common support assumption" $p(X_i) < 1$, namely the existence of some comparable control units for each treated unit), we estimate the *ATT* as

$$ATT = E[\,Y_{i1} \big| FR_i = 1, p(\,X_i\,)\,] - E[\,Y_{i0} \big| FR_i = 0, p(\,X_i\,)\,] \tag{4.5}$$

4.3.2. Estimating the propensity scores (*PS*)

We estimate the *PS* using a *probit* model with the binary variable FR as the dependent variable. Our baseline selection equation includes past fiscal development variables (CAPB and Debt, both as GDP percentage, and lagged one year), the real per capita GDP growth rate, dependency ratio, government stability, government fractionalization, inflation and a dummy for the presence of a supranational FR.

We expect FRs to be introduced more likely in fiscally healthier countries, since the public credibility regarding the ability of government to meet its announced targets for fiscal aggregates is the cornerstone of FRs (Calderon & Schmidt-Hebbel, 2008; and IMF, 2009). Accordingly, we expect a positive correlation between the probability of FR adoption and the lagged value of CAPB, but a negative correlation with the lagged value of public debt.[93] We also expect FRs to be adopted more likely in countries with good macroeconomic

[93] It is worth noting that the relationship might be non-linear for public debt, with the likelihood of FR introduction increasing below a given threshold, while decreasing above that threshold. We check for such a non-linear effect in *section 4.4*.

performances (IMF, 2009). As a result, the expected signs on the estimated coefficients of real per capita GDP growth rate and inflation are positive and negative, respectively. Countries with higher dependency ratio, which implies generally higher public fiscal burden, are less likely to adopt rule-based fiscal frameworks (Calderon & Schmidt-Hebbel, 2008). We therefore expect a negative correlation between FRs adoption and dependency ratio, that is the ratio of dependents (people younger than 15 or older than 64) to working-age population (those ages 15-64). Regarding the politico-institutional factors, we expect a positive link between the probability of adopting FRs and the fragmentation of government. Indeed, according to the "tying their hands" approach, FR introduction can be viewed as a mechanism to rule out the deficit bias originating from the so-called "common-pool" problem (Alesina & Perotti, 1995; and Ayuso-i-Casals et *al*., 2006). The expected sign on government stability is ambiguous *a priori*. Indeed, on the one hand, greater government stability may lead to lower *deficit bias*, which in turn should be associated positively with FR adoption. On the other hand, government instability, that is the inability of the government to stay in office and carry out its declared programs, may encourage governments to tie their hands through FR adoption in order to ensure fiscal discipline despite the succession of different executive teams. In this spirit, greater government stability might be less conducive to FR adoption. Finally, we expect a positive link between the supranational fiscal rule dummy and *FRs* adoption at the national level, as the presence of supranational fiscal rule may catalyze the introduction of the national ones (Ayuso-i-Casals et *al*., 2006; and IMF, 2009). *Table 4.2* below reports the *probit* estimates of the *PS*.[94]

Column [1] displays the *probit* results with FR as the dependent variable. Recall that FR is a dummy variable equaling one, if in a given country at a given year a numerical constraint exists on fiscal aggregates (budget balance, expenditure, or debt). Most coefficients are significant and have the expected signs. Lagged CAPB, real per capita GDP growth rate, government fractionalization and supranational FR dummy are correlated positively with *FRs* adoption. Note however that the estimated coefficient on supranational FR dummy is not significantly different from zero. Lagged government debt, dependency ratio and inflation are negatively associated with the probability of adopting FRs. Finally, the sign of the estimated coefficient on government stability is negative, suggesting that FRs in our sample are

[94] According to the *conditional independence* assumption, omitting in the *probit* model, variables that systematically affect the probability of enacting FRs but do not affect budgetary outcomes, has little influence on results (Persson, 2001). In other words, an estimate bias occurs only if we omit an explanatory variable that simultaneously affect fiscal discipline and the probability of adopting FRs. We give much attention to this issue when selecting variables into the *probit* model.

introduced for "tying their hands" reasons. *Column* [1] of *Appendices 4.2*, *4.3* and *4.4* display the *probit* results for Budget Balance Rule (*BBR*), Expenditure Rule (*ER*) and Debt Rule (*DR*) respectively. The results remain almost identical to those of *Table 4.2*, except in some cases.[95]

Table 4. 2: Probit estimates of the propensity scores

Dependent Variable	**Fiscal Rule (FR) Dummy Variable**					
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
CAPB (GDP%) lagged one year	0.045**	0.047***	0.045**	0.044**	0.044**	0.047**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Public Debt (GDP %) lagged one year	-0.005**	0.002	-0.005*	-0.004*	-0.005**	-0.005**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Real per capita GDP growth rate	0.032**	0.028**	0.033**	0.041***	0.034***	0.032**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Dependency ratio	-0.007	-0.007	-0.007	-0.003	-0.008	-0.007
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Government stability	-0.121***	-0.125***	-0.121***	-0.104***	-0.123***	-0.118***
	(0.031)	(0.031)	(0.032)	(0.033)	(0.032)	(0.031)
Government fractionalization	0.383*	0.386*	0.384*	0.345*	0.367*	0.343*
	(0.205)	(0.204)	(0.205)	(0.207)	(0.203)	(0.206)
Inflation	-0.023***	-0.023***	-0.023***	-0.022***	-0.025***	-0.021***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
Supranational FR Dummy	0.049	0.006	0.046	0.055	0.124	0.048
	(0.178)	(0.180)	(0.183)	(0.183)	(0.184)	(0.179)
Squared public debt (lagged one year)		-0.178**				
		(0.081)				
Logarithm of Real per capita GDP			0.011			
			(0.130)			
Quality of the bureaucracy				0.251***		
				(0.069)		
Trade Openness					-0.002	
					(0.002)	
International Official Reserves to GDP						-0.001
						(0.004)
Number of observations	772	772	772	772	772	757
Pseudo R^2	0.100	0.107	0.100	0.114	0.102	0.100

Note: Robust standard errors are reported in brackets. Constants included (but not reported). *, **, and ***: significance level of 10%, 5% and 1% respectively.

4.3.3. Results from matching on propensity scores.

Based on the *PS* estimated above, we employ four commonly used methods to match each FRer with non-FRers, depending on the closeness of their scores to that of the FRer.[96] First, the *nearest neighbor matching* with replacement, which matches each *treated* country to the N *control* countries that have the closest *PS* (we use $N=1$, $N=2$ and $N=3$). Second, the *radius matching*, which performs the *matching* based on *PS* falling within a certain *radius* or "caliper" R (we use a small *radius R=0.005*, a medium *radius R=0.01* and a wide *radius*

[95] The estimated coefficient on lagged public debt becomes positive with *BBR* and *DR*, but remains negative (although not statistically significant) with *ER*. The estimated coefficient on the supranational dummy becomes negative with *BBR* and *ER* but proved to be not significantly different from zero.

[96] While matching FRers to non-FRers, we employ the "*common support*" option, *i.e.* we exclude the *treated* countries whose the *PS* is higher than the maximum or less than the minimum *PS* of the *untreated* countries.

R=0.05). The third method is the *regression-adjusted local linear matching* developed by Heckman et *al*. (1998). Fourth, we consider the *kernel matching*, which matches a FRer to all non-FRers weighted proportionally to their closeness to the *treated* country. As the matching estimator presents no analytical variance, we compute standard errors by bootstrapping (that is by re-sampling the observations of the *control* group, see Dehejia & Wahba, 2002).

The upper panel of *Table 4.3* below (line [1]) reports the estimated *ATT* of FRs on the CAPB. Irrespective of the *matching* method, the estimation results show that FR adoption does improve fiscal discipline, as the estimated *ATT* is positive and statistically significant. The amplitude of the estimated *ATT* ranges from 0.642 (*kernel* matching) to 1.180 percentage points of GDP (*1-Nearest-neighbor*), suggesting that on average, *FRs* adoption enhances the CAPB by 0.642 and 1.180 percentage points of GDP, respectively. Does the discipline-enhancing effect of FRs on fiscal policy vary depending on the type of rule (*BBR*, *ER*, *DR*)? The upper panel (line [1]) of *Tables 4.4, 4.5* and *4.6* addresses this issue.[97]

Panel [1] of *Table 4.4* below reports the *ATT* with *BBR* as the *treatment* variable and the CAPB as the budgetary outcome. The *ATTs* still are positive, suggesting that placing numerical constraints on the budget balance allows enhancing the CAPB. But the statistical significance and the magnitude of the estimated *ATTs* decrease slightly with respect to those estimated with FR as *treatment* variable (*Panel* [1] of *Table 4.3*). *Panel* [1] of *Table 4.5* reports the estimated *ATT* with this time, *ER* as the *treatment* variable, and CAPE as the budgetary outcome. Irrespective of the *matching* estimator, the estimation results show that *ER* adoption does reduce the CAPE. The amplitude of the *ATT* is even higher than that estimated in *panel* [1] of *Table 4.3* and *4.4*: it extends from -0.866 (local linear regression matching) to -1.612 (*1-Nearest-neighbor*) percentage points of GDP. Finally, panel [1] of *Table 4.6* displays the *matching* results for *DR*. The estimated *ATTs* are not statistically different from zero, suggesting that in our sample, countries having enacted *DR* do not perform better than countries that did not introduce *DR*, in terms of government debt. But one might be cautious in interpreting this last result. Indeed, the lack of significance of the estimated *ATT*, and to a lesser extent the fact that in some cases the sign of the *ATT* of *DR* is even positive, might be due to the inability of the simple binary measure of *DR* to account for the other important aspects – enforcement, monitoring, transparency, sanctions - necessary for the success of the rules.

[97]We do not assess the effect of *RR* because only two countries (Kenya and Nigeria) enacted them in our sample.

Table 4. 3: Matching results (With FR Dummy as *Treatment* Variable)

Treatment Variable	1-Nearest-Neighbor Matching	2-Nearest-Neighbor Matching	3-Nearest Neighbor Matching	Radius Matching			Local Linear Regression Matching	Kernel Matching
				r=0.005	r=0.01	r=0.05		
Fiscal Rule (FR)	**Dependent variable: Cyclically-Adjusted Budget Balance (CAPB, GDP %)**							
[1]: Average Treatment on the Treated (ATT)	1.180***	0.828**	0.820**	0.772***	0.691***	0.644***	0.685***	0.642***
	(0.424)	(0.389)	(0.357)	(0.289)	(0.263)	(0.244)	(0.259)	(0.246)
Number of Treated observations	128	128	128	125	127	128	128	128
Number of Control observations	640	640	640	640	640	640	640	640
	Robustness Checks							
[2]: Adding squared public debt (lagged)	1.250*	0.762*	0.750**	0.675**	0.690***	0.715***	0.737***	0.698***
	(0.697)	(0.409)	(0.364)	(0.294)	(0.260)	(0.241)	(0.262)	(0.239)
[3]: Adding Logarithm of Real per capita GDP	1.405**	1.373**	1.248**	1.170**	1.099**	1.138**	1.206***	1.144**
	(0.594)	(0.549)	(0.510)	(0.505)	(0.466)	(0.463)	(0.440)	(0.458)
[4]: Adding Quality of the bureaucracy	1.218*	1.365*	1.355**	1.416***	1.248**	1.225***	1.222***	1.224***
	(0.708)	(0.704)	(0.646)	(0.538)	(0.502)	(0.446)	(0.471)	(0.448)
[5]: Adding Trade Openness	1.980***	1.760***	1.567***	1.333***	1.375***	1.200***	1.344***	1.215***
	(0.672)	(0.593)	(0.543)	(0.493)	(0.482)	(0.465)	(0.485)	(0.463)
[6]: Adding International Official Reserves to GDP	1.872***	1.590***	1.455**	1.330***	1.276**	1.259***	1.297***	1.270***
	(0.570)	(0.571)	(0.568)	(0.478)	(0.497)	(0.474)	(0.490)	(0.475)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.

Table 4. 4: Matching results (With BBR Dummy as *Treatment* Variable)

Treatment Variable	1-Nearest-Neighbor Matching	2-Nearest-Neighbor Matching	3-Nearest Neighbor Matching	Radius Matching			Local Linear Regression Matching	Kernel Matching
				r=0.005	r=0.01	r=0.05		
Budget Balance Rule (BBR)	**Dependent variable: Cyclically-Adjusted Budget Balance (CAPB, GDP %)**							
[1]: Average Treatment on the Treated (ATT)	0.707	0.810*	0.676*	0.588*	0.486*	0.465*	0.417*	0.478**
	(0.488)	(0.441)	(0.403)	(0.345)	(0.247)	(0.260)	(0.272)	(0.243)
Number of Treated observations	80	80	80	78	78	80	80	80
Number of Control observations	688	688	688	688	688	688	688	688
	Robustness Checks							
[2]: Adding squared public debt (lagged)	0.826*	1.051**	1.137**	1.049***	1.070***	1.083***	1.034***	1.083***
	(0.493)	(0.459)	(0.453)	(0.379)	(0.365)	(0.359)	(0.360)	(0.360)
[3]: Adding Logarithm of Real per capita GDP	0.640*	0.437	0.789**	0.816**	0.942**	0.965**	0.901**	0.961**
	(0.326)	(0.411)	(0.394)	(0.376)	(0.367)	(0.377)	(0.369)	(0.377)
[4]: Adding Quality of the bureaucracy	0.791*	0.909**	1.020**	0.897**	0.923**	0.919**	0.830**	0.910**
	(0.469)	(0.436)	(0.425)	(0.394)	(0.394)	(0.384)	(0.394)	(0.384)
[5]: Adding Trade Openness	1.283***	1.188***	1.213***	1.204***	1.212***	1.242***	1.157***	1.240***
	(0.469)	(0.427)	(0.388)	(0.345)	(0.347)	(0.353)	(0.345)	(0.350)
[6]: Adding International Official Reserves to GDP	1.112**	1.177***	1.146***	1.187***	1.168***	1.220***	1.164***	1.142***
	(0.453)	(0.434)	(0.424)	(0.381)	(0.377)	(0.364)	(0.355)	(0.360)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.

Table 4. 5: Matching results (With ER Dummy as *Treatment* Variable)

Treatment Variable	1-Nearest-Neighbor Matching	2-Nearest-Neighbor Matching	3-Nearest Neighbor Matching	Radius Matching			Local Linear Regression Matching	Kernel Matching
				r=0.005	r=0.01	r=0.05		
Expenditure Rule (ER)	**Dependent variable: Cyclically-Adjusted Primary Expenditure (CAPE, GDP %)**							
[1]: Average Treatment on the Treated (ATT)	-1.612**	-1.148*	-1.147*	-0.936**	-0.874**	-0.966**	-0.866**	-0.957**
	(0.794)	(0.672)	(0.600)	(0.431)	(0.437)	(0.433)	(0.440)	(0.430)
Number of Treated observations	40	40	40	40	40	40	40	40
Number of Control observations	722	722	722	722	722	722	722	722
	Robustness Checks							
[2]: Adding squared public debt (lagged)	-1.322***	-1.262***	-1.227***	-1.002***	-0.983***	-0.925***	-0.911***	-0.933***
	(0.492)	(0.453)	(0.404)	(0.355)	(0.317)	(0.285)	(0.296)	(0.285)
[3]: Adding Logarithm of Real per capita GDP	-0.891*	-0.757*	-0.784*	-0.730**	-0.753**	-0.777**	-0.868***	-0.779**
	(0.514)	(0.448)	(0.406)	(0.355)	(0.352)	(0.318)	(0.329)	(0.319)
[4]: Adding Quality of the bureaucracy	-1.085**	-0.805*	-0.897**	-0.554	-0.782**	-0.926***	-0.838**	-0.917***
	(0.491)	(0.478)	(0.447)	(0.375)	(0.367)	(0.329)	(0.340)	(0.325)
[5]: Adding Trade Openness	-1.158**	-1.040**	-1.167***	-1.037***	-1.092***	-1.037***	-1.079***	-1.050***
	(0.514)	(0.471)	(0.451)	(0.322)	(0.322)	(0.299)	(0.323)	(0.301)
[6]: International Official Reserves to GDP	-1.310***	-0.735*	-0.800**	-0.807**	-0.853***	-0.947***	-0.929***	-0.938***
	(0.493)	(0.420)	(0.377)	(0.336)	(0.326)	(0.271)	(0.282)	(0.271)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.

Table 4. 6: Matching results (With DR Dummy as *Treatment* Variable

Treatment Variable	1-Nearest-Neighbor Matching	2-Nearest-Neighbor Matching	3-Nearest Neighbor Matching	Radius Matching			Local Linear Regression Matching	Kernel Matching
				r=0.005	r=0.01	r=0.05		
Debt Rule (DR)	**Dependent variable: Public Debt (GDP %)**							
[1]: Average Treatment on the Treated (ATT)	-2.788	-2.613	-0.371	-0.549	1.546	0.520	3.406	0.964
	(8.638)	(6.757)	(6.757)	(6.757)	(6.757)	(6.757)	(6.757)	(6.757)
Number of Treated observations	73	73	73	72	73	73	73	73
Number of Control observations	686	686	686	686	686	686	686	686
	Robustness Checks							
[2]: Adding squared public debt (lagged)	0.601	1.456	0.0732	-0.858	-0.790	-3.322**	-0.734	-2.806**
	(2.695)	(2.587)	(2.349)	(1.302)	(1.237)	(1.290)	(1.286)	(1.251)
[3]: Adding Logarithm of Real per capita GDP	-0.839	1.736	1.199	-0.259	-0.811	-4.269***	-0.425	-3.762***
	(3.194)	(2.753)	(2.544)	(1.451)	(1.347)	(1.281)	(1.309)	(1.253)
[4]: Adding Quality of the bureaucracy	-0.263	1.631	0.253	-0.906	-0.770	-3.848***	-1.018	-3.338**
	(3.758)	(3.167)	(3.122)	(1.845)	(1.603)	(1.353)	(1.457)	(1.322)
[5]: Adding Trade Openness	-7.097*	-5.461*	-4.526	-2.490	-2.470	-4.583***	-2.588	-4.503***
	(3.821)	(3.170)	(2.790)	(1.818)	(1.743)	(1.418)	(1.581)	(1.430)
[6]: International Official Reserves to GDP	-0.557	-1.415	-1.085	-0.672	-0.319	-3.181***	-0.569	-3.022***
	(3.925)	(3.213)	(2.861)	(1.660)	(1.402)	(1.181)	(1.316)	(1.147)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.

4.4. Robustness Checks

To make sure that we filter out sufficiently any possible polluting effect resulting from observables known to affect both fiscal performances and the probability of adopting FRs, we augment the *probit* model by controlling respectively for the lagged value of the squared public debt (for a possible non-linearity in the effect of public debt), the logarithm of real per capita GDP (proxy for the level of economic development), quality of the bureaucracy (proxy for institutional quality), trade openness, and international official reserves to GDP.[98] *Columns* [2], [3], [4], [5] and [6] of *Table 4.2* show the *probit* results when using FR dummy as the selection variable, and their corresponding results for the *ATT* are depicted in *Table 4.3* (*lines* [2] to [6]). The *probit* results when using *BBR*, *ER* and *DR* dummies as the selection variables are depicted in columns [2] to [6] of *Appendices 4.2*, *4.3* and *4.4* respectively, while their corresponding *ATT* results are depicted in *lines* [2] to [6] of *Tables 4.4*, *4.5*, and *4.6* respectively. The results remain robust to these new specifications: the *probit* results as well as the estimated *ATT* do not change qualitatively and quantitatively.

4.5. Exploring the heterogeneity in the treatment effect

Even though developing countries share some common features, there exists however some differences between them, including *inter alia*, their socio-political and institutional contexts. They may even differ in some aspects related to the way they apply FRs. Given that these factors may make different the *ATT* of FRs on fiscal discipline, we explore in this section the presence of heterogeneity in the *treatment* effect of FRs. We test five possible sources of heterogeneity: the number of FRs in place, the time length since FRs introduction, the presence of a supranational FR, government fractionalization and government stability.[99]

For this purpose, we use a control function regression approach, adapted from Lin & Ye (2009) and described as follows. We perform, within the *common support* from the *matching* in previous section, the simple following OLS regression:

$$CAPB_{it} = \alpha + \beta FR_{it} + \gamma Pscore_{it} + \phi X_{it} + \theta FR_{it} * X_{it} + \varepsilon_{it} \quad (4.6)$$

[98] These variables are considered in the literature as possible determinants of the probability of FRs adoption (see, *e.g.*, Calderon & Schmidt-Hebbel, 2008; and IMF, 2009).

[99] It would be interesting to check for possible heterogeneity due to factors related to the strength of FRs (enforcement, monitoring, transparency and sanctions). However, the lack of such detailed data for a sufficient number of countries in our sample prevents us from doing so.

$Pscore_{it}$, the estimated *PS* from our baseline *probit* model, is included as a control function. X_{it} is the set of possible sources of heterogeneity variables. The coefficient of the interaction between FR and Xit, θ , catches the heterogeneity feature of the *treatment* effect of FRs.

Table 4.7 below reports the estimated *treatment* effect of FRs on the CAPB, based on the control function regression approach. The first column shows a simple OLS regression linking the FRs dummy to the CAPB within the *common support*. The estimated coefficient of FRs, which catches the difference in mean CAPB between FRers and non-FRers, is positive and significantly different from zero. Then, in the second column, we include $Psocre_{it}$ as a control function. Its estimated coefficient is positive and significantly different from zero, indicating that *self-selection* bias is at work in the evaluation of the *treatment* effect of FRs upon fiscal discipline in our sample. This justifies *a posteriori* the use of *propensity scores-matching* in the previous section. The estimated coefficient of FR is still significantly different from zero but smaller in magnitude. The estimated average *treatment* effect of FR on the CAPB as GDP percentage, after controlling for *self-selection* is about 0.689, which is close to the *ATT* obtained from *matching*. The last five columns of *Table 4.7* are devoted to possible heterogeneity of the *treatment* effect of FRs, through the estimated coefficients of the interactive terms as described above.[100]

Table 4. 7: Heterogeneity in the treatment effect of Fiscal Rules on Structural Primary Balance

Dependent Variable: CAPB (GDP %)	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
FR Dummy	0.828***	0.689**	-0.294	0.975**	0.797**	1.306***	-2.820*
	(0.317)	(0.291)	(0.603)	(0.400)	(0.311)	(0.483)	(1.696)
Propensity Score		1.570*	1.690	1.719*	1.800*	2.476**	1.993*
		(0.801)	(1.038)	(1.027)	(1.084)	(1.094)	(1.043)
FR * Number of FRs			0.645*				
			(0.358)				
FR * Time				-0.0549*			
				(0.0309)			
Supranational Dummy					0.443		
					(0.654)		
FR * Supranational					-1.239*		
					(0.681)		
Gov. Fractionalization						-0.419	
						(0.502)	
FR*Gov. Fractionalization						-2.304**	
						(0.922)	
Government stability							-0.022
							(0.072)
FR*Government Stability							0.434**
							(0.219)
Observations	768	768	768	768	768	768	768
R^2	0.009	0.011	0.014	0.013	0.013	0.021	0.017

Note: in brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant terms are included but not reported.

[100] Note that as this appears in equation (4.6), normally, both interacted variables, FR and X_{it}, should be included in the regression individually. But in column [3] of *Table 4.3*, we do not include *Number of* FRs in the regression because the interaction term is the same as *Number of FRs.* Similarly, *Time* is not included in the regression of column [4], because the interaction term is the same as *Time*.

In column [3], the estimated coefficient of the interaction of FR and the number of FRs in place is positive and significantly different from zero, suggesting that the more the number of rules in place, the larger the discipline-enhancing effect of FRs on fiscal policy. The adoption of a constraint on an additional fiscal aggregate increases the *treatment* effect by 0.645 percentage point. It is worth noting that even though this is not a real measure of the intensity of FRs, this result seems to indicate to some extent that the intensity in the use of FRs matters, in accordance with the existing literature (Debrun et *al*., 2008).[101]

Column [4] shows that time length since FRs adoption reduce the disciplinary effect of FRs, as the estimated coefficient of the interaction term between FR and *Time* is negative and significantly different from zero. This suggests that the credibility component of FRs comes more from the "signals" they send to the public and financial markets rather than from any reputation acquired due to length of time in the use of FRs. Results in columns [5], [6] and [7] show that the *treatment* effect of FRs is reduced by the presence of supranational rules and government fragmentation whereas it is enhanced by government stability. The first result of this set of three may be due to the fact that supranational FRs are weakly enforced in developing countries, as documented in Prakash & Cabezon (2008), so that this may result in negative externalities onto the national rules, leading to an overall smaller *treatment* effect. Regarding the role of government fragmentation, it is in accordance with Alesina & Perotti (1995) who argue that the *common pool* problem is expected to be stronger in fragmented and heterogeneous government coalitions. Finally, the enhanced *treatment* effect of FRs in more stable governments suggests that the ability of government to stay in power and carry out its declared programs, including the fulfillment of the announced targets for fiscal aggregates, is a key element of the effectiveness of FRs.

We also explore the heterogeneity in the *treatment* effect of *ER* on the CAPE. The results (see *Table 4.8*) confirm the previous conditional discipline-enhancing effects of FR on fiscal policy. Indeed, it appears that while the reducing-effect of *ER* on the CAPE decreases with the existence of supranational FRs and the degree of fractionalization of the government, it increases with the degree of stability of the government. Note however that the number of rules in place as well as the time length since the introduction of an *ER* does not influence any more significantly the reducing-effect of *ER* on the CAPE.

[101] It would have been more relevant to use for example the share of government finances covered by rules. But the lack of availability of such data in developing countries prevents us from using this measure.

Table 4. 8: Heterogeneity in the treatment effect of ER on the CAPE (GDP %)

Dependent Variable: CAPE (GDP %)	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
ER Dummy	-1.023*	-0.933**	-1.414	-0.911	-1.057**	-2.142***	3.501*
	(0.522)	(0.470)	(1.136)	(0.689)	(0.519)	(0.667)	(2.008)
Propensity Score		-4.381*	-4.335*	-4.368*	-4.712*	-4.863*	-4.678*
		(2.305)	(2.281)	(2.298)	(2.480)	(2.559)	(2.386)
ER * Number of FRs			0.256				
			(0.497)				
ER * Time				-0.00599			
				(0.117)			
Supranational Dummy					0.153		
					(0.335)		
ER * Supranational					1.295*		
					(0.690)		
Gov. Fractionalization						-0.0327	
						(0.400)	
ER *Gov. Fractionalization						4.539***	
						(1.124)	
Government stability							0.0764*
							(0.040)
ER *Government Stability							-0.543**
							(0.259)
Observations	762	762	762	762	762	762	762
R^2	0.005	0.007	0.007	0.007	0.008	0.018	0.012

Note: ER=Expenditure Rule; CAPE: Cyclically-Adjusted Primary Expenditure. In brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant terms are included but not reported.

Finally, for the sake of robustness check, we carried out the same control function regressions, but controlling for country-fixed and year-fixed effects this time. The main results remain robust to these new specifications (see *Appendices 4.5* and *4.6* for the effect of *FR* on the CAPB and the effect of *ER* on the CAPE, respectively).

4.6. Concluding Remarks and Policy Implications

In this chapter, we analyzed the relationship between national fiscal rules (FRs) and fiscal discipline in developing countries. Based on a wide panel data of 74 developing countries over the period 1990-2007, this chapter is the first study, to the best of our knowledge, to take into account the *self-selection* problem in policy adoption while evaluating the effect of FRs on fiscal performances. Relying on a variety of *propensity scores matching* methods, which allows us controlling for *self-selection*, this chapter therefore reassessed more formally the impact of FRs on budgetary outcomes. It found that the Average Treatment effect (*ATT*) of FRs on the Cyclically-Adjusted Primary fiscal Balance (CAPB) is significantly positive and robust to a variety of alternative specifications. The magnitude of the contribution of FRs to the CAPB is rather important, as FRs enhance the CAPB by at least 0.642 and up to 1.180 percentage points of GDP. We also found that the *treatment* effect varies with the type of FRs: while Budget Balance Rules and Expenditure Rules have significant discipline-

enhancing effects, the effect of Debt Rules appears mixed and not significantly different from zero. Last but not the least, we showed that there is heterogeneity in the *treatment* effect of FRs, depending on countries' characteristics: number of FRs in place, time length since FRs adoption, presence of supranational FRs, government fractionalization and government stability.

In terms of policy implications, this study suggests that the introduction of rule-based fiscal policy frameworks remains a credible remedy for governments in developing countries against fiscal indiscipline. This is particularly important in the current context, where the implementation of massive stimulus plans has eroded fiscal positions in many countries, which commands to undertake credible measures to put back public finances on a sustainable path. Nevertheless, it is important to keep in mind that the simple adoption of FRs is not sufficient to guarantee fiscal credibility and fiscal discipline. Their adoption must be accompanied with a set of other measures, beyond the scope of this chapter, but essential to the success of FRs. Such measures include *inter alia*, fiscal transparency, fiscal responsibility, enforcement mechanisms, sanctions and independent fiscal institutions (fiscal councils).

Besides, it is worth noting that sound fiscal policies may also be implemented for purposes of ensuring the compatibility of the fiscal stance with MP frameworks, such as IT. Indeed, as any MP framework, a credible adoption of IT needs to be grounded on a strong and sound fiscal stance, in order to send strong signals to the general public and the financial markets that MP will not be subordinated to fiscal policy. Consequently, the simple adoption of an IT regime may be sufficiently binding for the government to set off fiscal discipline, with certainly the support of FRs. From a broader standpoint, fiscal outcomes or other macroeconomic variables may be the result of the interplay between monetary and fiscal policymakers, and not just the fruit of their actions taken separately. The next three chapters of the thesis address thoroughly the extent to which such issues matter for macroeconomic performances.

Appendices

Appendix 4.1: Country List

***Treatment* Group**		***Control* group**		
Angola	Panama	Albania	Georgia	Philippines
Argentina	Peru	Algeria	Guatemala	Romania
Bulgaria	Poland	Azerbaijan	Hungary	Russian Federation
Brazil	Sri Lanka	Bangladesh	Iran, Islamic Rep.	Serbia
Botswana		Bahrain	Korea, Republic	Slovak Republic
Cape Verde		Belarus	Lesotho	Slovenia
Chile		Bolivia	Malaysia	South Africa
Costa Rica		Chad	Mauritius	Sudan
Czech Republic		Cameroon	Mexico	Swaziland
Ecuador		China	Mongolia	Syrian Arab Rep.
Estonia		Colombia	Morocco	Thailand
India		Congo, Republic	Mozambique	Trinidad & Tobago
Indonesia		Côte d'Ivoire	Jamaica	Tunisia
Israel		Croatia	Jordan	Turkey
Kenya		Dominican Republic	Kazakhstan	Ukraine
Lithuania		Egypt	Latvia	Uruguay
Nigeria		Fiji	Paraguay	Venezuela
Pakistan		Gabon		

Appendix 4.2: Probit estimates of the propensity scores (With BBR as dependent variable)

Dependent Variable	**Budget Balance Rule (BBR) Dummy Variable**					
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
CAPB (GDP%) lagged one year	0.063***	0.070***	0.062***	0.064***	0.059***	0.076***
	(0.022)	(0.022)	(0.021)	(0.022)	(0.020)	(0.023)
Public Debt (GDP %) lagged one year	0.003	0.016***	0.004*	0.004	0.003	0.002
	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
Real per capita GDP growth rate	0.013	0.001	0.017	0.023	0.015	0.016
	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)
Dependency ratio	-0.024***	-0.025***	-0.016**	-0.019***	-0.028***	-0.032***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.008)
Government stability	-0.153***	-0.156***	-0.146***	-0.138***	-0.157***	-0.138***
	(0.036)	(0.037)	(0.037)	(0.039)	(0.036)	(0.036)
Government fractionalization	0.781***	0.790***	0.799***	0.756***	0.747***	0.833***
	(0.249)	(0.256)	(0.247)	(0.251)	(0.248)	(0.260)
Inflation	-0.039***	-0.041***	-0.039***	-0.037***	-0.046***	-0.041***
	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)
Supranational FR Dummy	-0.534*	-0.722**	-0.624**	-0.564*	-0.325	-0.557**
	(0.283)	(0.291)	(0.281)	(0.295)	(0.285)	(0.280)
Squared public debt (lagged one year)		-0.334***				
		(0.089)				
Logarithm of Real per capita GDP			0.298*			
			(0.155)			
Quality of the bureaucracy				0.311***		
				(0.084)		
Trade Openness					-0.005**	
					(0.002)	
International Official Reserves to GDP						-0.035***
						(0.010)
Number of observations	772	772	772	772	772	757
Pseudo R^2	0.143	0.174	0.151	0.163	0.154	0.169

Robust standard errors are reported in brackets. Constants included (but not reported). *, **, and ***: significance level of 10%, 5%, and 1%.

Appendix 4.3: Probit estimates of the propensity scores (With ER as dependent variable)

Dependent Variable	ER Dummy Variable					
	[1]	[2]	[3]	[4]	[5]	[6]
CAPB (GDP%) lagged one year	0.072**	0.074***	0.073**	0.072**	0.068**	0.071***
	(0.029)	(0.028)	(0.029)	(0.029)	(0.023)	(0.028)
Public Debt (GDP %) lagged one year	-0.002	0.002	0.002	-0.002	-0.003	-0.001
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Real per capita GDP growth rate	0.023	0.020	0.032*	0.027	0.029	0.023
	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)
Dependency ratio	-0.012*	-0.011*	0.010	-0.009	-0.014*	-0.012*
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Government stability	-0.092**	-0.095**	-0.079	-0.083*	-0.095**	-0.107**
	(0.047)	(0.046)	(0.051)	(0.048)	(0.047)	(0.046)
Government fractionalization	-0.003	0.005	0.064	-0.020	-0.070	0.006
	(0.312)	(0.311)	(0.313)	(0.317)	(0.303)	(0.314)
Inflation	-0.010**	-0.010**	-0.011**	-0.010**	-0.013**	-0.010**
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Supranational FR Dummy	-0.138	-0.159	-0.345	-0.147	0.108	-0.142
	(0.273)	(0.281)	(0.284)	(0.276)	(0.268)	(0.273)
Squared public debt (lagged one year)		-0.111				
		(0.106)				
Logarithm of Real per capita GDP			0.847***			
			(0.171)			
Quality of the bureaucracy				0.130		
				(0.090)		
Trade Openness					-0.006**	
					(0.002)	
International Official Reserves to GDP						0.008**
						(0.004)
Number of observations	772	772	772	772	772	757
Pseudo R^2	0.077	0.080	0.136	0.081	0.093	0.087

Robust standard errors are reported in brackets. Constants included (but not reported).*, **, and ***: significance level of 10%, 5%, and 1%.

Appendix 4.4: Probit estimates of the propensity scores (With DR as dependent variable)

Dependent Variable	DR (Debt Rule) Dummy Variable					
	[1]	[2]	[3]	[4]	[5]	[6]
CAPB (GDP%) lagged one year	0.032*	0.029	0.034*	0.030*	0.029*	0.038**
	(0.017)	(0.018)	(0.018)	(0.017)	(0.017)	(0.019)
Public Debt (GDP %) lagged one year	0.004**	-0.018**	0.003	0.004**	0.004**	0.003
	(0.002)	(0.008)	(0.002)	(0.002)	(0.002)	(0.002)
Real per capita GDP growth rate	-0.0005	0.010	-0.004	0.003	0.001	0.002
	(0.012)	(0.014)	(0.012)	(0.012)	(0.012)	(0.012)
Dependency ratio	-0.017***	-0.019***	-0.025***	-0.014**	-0.022***	-0.024***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Government stability	-0.109***	-0.113***	-0.114***	-0.099***	-0.115***	-0.093***
	(0.033)	(0.034)	(0.034)	(0.035)	(0.034)	(0.034)
Government fractionalization	0.277	0.256	0.266	0.282	0.226	0.290
	(0.212)	(0.217)	(0.215)	(0.215)	(0.207)	(0.214)
Inflation	-0.023***	-0.022***	-0.023***	-0.022***	-0.029***	-0.022***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)
Supranational FR Dummy	-0.047	0.060	0.020	-0.044	0.146	-0.046
	(0.211)	(0.221)	(0.217)	(0.214)	(0.223)	(0.213)
Squared public debt (lagged one year)		0.628***				
		(0.174)				
Logarithm of Real per capita GDP			-0.238*			
			(0.132)			
Quality of the bureaucracy				0.157**		
				(0.068)		
Trade Openness					-0.006***	
					(0.002)	
International Official Reserves to GDP						-0.028***
						(0.010)
Number of observations	772	772	772	772	772	757

Pseudo R^2	0.074	0.111	0.079	0.079	0.090	0.094

Robust standard errors are reported in brackets. Constants included (but not reported).*, **, and ***: significance level of 10%, 5%, and 1%.

Appendix 4.5: Heterogeneity in the effect of FR on the CAPB (Country & Time Fixed Effect Estimations)

Dependent Variable: CAPB (GDP %)	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
FR Dummy	2.660**	2.430**	-0.266	2.281**	2.607**	3.041**	-1.931
	(1.208)	(1.133)	(2.199)	(1.019)	(1.134)	(1.415)	(2.866)
Propensity Score		4.513*	4.355*	4.398*	4.660*	5.354*	6.053**
		(2.302)	(2.222)	(2.243)	(2.817)	(2.813)	(2.912)
FR * Number of FRs			1.671*				
			(0.852)				
FR * Time				0.0709			
				(0.279)			
Supranational Dummy					1.199*		
					(0.612)		
FR * Supranational					-1.875*		
					(0.956)		
Government Fractionalization						-0.730	
						(0.887)	
FR *Government Fractionalization						-3.893*	
						(1.986)	
Government stability							0.093
							(0.159)
FR *Government Stability							0.531*
							(0.271)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	768	768	768	768	768	768	768
R^2	0.133	0.141	0.152	0.141	0.145	0.152	0.150

Note: CAPB: Cyclically-Adjusted Primary Balance. In brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant terms are included but not reported.

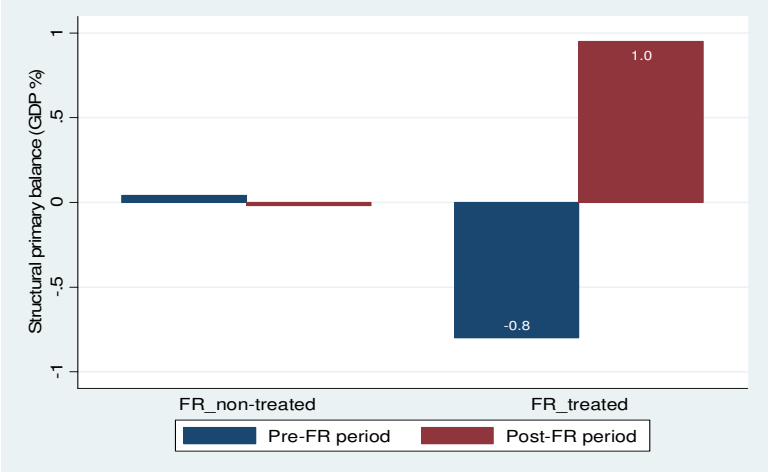
Appendix 4.6: Heterogeneity in the effect of ER on the CAPE (Country and Time Fixed Effect Estimations)

Dependent Variable: CAPE (GDP %)	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
ER Dummy	-3.048**	-2.523*	-3.376	-2.470	-2.766*	-4.873***	3.728
	(1.456)	(1.418)	(2.491)	(1.748)	(1.603)	(1.436)	(2.706)
Propensity Score		-21.55***	-21.77***	-21.51***	-21.23**	-21.78***	-20.62**
		(8.240)	(8.303)	(8.242)	(8.258)	(8.365)	(8.128)
ER * Number of FRs			0.486				
			(1.582)				
ER * Time				-0.015			
				(0.215)			
Supranational Dummy					0.642		
					(0.808)		
ER * Supranational					1.996*		
					(1.018)		
Gov. Fractionalization						-0.070	
						(0.826)	
ER *Gov. Fractionalization						8.986***	
						(2.263)	
Government stability							0.209*
							(0.107)
ER *Government Stability							-0.751**
							(0.319)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	762	762	762	762	762	762	762
R^2	0.127	0.144	0.144	0.144	0.147	0.170	0.152

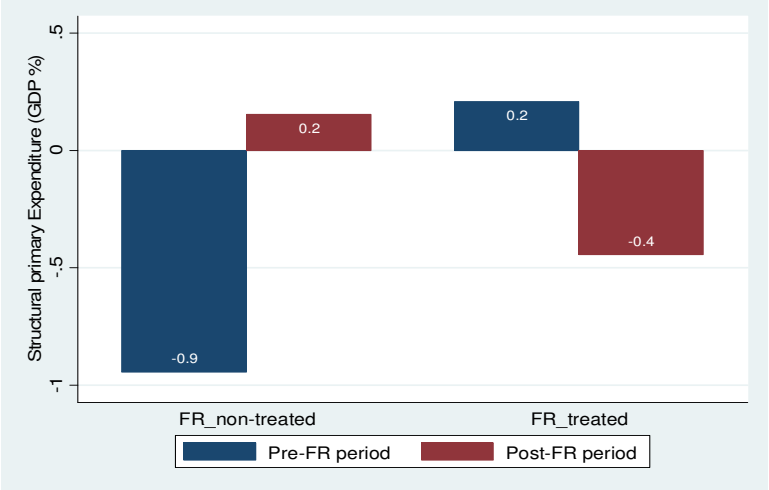
Note: ER=Expenditure Rule; CAPE=Cyclically-Adjusted Primary Expenditure. In brackets the bootstrapped standard errors (with 500 replications). *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively. Constant terms are included but not reported.

Appendix 4.7

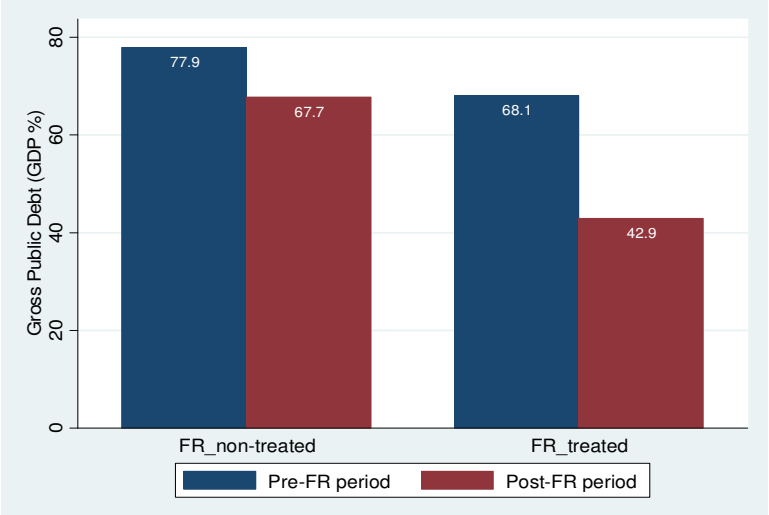
4. 9: Structural Primary balance, 1990-2007



4. 10: Structural primary expenditure, 1990-2007



4. 11: Gross Public Debt, 1990-2007



Notes for Figures 4.1, 4.2 and 4.3: FR_treated Vs. FR_non-treated
Sources: World Economic Outlook, WEO (2011) for Figures 4.1 and 4.2; Ali Abbas et *al.* (2010) for Figure 4.3.

Appendix 4.8: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Cyclically-Adjusted Primary Fiscal Balance (GDP %)	1074	0.016	3.492	-18.344	24.618
Cyclically-Adjusted Primary Expenditure (GDP %)	1075	-0.188	3.660	-26.182	25.411
Government Debt (GDP %)	1195	56.838	41.593	3.742	454.864
Fiscal Rule (FR)	1332	0.131	0.337	0.000	1.000
Budget Balance Rule (BBR)	1332	0.092	0.289	0.000	1.000
Expenditure Rule (ER)	1332	0.035	0.185	0.000	1.000
Revenue Rule (RR)	1332	0.013	0.112	0.000	1.000
Debt Rule (DR)	1332	0.068	0.251	0.000	1.000
Supranational Dummy	1314	0.066	0.249	0.000	1.000
Real per capita GDP growth rate	1280	2.670	5.803	-32.935	44.281
Dependency ratio	1332	64.997	16.581	38.100	106.900
Government stability	1118	8.008	2.003	1.000	12.000
Government Fractionalization	1197	0.224	0.273	0.000	0.893
Inflation	1279	55.109	340.794	-11.686	7481.664
Number of FR	1332	0.191	0.543	0.000	3.000
Time since FR adoption	1332	0.748	2.894	0.000	28.000
Real per capita GDP	1292	7223.490	4777.399	955.786	26306.430
Quality of the bureaucracy	1118	2.023	0.845	0	4
Trade Openness	1292	80.787	41.214	10.094	222.288
International Official Reserves to GDP	1254	15.047	14.009	0	114.448

Appendix 4.9: Sources and definitions of data

Variables	Definition	Sources
Fiscal Rule (*FR*)	Dummy Variable taking the value 1 if in a given year a country has in place, a national numerical constraint on government budget aggregates.	Fiscal Rules Database by the IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division (2009), available at www.imf.org/external/np/pp/eng/2009/121609.pdf
Budget Balance Rule (*BBR*)	Dummy Variable taking the value 1 if in a given year a country has in place, a national numerical constraint on government Fiscal Balance.	
Expenditure Rule (*ER*)	Dummy Variable taking the value 1 if in a given year a country has in place, a national numerical constraint on government Expenditure.	
Revenue Rule (*RR*)	Dummy Variable taking the value 1 if in a given year a country has in place, a national numerical constraint on government Revenue.	
Debt Rule (*DR*)	Dummy Variable taking the value 1 if in a given year a country has in place, a national numerical constraint on government Debt.	
Supranational Dummy	Dummy Variable taking the value 1 if in a given year a country has in place, a supranational numerical constraint on government fiscal aggregates.	
Structural Primary Fiscal Balance	Difference between General Government revenue and expenditure (excluding interest payments), adjusted for business fluctuations, as GDP percentage.	Author's calculations based on World Economic Outlook (WEO, 2010)
Structural Primary Expenditure	General government expenditure excluding interest payments, adjusted for business fluctuations, as GDP percentage.	
Government Debt	Gross General government debt, as GDP percentage	Ali Abbas et *al.* (2010)
Real per capita GDP growth rate	Annual growth rate of real output per capita	Penn World Table (PWT6.3)
Trade openness	Sum of imports and exports divided by GDP	
Real per capita GDP	GDP per capita at constant prices.	
Inflation	Annual growth rate of average CPI	World Economic Outlook (WEO, 2010)
Government stability	Index ranging from 0 to 12 and measuring the ability of government to stay in office and to carry out its declared program(s).The higher the index, the more stable the government is.	International Country Risk Guide (ICRG, 2009)
Quality of the bureaucracy	Index ranging from 0 to 4 and measuring the institutional strength and expertise that the bureaucracy has to govern without drastic changes in policy or interruptions in government services.	
Government Fractionalization	Index measuring the Probability that two deputies picked at random among from the government parties will be of different parties.	World Bank Database of Political Institutions (2010)
Dependency Ratio	Ratio of dependents (people younger than 15 or older than 64) to working-age population (those ages 15-64)	World Development Indicators (WDI, 2010)
Total Official reserves	Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities.	

Appendix 4.10: Strength of the instruments in the 2SLS estimations of the CAPB (key test statistics)

Country	1st step F-Statistic	Shea's Partial R^2	Country	1st step F-Statistic	Shea's Partial R^2
Albania	4,026	20,609	Jamaica	16,110	38,874
Algeria	13,495	40,149	Jordan	7,185	96,424
Angola	29,271	66,217	Kazakhstan	6,949	78,133
Argentina	19,860	39,684	Kenya	30,856	55,671
Azerbaijan	15,210	47,783	Korea, South	4,845	20,089
Bahrain	12,149	12,679	Latvia	54,175	85,632
Bangladesh	17,237	33,684	Lesotho	8,621	20,203
Belarus	14,547	68,915	Lithuania	15,126	39,706
Bolivia	38,734	58,501	Malaysia	25,590	42,945
Botswana	34,775	58,553	Mauritius	16,772	34,126
Brazil	14,882	32,015	Mexico	14,064	23,990
Bulgaria	30,449	68,911	Mongolia	21,202	51,623
Cameroon	67,185	73,437	Morocco	5,481	8,164
Cape Verde	5,934	2,560	Mozambique	5,291	8,672
Chad	13,706	27,429	Nigeria	19,133	34,812
Chile	11,241	24,787	Pakistan	24,702	27,497
China	29,767	87,034	Panama	14,167	32,855
Colombia	46,529	58,981	Paraguay	4,440	88,059
Congo	18,401	1,795	Peru	25,213	59,021
Costa Rica	12,219	49,645	Philippines	4,010	29,161
Cote d'Ivoire	38,633	53,911	Poland	6,978	29,281
Croatia	42,304	82,674	Romania	6,466	20,803
Czech Republic	14,792	62,529	Russia	33,342	41,799
Dominican Republic	14,208	48,548	Serbia	4,305	14,683
Ecuador	10,121	53,928	Slovakia	12,194	55,197
Egypt	16,883	28,922	South Africa	25,328	69,019
El Salvador	15,579	49,139	Sri Lanka	23,466	44,097
Estonia	18,083	74,633	Sudan	6,305	12,588
Fiji	4,012	2,602	Swaziland	14,378	29,410
Gabon	6,688	9,525	Syria	4,977	10,862
Georgia	8,767	41,462	Thailand	17,639	40,194
Guatemala	7,506	25,355	Trinidad & Tobago	6,130	35,457
Hungary	85,210	45,385	Tunisia	6,358	3,690
India	20,087	51,373	Turkey	7,325	23,807
Indonesia	338,076	98,888	Ukraine	97,600	98,079
Iran	17,732	41,941	Uruguay	23,414	47,324
Israel	4,005	53,022	Venezuela	10,001	35,960

Chapter 5

Does Inflation Targeting Improve Fiscal Discipline?

"*Inflation Targeting […] compels policymakers to deepen reforms, enhance transparency, and improve the fiscal stance*"
(E. Croce & M. Khan, Finance and Development, September 2000, Volume 37, Number 3, p.51)

5.1. Introduction

The present chapter of the dissertation extends the literature on the macroeconomic consequences of IT by focusing on the linkage between IT monetary regimes and fiscal policy. In addition to the monetarist view, which defends an exclusive role for monetary policy regarding inflation dynamics, an influential strand of the literature, inspired by the seminal contribution of Sargent & Wallace (1981), points out that fiscal policy can equally be a source of inflation (see, *e.g.*, Aiyagari & Gertler, 1985; Sims, 1988; or Leeper, 1991, for a discussion on price level determinacy, and Woodford's, 1994, fiscal theory of price level). Indeed, in a context of fiscal dominance (*i.e.* when fiscal balances evolve independently of public debt so that the equilibrium price level changes to ensure fiscal solvency), a restrictive monetary policy may even result in higher inflation if the main source of government funding is seigniorage, and if the fiscal balance is not adjusted after seigniorage receipts collapse (such a reasoning appears in Sims, 2011, who analyses the role of fiscal policy in the inflation of the 1970s).

These findings influenced the implementation of IT regimes. Indeed, in addition to conventional monetary preconditions (a sufficient degree of central bank operational independence, a sound financial system, a resilience to changes in exchange and interest rates, absence of dollarization, absence of price regulation, and the availability of a developed technical infrastructure for forecasting the inflation process and the transmission mechanism, see Amato & Gerlach, 2002; or Batini & Laxton, 2007), several authors, including Masson et *al.* (1997), Mishkin (2000), Sims (2004), or Bernanke & Woodford (2004), have expressed doubts on the feasibility of IT in the presence of fiscal dominance and/or a poor fiscal stance, and consequently suggested extending preconditions for IT adoption to sustainable fiscal policies.

However, contrary to the undeniable role of fiscal discipline (FD) as a prerequisite for IT implementation, little is said about the eventual effect of IT adoption on FD. The aim of the present chapter is to investigate precisely this possible reversed effect, *i.e.* could the adoption of IT lead to the improvement of the fiscal stance? This is all the more plausible since, as pointed out by Amato & Gerlach (2002) and Batini & Laxton (2007), most IT countries, and especially developing countries, did not satisfy the prerequisites for a credible IT adoption, including in terms of FD. Accordingly, to convince private agents and financial markets that

such bad fiscal stance prior to IT adoption will not be an impediment toward hitting the inflation target, a discipline-enhancing effect on the conduct of fiscal policy may have followed IT adoption in these countries. Consequently, even though IT is not directly devoted to fiscal goals, the fear of missing the inflation target may however be sufficiently binding for monetary, as well as for fiscal authorities, so that it will have a side effect on FD.[102] This stems from the fact that a credible adoption of IT requires the joint commitment of the central bank and the government in hitting the inflation target.[103] Moreover, good theoretical arguments suggest that, even if IT is primarily devoted to inflation goals, IT adoption could also lead to a FD improvement. We discuss these arguments with respect to two of the most important features of IT regimes, namely (i) credibility and (ii) commitment to a low (single digit) inflation target.

On the one hand, Roger (2009) and Freedman & Ötker-Robe (2010) stressed out that IT adoption may catalyze the implementation of FD for preserving the viability of the IT regime itself (a direct argument).[104] For example, according to Mishkin (2000), fiscal policy should be kept sound enough to eliminate any speculation regarding a possible monetization of public debt in the future, which would have dramatic consequences on the merely existence of the IT monetary regime.

On the other hand, the fact that IT regimes lead to low inflation rates (see, *e.g.*, Vega & Winkelried, 2005; Pétursson, 2005; Batini & Laxton, 2007; Mishkin & Schmidt-Hebbel, 2007; Gonçalves & Salles, 2008; or Lin & Ye, 2009) has multiple consequences on the way the government conducts fiscal policy (indirect, inflation-based, arguments). First, in light of the Tinbergen's rule, and given the overriding goal of price stability assigned to MP under IT, interest rates can no longer be used to achieve both price stability and fiscal solvency. Consequently, this is likely to leave the government with the improvement of FD as the only

[102] For example, IT may act as a "tying your own hands" mechanism and rule out the so-called "deficit bias" (Buchanan & Wagner, 1977; Kydland & Prescott, 1977; and Cukierman & Meltzer, 1986), by preventing fiscal authorities from manipulating fiscal policy for electoral purposes.

[103] This is why IT implementation goes along with the adoption of legislation measures prohibiting monetization of public debt, while in some countries the inflation target is jointly defined by the central bank and the government, in order to send a clear signal about their joint willingness to respect the inflation target (see Freedman & Ötker-Robe, 2010).

[104] The fact that IT may fail in anchoring credibly inflation expectations in a country with bad fiscal stance is well documented in the literature (see, *e.g.*, Loyo, 1999; Sims, 2004; Bernanke & Woodford; 2004, Favero & Giavazzi, 2005; or Blanchard, 2005).

main instrument to meet its intertemporal budget constraint.[105] Second, lower inflation rates weaken seigniorage revenue, a loss which can be compensated by either alternative financing sources (mainly taxes, since the public debt must be kept under strict control), or a better collection of resources, through a strengthening of the tax collection system.[106] Altogether, these arguments could support a possible increase in FD following the adoption of an IT monetary regime.

To explore the possible existence of an effect from IT to FD, we follow the very recent contributions of Vega & Winkelried (2005) and Lin & Ye (2007, 2009), and draw upon a variety of propensity scores-matching methods. Evidence based on a sample of both developing and developed countries shows that IT exerts a positive and significant effect on FD. To the best of our knowledge, this is the first study emphasizing such an effect running from IT towards FD. Besides, our result is found to be extremely robust when (i) using different measures of FD, (ii) considering alternative specifications for computing *propensity scores*, or (iii) when accounting for different definitions of IT *starting* dates (*i.e. conservative* or *default* dates).

Moreover, we extend our analysis by studying the relation between IT and FD on the group of developed, respectively developing countries. Although IT does not seem to exert a robust effect on FD in developed countries (the *ATT* is positive but not statistically significant), we show that developing countries significantly improved their FD following the adoption of an IT monetary regime. A possible explanation is that developed countries were judged by financial markets as presenting sustainable fiscal stance when they adopted IT, so their efforts to increase FD following IT adoption is not significant, while developing countries adopted IT despite the presence of potential risks on their fiscal stance, but were forced to improve their FD following IT adoption to maintain the durability of the IT regime.

[105] The same holds regarding the effect of IT on FD via the exchange rate channel. Since in an IT regime central banks should react to exchange rate movements only when they affect inflation, IT adoption should go hand in hand with more *de facto* flexible exchange rates (Roger, 2009), and, according to Tornell & Velasco (2000), with more FD.

[106] This strengthening of the tax collection system is all the more welcomed under an IT regime, since low inflation rates mitigate the negative Oliveira-Keynes-Tanzi effect (the erosion in the real value of taxes between the date of imposition and the date of collection decreases, see Tanzi, 1992), while the decrease in inflation volatility (outlined, among others, by Mishkin & Schmidt-Hebbel, 2007; Gonçalves & Salles, 2008; or Lin & Ye, 2009) allows stabilizing and making more predictable the tax base, improving therefore tax collection.

To sum up, our results have policy implications that could contribute to the current debate regarding the relevance of IT adoption in general, and particularly for developing countries. Indeed, whilst most existing studies simply point out that FD is a prerequisite for a credible adoption of IT, our findings, in addition to not denying this reality, go beyond it and suggest that IT adoption could enhance FD, especially in developing countries. Consequently, IT adoption, by improving FD, can maintain or strengthen macroeconomic stability, which is a key factor in the strength of a country's financial system, and hence a precondition for a strong and balanced long term economic growth (Fischer, 1993). Indeed, in the current context of financially integrated markets, weak FD and weak banking system may feed negatively on each other to compromise stability and growth, and even lead to economic and financial crises (Mishkin, 1996). Maintaining FD is also important in that it allows reducing the vulnerability of a country to interest rate and economic growth shocks. In addition, recent contributions (including Minea & Villieu, 2009; Kumar & Woo, 2010; Reinhart & Rogoff, 2010; or IMF, 2011d), emphasized that debt levels beyond certain thresholds may reduce economic growth, which itself might fuel the debt distress problem. Finally, sound fiscal policies may provide room for policymakers to foster economic growth through the provision of public goods (particularly physical and social infrastructures), and to conduct countercyclical fiscal policies to buffer the adverse effects of unexpected shocks (Chalk & Hemming, 1998).

The rest of the chapter is organized as follows. Section two briefly displays some stylized facts. Section three presents the dataset and discusses the methodology, section four shows the matching results, and then illustrates the influence of IT adoption on FD for the full sample and for developed and developing countries respectively, and section five concludes.

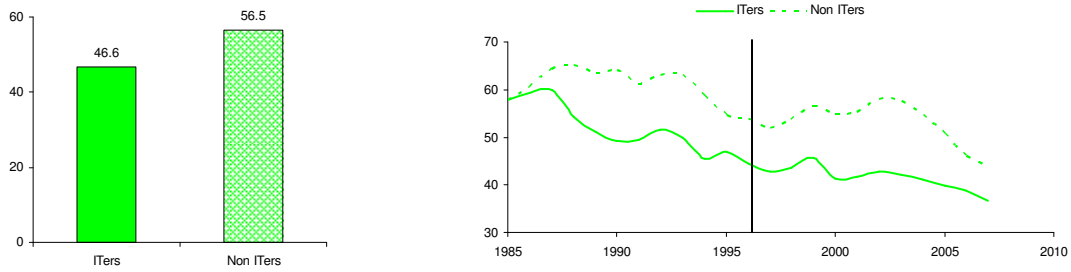
5.2. Stylized facts

Before introducing the dataset and describing the econometric methodology, let observe some stylized facts relating IT to primary aspects of FD, namely the Debt-to-GDP ratio as well as its relative change.

The left-hand chart of *Figure 5.1* shows that the average public debt (in % of GDP) is lower in the ITers, compared to the non-ITers. But this naive correlation cannot be evidence of

better FD recorded by the ITers, as it may only reflect a "*self-selection*" result, *i.e.* countries with lower public debt are those that more likely adopt IT. To mitigate this *self-selection* problem in IT adoption, we present in the right-hand chart of *Figure 5.1* the evolution of debt-to-GDP ratio for the ITers and the non-ITers, respectively. If we take as reference the middle year before the first IT adoption (1990, New Zealand) and the last IT adoption (2002, Peru and Philippines) for the countries in our sample, namely 1996, we can see that, although on average both ITers and non-ITers presented downward trends in their debt ratios before 1996, only ITers managed to maintain this decrease in the years just after 1996.

Figure 5. 1: Public debt (in % of GDP) in IT compared to non-IT countries

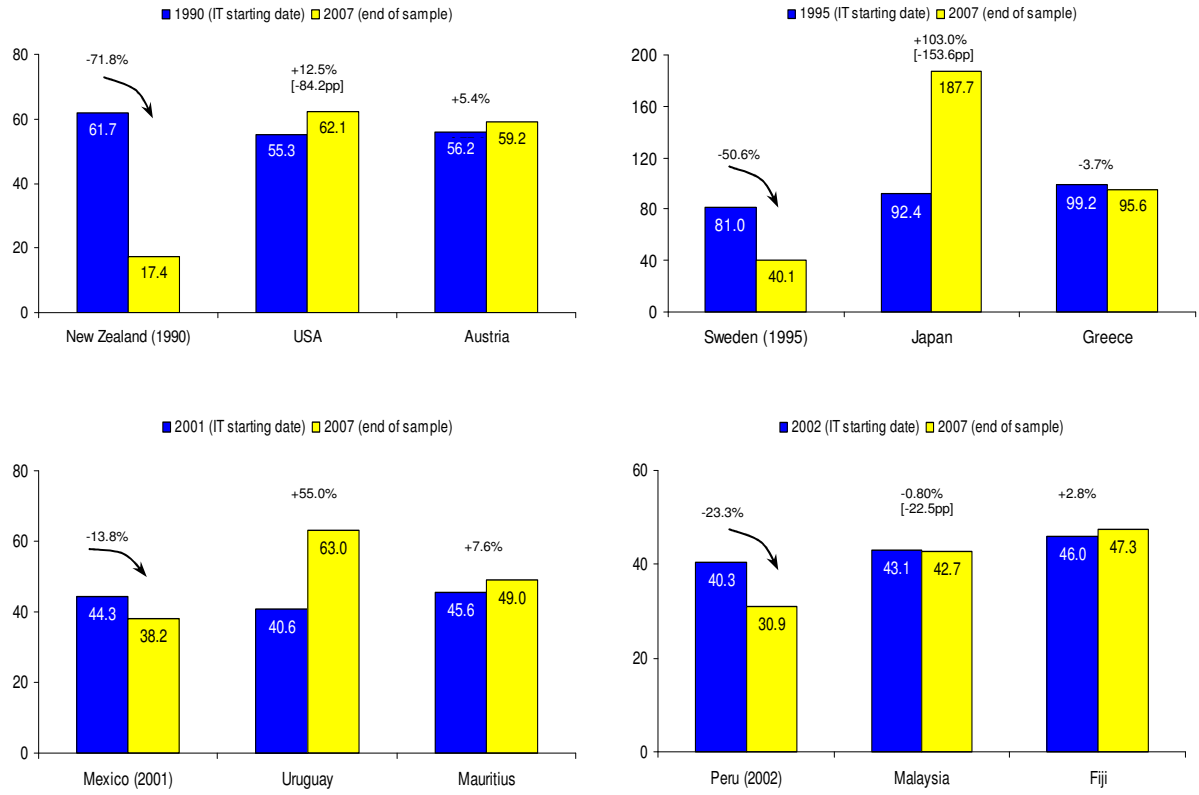


Note for Figures 1 and 2: data on public debt come from the recent database of Ali Abbas et *al.* (2010).

Of course, this interpretation may be criticized on the basis that it compares public debt evolution before and after a *common* year (1996) for IT adoption for all countries in the sample. *Figure 5.2* below illustrates one way to avoid this problem, by presenting statistics at country-level. For generality, we display countries having adopted IT at the beginning of our sample (namely, New Zealand, 1990, and Sweden, 1995) and at the end of our sample (namely, Mexico, 2001, and Peru, 2002). For each of these countries, we present the change in the debt-to-GDP ratio between the year of IT adoption and the last year of our sample (2007), as well as the change in the debt-to-GDP ratio between the same period for countries that have not adopted IT, but display relatively close debt-to-GDP ratios in the year of IT adoption of the ITers. As depicted by *Figure 5.2*, the debt ratio decreased in the ITers, while it increased (or at best changed marginally) in the non-ITers, during the same time period, and controlling for the fact that these countries presented relatively close debt ratios in the year of IT adoption. Consequently, *Figure 5.2* shows the existence of large discrepancies regarding the evolution of the debt ratio in ITers compared to non-ITers (the relative difference between the two categories of countries is presented in brackets, and is measured in percentage point changes). This therefore provides a first indication that IT adoption seems to improve FD.

But, is such a correlation corroborated by a more rigorous econometric analysis? Next sections of this chapter will focus on addressing this issue.

Figure 5. 2: The change in the debt-to-GDP ratio: ITers vs. non ITers



5.3. Dataset and methodology

5.3.1. Dataset

Our dataset consists of 84 countries, of which 62 developing and 22 developed countries, examined over the 1985-2007 period. Among the 84 countries, 28 countries (called ITers or *treatment* group) adopted IT by the end of 2007. Due to lack of data on FD, Romania and Serbia, which adopted IT in 2005 and 2006 respectively, do not appear in our sample. Moreover, given that our sample ends up in 2007, we still treat the new ITers as non ITers.[107] Accordingly, this leaves us with 23 ITers. In addition, to ensure that non-ITers (called *control* group) are a good counterfactual of the *treatment* group, *i.e.* the two groups are reasonably comparable, we follow Lin & Ye (2009) and include in the control group only non-ITers that have a real per capita GDP at least as large as that of the poorest ITer, and with a population

[107] New ITers are countries having adopted IT after 2005, namely Indonesia (2005), Slovak Republic (2005), Guatemala (2005), Turkey (2006) and Ghana (2007).

size at least as large as that of the smallest ITer.[108] The 23 ITers and the 61 control countries that satisfy these criteria are listed in *Appendices 5.1* and *5.2* respectively.[109]

Data on *starting* dates of IT come from Rose (2007), who distinguishes two dates, namely *default starting* years and *conservative starting* years (see *Appendix 5.1*).[110] For robustness issues, we perform our analysis on both dates.

Let us now discuss in detail our outcome variable, namely FD. Remark that despite the relative consensus among macroeconomists and policymakers regarding the crucial importance of FD in preserving macroeconomic stability, reducing vulnerabilities, and improving aggregate economic performance, there is no accurate definition of the concept of FD. Most of the time, FD is commonly associated with the notions of *fiscal policy sustainability* and *public debt sustainability*, which are two inter-related concepts whose analysis is a complex and multifaceted exercise. Both concepts are supposed to reflect at best the government's fiscal stance, and a simple rule of thumb that generally emerges from their analysis is that a government's fiscal policy will be regarded as *disciplined* if its fiscal policy, as well as its public debt, is sustainable (IMF, 2011d). First, *public debt sustainability* relates to the government long-term solvency: assuming that the interest rate on public debt exceeds the growth rate of the economy, the government's public debt will be said sustainable when its intertemporal budget constraint is met, namely when its debt-to-GDP ratio is stable (Bartolini & Cottarelli, 1994). Second, *fiscal policy sustainability* relates to the liquidity of the government's short-term assets, namely its ability to run primary fiscal balance capable of stabilizing the debt-to-GDP ratio without resorting to a fiscal adjustment and/or a debt restructuring.[111]

From an operational viewpoint, as underlined by Tornell & Velasco (2000), FD is defined and measured in terms of meeting some numerical thresholds on key fiscal aggregates, namely the

[108] The poorest ITer in our sample is Philippines with a real per capita GDP of 3994 USD in 2004 (the year just before the *starting* date of the new ITers), while the smallest ITer in terms of population size is Iceland, with around 0.3 million inhabitants in 2004.
[109] Finally, note that Finland and Spain, which adopted IT respectively in 1993 and 1995, abandoned it in 1999 to join the Euro area. We therefore treat them as ITers between 1993-1998 and 1995-1998, respectively, and as non-ITers after 1999.
[110] See chapter 1, *section 1.2.1* for further details on the differences between these two kinds of date.
[111] It is worth noting that a government's fiscal policy may be currently unsustainable, whereas its public debt can be regarded as sustainable. Indeed, the current level of the primary balance might not be sufficient to stabilize the debt-to-GDP ratio, but a sufficient fiscal adjustment would be realistic (both economically and politically) to bring the primary balance to a level that is necessary to service public debt.

fiscal balance and the *debt-to-GDP ratio*.[112] However, as emphasized by IMF (2011d), these thresholds should be employed flexibly to trigger in-depth analysis of the fiscal risks and fiscal vulnerabilities faced by a country, once its fiscal performances breach them, rather than considered as actual systematic indicators of FD. When it comes to performing econometric analysis regarding the FD, Bénassy-Quéré & Pisani-Ferry (1994) suggest measuring it with indicators derived from the accounting relationships between public debt and fiscal balances, namely the *annual change in the fiscal balance* (overall balance and/or primary balance) and the *annual change in the debt-to-GDP ratio*.

Nevertheless, the relevance of these indicators as actual measures of FD is subject to debate. As acknowledged in the literature (see, *e.g.*, Gali & Perotti, 2003; Fatás & Mihov, 2003; or, more recently, Debrun et *al.*, 2007a), fiscal balances are the result of fiscal decisions of policymakers (structural component) and the effects of business cycle fluctuations (cyclical component). Since the latter is not under the direct control of the government (at least in the short term), it is important to filter out the impact of business cycle fluctuations (automatic stabilizers) on the primary and/or overall fiscal balance, to better capture fiscal behavior. Accordingly, we measure FD by the (i) Cyclically-Adjusted Primary Fiscal Balance (CAPB) and the (ii) Cyclically-Adjusted overall Fiscal Balance (CAB) respectively, both as percentage of GDP.[113] In addition, for the sake of further robustness check, we also employ the (iii) relative change in the debt-to-GDP ratio as a subsequent alternative measure of FD (consistently with the stylized facts exposed in section 5.2). *Appendices 5.3* and *5.4* present the definitions, sources and descriptive statistics of all variables used in our analysis.

5.3.2. Methodology

We aim at evaluating the treatment effect of IT adoption on FD[114] in countries having adopted IT (ITers), namely the so-called *average treatment effect on the treated* (*ATT*)

$$ATT = E\left[\left(FD_{i1} - FD_{i0}\right)\middle|IT_i = 1\right] = E\left[FD_{i1}\middle|IT_i = 1\right] - E\left[FD_{i0}\middle|IT_i = 1\right], \quad (5.1)$$

[112] Such measures of FD appear in some monetary unions, as for example the EMU or the WAEMU. In the former case, FD is regarded as the ability of a government to maintain a fiscal balance (as percentage of GDP) and a debt-to-GDP ratio lower than 3% and 60% respectively, while in the latter these thresholds are set to 0% (for the basic balance) and 70% respectively.

[113] *Appendix 5.5* reveals the calculation of these two variables.

[114] Recall that we measure FD in three alternative ways, namely the Cyclically-Adjusted Primary fiscal Balance (CAPB), the Cyclically-Adjusted overall fiscal Balance (CAB) and the relative change in the debt-to-GDP ratio.

where IT_i is a dummy variable, which equals 1 if the country i is targeting inflation and 0 if not. $FD_{i1}|IT_i = 1$ measures the change in FD if country i has adopted IT, and $FD_{i0}|IT_i = 1$ measures the change in FD that would have been observed if the country i had not adopted IT. Equation (5.1) therefore compares the outcome value, namely FD, observed in the *treatment* group (ITers), with the outcome value that would have been observed in the same countries if they had not adopted IT. Unfortunately, it is not possible to observe this latter value, and we face here, as it is common in non-experimental studies, an identification problem. A conventional approach to circumvent this difficulty is to compare the mean of the variable FD for the *treatment* group (ITers), with its mean for the *control* group (non-ITers).

However, this solution holds provided that the assignment to the *treatment* is random; yet, IT adoption may be non-random, since it may be correlated with a set of observable variables that also affects the outcome variable (FD in our case), leading to the so-called "*self-selection*" problem.[115] Consequently, a simple comparison of the sample mean value of FD between the two groups would produce biased estimates of the *ATT*. To overcome this selection on observables problem, we make use of a variety of *propensity score-matching* methods recently employed in the related *treatment* literature (see, *e.g.* Vega & Winkelried, 2005; Lin & Ye, 2007, 2009; Lin, 2010; or Flood & Rose, 2010).

The consistency of the *ATT* estimate strongly depends on the relevance of the counterfactual (*control* or comparison) group. The *propensity score-matching* methods allow us to pair ITers with non-ITers that have similar observed characteristics, so that the difference between FD in ITers and FD in a matched counterfactual is attributable to the *treatment*, namely the IT adoption. The technique consists of mimicking a randomized experiment on the basis of observable characteristics (X), namely countries with the same observable characteristics face a randomized experiment, as to whether they adopt IT or not. The key assumption underlying this matching method is the conditional independence assumption, namely $FD_0 \perp IT|X$ and $FD_1 \perp IT|X$, which requires for, conditional on observables X , the outcomes FD_0 and FD_1 to be independent of the *treatment* variable. Under this assumption, equation (5.1) can be rewritten as

[115] See Heckman et *al.* (1998) and Dehejia & Wahba (2002). Also, note that the selectivity problem here is neither selection on unobservables (omitted variables), nor a Heckman-type sample selection problem (since matching on the *propensity scores* implicitly assumes that unobservables play no role in the *treatment* assignment).

$$ATT = E\left[FD_{i1}\middle|IT_i = 1, X_i\right] - E\left[FD_{i0}\middle|IT_i = 0, X_i\right], \tag{5.2}$$

where we replaced $E\left[FD_{i0}\middle|IT_i = 1, X_i\right]$ by $E\left[FD_{i0}\middle|IT_i = 0, X_i\right]$, which is observable. However, as the number of explanatory variables (X) increases, such a matching on X would be difficult to implement in practice. To overcome this high dimension problem, Rosenbaum & Rubin (1983) suggest carrying out the matching using *propensity scores*, instead of X, with the *propensity score* defined as the probability of adopting the IT regime conditional on the observable variables X, namely $p(X_i) = E\left[IT_i\middle|X_i\right] = \Pr\left(IT_i = 1\middle|X_i\right)$. Under the additional "common support" assumption (namely, $p(X_i) < 1$), requiring the existence of some comparable *control* units (non-ITers) for each *treated* unit (ITer), the *ATT* can be estimated as

$$ATT = E\left[FD_{i1}\middle|IT_i = 1, p(X_i)\right] - E\left[FD_{i0}\middle|IT_i = 0, p(X_i)\right]. \tag{5.3}$$

We consider four commonly used *propensity score-matching* methods. First, the *nearest-neighbor* matching with replacement, which matches each *treated* unit to the n *control* units having the closest *propensity scores* (we consider $n = 1$, $n = 2$ and $n = 3$). Second we draw on *radius* matching, which matches a *treated* unit to the *control* units with estimated *propensity scores* falling within a radius (or caliper) of length r (we consider a large radius $r = 0.10$, a medium radius $r = 0.05$, and a small radius $r = 0.01$).[116] The third method is the *regression-adjusted local linear matching* developed by Heckman et *al.* (1998). Finally, we employ (Epanechnikov) *kernel* matching, which matches a *treated* unit (an ITer) to all *control* units (non-ITers) weighted proportionately by their closeness (in terms of *propensity scores*) to the *treated* unit. Since the matching estimator has no analytical variance, we follow Dehejia & Wahba (2002) and compute standard errors by bootstrapping (*i.e.* by re-sampling the observations of the *control* group).

[116] As in Lin (2010), the medium radius is set equal to the standard deviation of the estimated propensity scores while the large and the small radius are set equal to the double and the half of the medium radius, respectively.

5.4. The influence of IT adoption on Fiscal Discipline (FD)

5.4.1. The estimation of propensity scores

We estimate the *propensity scores* using a *probit* model,[117] in which the dependent variable is a binary variable, taking the value 1 if in a given year a country operates under IT framework and zero if not. We consider two sets of explanatory variables, namely one to account for the fact that a country should reasonably adopt IT after having met some preconditions, and the other to account for the likelihood for a country to adopt an alternative framework for MP (for example, exchange rate or money growth targeting).

The precondition variables include lagged inflation rate, central bank governors' turnover rates (reverse proxy for independence of the central bank), lagged debt-to-GDP ratio, real per capita GDP growth rate and CAPB (or alternatively CAB or the change in the debt-to-GDP ratio). We expect a negative correlation between the probability of IT adoption and the first three variables and a positive correlation with the last two variables (except for the coefficient of the change in the debt-to-GDP ratio which is expected to be negative). Concerning the second set of controls, we consider a fixed exchange rate regime dummy and trade openness. We expect a negative correlation between the probability of IT adoption and these two variables.[118]

Before going any further, let us point out that past FD is included in the *probit* model in order to control for the fact that even though IT can improve FD (as we intend to show in this study), initial (past) fiscal stances could also be a determinant of IT adoption. Indeed, on the one hand, better fiscal balance (CAPB or CAB), or a past reduction in the debt-to-GDP ratio, may influence positively the probability of IT adoption. On the other hand, past fiscal performances can also affect current fiscal outcomes. First, poor past FD may be associated with high interests on the issued debt, which worsens current FD. Second, poor past FD can stimulate the government to proceed to adjustments for ensuring solvency, which improves current FD. Consequently, past fiscal aggregates, as measured by lagged CAPB, lagged CAB or lagged change in the debt-to-GDP ratio, may affect IT adoption as well as current FD, and

[117] Using a *Logit* model does not change the results.

[118] It is important to keep in mind that, when estimating *propensity scores*, the goal is not to find the best statistical model to explain the probability of IT adoption; according to the conditional independence assumption, omitting in the *probit* regression variables that systematically affect the targeting probability, but do not affect FD, has little influence on results (Persson, 2001).

their inclusion in the *probit* model allows ruling out to some extent any polluting effect arising from a likely two-way relationship between IT and FD.

Table 5. 1: *Probit* estimates of the Propensity Scores (Full Sample)

Dependent variable : Inflation Targeting (*Conservative starting* dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.102***	-0.102***	-0.101***	-0.102***	-0.102***	-0.083***	-0.102***
	(0.011)	(0.011)	(0.011)	(0.013)	(0.011)	(0.011)	(0.011)
Governors' turnover rate	-0.844**	-0.847**	-0.918***	-0.842**	-0.857**	-0.856**	-0.838**
	(0.363)	(0.359)	(0.349)	(0.366)	(0.358)	(0.383)	(0.364)
Debt/GDP (lagged one year)	-0.007***	-0.007***	-0.006***	-0.007***	-0.006***	-0.009***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Real per capita GDP growth rate	0.016	0.015	0.002	0.016	0.012	0.015	0.016
	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Fixed Exchange rate dummy	-1.450***	-1.456***	-1.374***	-1.449***	-1.408***	-1.404***	-1.450***
	(0.128)	(0.126)	(0.122)	(0.133)	(0.133)	(0.129)	(0.128)
Trade Openness	-0.005***	-0.005***	-0.004***	-0.005***	-0.005***	-0.003***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
CAPB (lagged one year)	0.024			0.024	0.028	0.006	0.024
	(0.021)			(0.021)	(0.020)	(0.021)	(0.021)
CAB (lagged one year)		0.016					
		(0.020)					
Debt Change (lagged one year)			-0.351				
			(0.303)				
Log of real per capita GDP				0.004			
				(0.101)			
Domestic credit to private sector					-9.42e-07		
					(2.17e-06)		
Fiscal rule dummy						0.625***	
						(0.148)	
Constant	1.116***	1.133***	0.912***	1.073	1.101***	0.719***	1.113***
	(0.184)	(0.181)	(0.168)	(1.065)	(0.188)	(0.194)	(0.185)
Number of observations	982	1030	1140	982	923	982	914
Pseudo R^2	0.341	0.347	0.325	0.341	0.341	0.365	0.323

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%. CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Table 5.1 above reports the *probit* estimates of *propensity scores* on the full sample, which includes both developing and developed countries, based on *conservative starting* dates of IT.[119] As expected, better monetary conditions (namely, low inflation) increase the IT adoption probability. The same also holds when the central bank is more independent, in the presence of good fiscal and macroeconomic performances (although the significance of the coefficient of the real per capita output growth rate is weak), or in more developed economies. Moreover, countries under a fixed exchange rate regime are found not to be interested in IT, confirming the conclusions of Amato & Gerlach (2002) regarding the incompatibility of IT with a rigid exchange rate regime. Finally, the stronger the (trade) openness, the lower the probability for a country to adopt an IT monetary system, since a more opened economy

[119] See *Appendix 5.A* for results based on *default starting* dates for IT adoption.

would favor a fixed exchange rate to foster trade integration (see, *e.g.*, Frankel & Rose, 2002).[120]

Let us now take a closer look at the way past fiscal performances impact on the adoption of an IT monetary regime. For robustness issues, we assume in the first three columns, alternative measures of FD, namely lagged CAPB (column [1]), lagged CAB (column [2]) and the lagged change in the debt-to-GDP ratio (column [3]). Despite having the expected sign, the coefficient of FD variables are not statistically significant, suggesting that, on the average, FD was not a key determinant of the decision of adopting IT when we consider the full sample.

To investigate the robustness of our results, we consider alternative specification for the computation of *propensity scores*. Keeping CAPB as the measure of FD,[121] we introduce progressively different control variables, namely the logarithm of real per capita GDP (proxy for the level of economic development) in column [4], the domestic credit to the private sector (proxy for financial development) in column [5], and a dummy variable which measures the presence/absence of fiscal rules in column [6]. Contrary to the first two control variables, the coefficient of the latter is significant, confirming that a credible adoption of IT may require the implementation of strong fiscal reforms, including binding rules-based fiscal frameworks (Roger, 2009; Freedman & Ötker-Robe, 2010). Finally, observe that our results are unaffected if we exclude hyperinflation episodes, namely annual inflation rates above 40%, as emphasized by regression [7].

5.4.2. The results from matching

Based on *propensity scores* estimated from regressions [1]-[7] presented in *Table 5.1*, we use equation (5.3) above to compute the *ATT* of IT adoption on FD.[122] As depicted by results on line [1] in *Table 5.2* below, whatever the matching estimator, the *ATT* coefficient is positive,

[120] In addition, the price level is highly subjected to movements in external prices in economies with a high openness degree, making the control of the price level by the central bank more difficult, and the adoption of an IT regime inappropriate.

[121] We consider that, out of the three measures of FD we employ, the CAPB reflects at best the concept of FD, since it focuses on fiscal performances attributable to current policymaking, namely it not only rules out the effects of past fiscal policies through the exclusion of interest payments, but also filters out the effects of automatic stabilizers.

[122] It is worth noting that we check the balancing properties of the *matches* using the standardized bias suggested by Rosenbaum & Rubin (1985). The results clearly reveal that the standardized biases for the matched data are all below the 3% or 5% rule of thumb (see Lechner, 1999; Sianesi, 2004; or Caliendo & Kopeinig, 2008), indicating that within the matched data, there is no significant difference between the ITers' observable characteristics and the non-ITers' observable characteristics (see *Appendix 5.F*).

and this positive effect is found to be statistically significant in 7 out of the 8 cases presented. Consequently, we find evidence supporting that IT adoption worked as a good device for increasing the CAPB. Moreover, robustness results presented on lines [2] and [3] show that IT adoption has equally increased the CAB, and decreased the growth rate of the public debt-to-GDP ratio (the *ATT* effect is significant in all 8 cases). Consequently, irrespective of its measure, FD is found to have benefited of the IT adoption. Moreover, the magnitude of this favorable effect is quite important, ranging between 0.56 and 1.01 percentage points for CAPB, between 0.85 and 1.45 percentage points for CAB, and between 4.9 and 9.1 percentage points for the change in the debt-to-GDP ratio.

In addition to alternative measures of FD, we check the robustness of our result in three ways. First, we present on lines [4]-[6] in *Table 5.2*, the *ATT* of IT adoption on FD based on *propensity scores* computed with additional control variables, namely the log of the real per capital GDP, the domestic credit to private sector, and the fiscal rule dummy, respectively. All *ATTs* are positive, and significant in at least 7 out of 8 cases, confirming that IT adoption improved FD. Second, we provide estimations on a sample excluding hyperinflation episodes; the sign and the significance (in all 8 cases) of *ATT* on line [7] show once again that IT improved FD. Finally, our findings still hold when computing *ATT* scores based on *default starting* dates of IT, as emphasized by *Appendix 5.A*.

Consequently, we show, for the first time to the best of our knowledge that the adoption of an IT monetary regime has worked as a good device for improving FD.[123] According to our estimations, the size of this effect is quite important, and as high as 1.65 percentage points if we measure FD by the CAPB.

[123] Recall that this result is obtained when controlling for the influence of past levels of CAPB (or alternatively CAB or the change in the debt-to-GDP ratio) on the probability of adopting IT, through its presence in the *probit* equations used to compute the IT adoption probability (see *Table 5.1* above).

Table 5. 2: The Influence of IT adoption on the Fiscal Discipline (FD) (Full sample)

Dependent Variable: CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *conservative starting* dates								
[1]: ATT	1.006**	0.698*	0.822*	0.572*	0.571**	0.599**	0.506	0.556*
	(0.486)	(0.367)	(0.428)	(0.292)	(0.244)	(0.262)	(0.399)	(0.298)
Number of Treated Obs.	135	135	135	135	135	135	135	135
Number of Controls Obs.	835	835	835	835	835	835	835	835
Total Observations (Obs.)	970	970	970	970	970	970	970	970
Robustness Checks								
Using alternative measures of Fiscal Discipline (FD) (instead of CAPB)								
[2]: Using CAB (GDP %)	0.833*	1.143*	1.083*	1.273***	1.350***	1.446***	1.275***	1.322***
	(0.425)	(0.658)	(0.571)	(0.444)	(0.434)	(0.389)	(0.484)	(0.431)
[3]: Using the relative change in the debt-to-GDP ratio	-0.091***	-0.065**	-0.055*	-0.053***	-0.052***	-0.049***	-0.050***	-0.052***
	(0.032)	(0.029)	(0.029)	(0.020)	(0.019)	(0.017)	(0.019)	(0.019)
Using CAPB as measure of FD, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	0.842*	0.741*	0.681*	0.638**	0.668**	0.670**	0.553*	0.643**
	(0.429)	(0.378)	(0.407)	(0.303)	(0.295)	(0.268)	(0.301)	(0.255)
[5]: Adding Domestic credit to private sector	1.180**	0.754**	0.579	0.581*	0.644**	0.673**	0.565*	0.642**
	(0.490)	(0.381)	(0.407)	(0.322)	(0.284)	(0.263)	(0.311)	(0.298)
[6]: Adding Fiscal rule dummy	1.346*	1.188**	1.042*	1.039*	1.109**	1.308***	0.835*	1.118**
	(0.725)	(0.589)	(0.580)	(0.551)	(0.453)	(0.387)	(0.439)	(0.471)
[7]: No hyperinflation episodes	1.649**	1.396**	1.577***	1.325***	1.307***	1.355***	1.278***	1.293***
	(0.714)	(0.623)	(0.605)	(0.500)	(0.391)	(0.440)	(0.468)	(0.433)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

We investigate in the following the pertinence of our results, by accounting for eventual differences in the group of developed, compared to the group of developing countries.

5.4.3. The effect of IT on FD: developed *versus* developing countries

We first analyze the effect of IT adoption on FD in the group of *developed* countries, which consists of 22 countries, namely 8 ITers and 14 non-ITers. The results of the *probit* equations used to compute *propensity scores*, presented in *Appendix 5.B*, are close to those performed on the full sample (see *Table 5.1* above), in terms of sign and significance of the estimated coefficients. In particular, we find again that FD seems not to have exerted a significant effect on the probability of adopting IT. These results remain robust when using different measures for FD, when accounting for additional determinants of IT adoption, or when excluding hyperinflation episodes (see regressions [1]-[7] in *Appendix 5.B*). Based on these *propensity scores*, *Table 5.3* illustrates the *ATT* of IT adoption on FD.

Compared to our findings for the full sample, results on line [1] of *Table 5.3* below show that the *ATT* of IT on FD is not statistically significant (although still with the positive sign) for the group of developed countries. Using different measures of FD (see lines [2] and [3]), adding additional variables (see lines [4] to [6]), or excluding hyperinflation episodes (see line [7]) does not dramatically affects our findings.[124] Consequently, although we detect some signs of a FD improvement in developed countries following IT adoption, this effect is not statistically significant. One possible explanation for the lack of a robust effect of IT on FD is that, at the time the IT regime was adopted, developed countries presented already strong fiscal institutions and a fiscal stance that was judged as sustainable by financial markets. Since the fiscal stance prior to IT adoption was strong enough to support the good functioning of, and the commitment to the IT framework, the pressure for performing important FD reforms following the IT adoption is weak in these countries.

[124] Except for some specifications (see line [5] in *Table 5.3* and *Appendix 5.C* based on *default starting* dates).

Table 5. 3: The Influence of IT on the Fiscal Discipline (FD) (*Developed* countries subsample)

Dependent Variable: CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *conservative starting* dates								
[1]: ATT	0.868	1.490	1.278	0.788	1.293	0.992	1.129	1.308
	(1.125)	(0.988)	(0.954)	(0.938)	(0.928)	(0.789)	(0.926)	(1.024)
Number of Treated Obs.	80	80	80	78	78	78	80	80
Number of Controls Obs.	269	269	269	269	269	269	269	269
Total Observations (Obs.)	349	349	349	347	347	347	349	349
Robustness Checks								
Using alternative measures of Fiscal Discipline (FD) (instead of CAPB)								
[2]: Using CAB (GDP %)	0.887	0.497	0.294	0.486	0.704	0.586	0.512	0.699
	(0.923)	(0.874)	(0.904)	(0.672)	(0.694)	(0.571)	(0.684)	(0.588)
[3]: Using the relative change in the debt-to-GDP ratio	-0.021	-0.012	-0.004	-0.014	-0.007	-0.014	-0.014	-0.009
	(0.030)	(0.027)	(0.030)	(0.023)	(0.020)	(0.016)	(0.017)	(0.019)
Using CAPB as dependent variable, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	0.374	0.132	0.0855	0.456	0.275	0.321	0.676	0.421
	(1.129)	(1.068)	(0.944)	(0.759)	(0.854)	(0.791)	(0.997)	(0.826)
[5]: Adding Domestic credit to private sector	1.786	1.735	1.823*	1.567*	1.569*	1.452*	1.350	1.614*
	(1.263)	(1.081)	(1.018)	(0.914)	(0.932)	(0.794)	(0.926)	(0.973)
[6]: Adding Fiscal rule dummy	-0.994	-1.299	-0.844	-0.691	-1.392	-0.912	-1.132	-1.365
	(1.215)	(1.203)	(1.249)	(0.939)	(1.110)	(0.984)	(1.092)	(0.987)
[7]: No hyperinflation episodes	0.868	1.490	1.278	0.788	1.293	0.992	1.129	1.308
	(0.855)	(0.914)	(1.073)	(0.864)	(0.906)	(0.690)	(0.805)	(0.830)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Let now focus on the effect of IT on FD for the group of *developing* countries, which covers 62 countries, namely 18 ITers and 44 non-ITers. The analysis of *probit* regressions [1] in *Appendix 5.D* reveals that, contrary to results for developed countries, the estimated coefficient for the CAPB is positive and significant. The same holds when we consider additional variables, when we abstract from hyperinflation episodes (see columns [4]-[7]), or when we use the CAB as alternative measure of past fiscal performance (Column [2]).[125] Consequently, we reveal that even though developing ITers adopted IT without having met the fiscal prerequisites (see Amato & Gerlach, 2002; or Batini & Laxton, 2007), they had better fiscal stances compared to developing countries non-ITers prior to IT adoption.

Based on these *propensity scores*, we display on line [1] of *Table 5.4*, the *ATT* of IT on the FD (measured by the CAPB), which we find to be significantly positive in 7 out of the 8 considered cases. In addition, subsequent results reported on lines [2]-[3] confirm that our findings are robust to alternative measures of FD. According to our estimations, the adoption of full-fledged IT regimes increased the CAPB by a value ranging between 1.85 (for $n=3$) and 3.43 (for $n=1$) percentage points, the CAB by 1.30 (for local linear regression matching) and up to 2.83 (for $n=1$) percentage points, and decreased the change in the public debt-to-GDP ratio by a range between 16.0 (for local linear regression matching) and 24.3 (for $n=3$) percentage points.[126]

Moreover, we question the robustness of the significance and the size of these favorable effects by presenting in the lower part of *Table 5.4* matching results based on alternative specifications for the computation of *propensity scores*. Irrespective of the additional variables we consider, the *ATT* of IT on FD is positive and significant in at least 7 out of the 8 cases displayed on each of lines [4]-[6], a result which still holds when excluding hyperinflation episodes on line [7]. In addition, the size of the positive effect on the CAPB is comparable to its size in the benchmark case depicted on line [1], namely between 1.34 ($r=0.03$ on line [6]) and 3.40 (for $n=1$ on line [5]) percentage points. Finally, *Appendix 5.E* illustrates that the favorable effect of IT on FD is qualitatively unchanged when accounting for *default*, instead of *conservative* IT *starting* dates.

[125] The change in the debt-to-GDP ratio is not found to significantly influence the IT adoption probability (see column [3], *Appendix 5.D*), while it turned to be significant when using the *default starting* dates (see column [3], *Appendix 5.E.1*); however, in both cases, IT adoption is found to have decreased the change in the debt-to-GDP ratio in ITers compared to non-ITers with comparable characteristics.

[126] The sign of the *ATT* of IT on different measures of FD is still the same if we consider soft IT regimes based on default starting dates (see *Appendix 5.E*).

Table 5. 4: The Influence of IT on the Fiscal Discipline (FD) (*Developing* countries subsample)

Dependent Variable: CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *conservative starting* dates								
[1]: ATT	3.426**	1.747	1.853*	2.064**	2.068**	2.353**	3.279**	2.378**
	(1.590)	(1.243)	(1.119)	(0.870)	(1.042)	(1.131)	(1.343)	(1.036)
Number of Treated Obs.	55	55	55	41	45	51	55	48
Number of Controls Obs.	566	566	566	566	566	566	566	566
Total Observations (Obs.)	621	621	621	607	611	617	621	614
Robustness Checks								
Using alternative measures of Fiscal Discipline (FD) (instead of CAPB)								
[2]: Using CAB (GDP %)	2.831*	1.851	2.118**	1.313*	1.414*	1.243	1.299*	1.596*
	(1.446)	(1.551)	(1.080)	(0.669)	(0.721)	(1.053)	(0.773)	(0.906)
[3]: Using the relative change in the debt-to-GDP ratio	-0.169*	-0.203*	-0.243**	-0.180**	-0.180**	-0.181**	-0.160**	-0.181**
	(0.100)	(0.112)	(0.107)	(0.0874)	(0.0888)	(0.0727)	(0.0809)	(0.0921)
Using CAPB as dependent variable, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	3.010**	2.560**	2.354**	2.048**	1.871*	1.932**	3.203**	2.042**
	(1.186)	(1.243)	(1.093)	(0.932)	(1.011)	(0.873)	(1.301)	(1.019)
[5]: Adding Domestic credit to private sector	3.403**	2.396**	2.155**	1.313	1.923*	2.390**	3.381**	2.188**
	(1.580)	(1.166)	(1.020)	(0.908)	(0.989)	(1.027)	(1.395)	(0.973)
[6]: Adding Fiscal rule dummy	1.823	2.616**	1.973**	1.340*	1.435*	1.497**	1.955*	1.406*
	(1.330)	(1.210)	(1.005)	(0.705)	(0.755)	(0.764)	(1.164)	(0.851)
[7]: No hyperinflation episodes	3.318**	1.755	1.835*	2.060**	2.075**	2.348**	3.326**	2.393**
	(1.686)	(1.411)	(1.028)	(0.868)	(1.043)	(1.144)	(1.358)	(1.111)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

The fact that IT adoption has a significant effect on FD only in developing countries is undoubtedly related to the fact that these countries have specific structural characteristics, which distinguish them from developed countries. In particular, developing countries present weak institutions, and seigniorage revenues still represent a substantial share of government revenue, making central banks less independent and less credible compared to central banks in developed countries (see Masson et *al.*, 1997; Calvo & Mishkin, 2003; or Jonas & Mishkin, 2004). In addition, many developing countries adopted IT despite displaying, at the time of IT adoption, fiscal stances that were judged as doubtful in terms of sustainability, or simply poor fiscal stance (compared to developed countries), as emphasized by Amato & Gerlach (2002) or Batini & Laxton (2007). Consequently, a radical improvement in the FD is necessary following the IT adoption, in order to send strong signals regarding the commitment of authorities in meeting the target established by the IT monetary regime, and from a larger standpoint, the commitment to preserve the IT viability.

5.5. Conclusion

The present chapter adds to the literature on the macroeconomic consequences of IT by studying, for the first time to the best of our knowledge, the link between IT and fiscal discipline (FD). Indeed, although the role of FD as a precondition for IT adoption was previously analyzed, little is said about the way IT adoption could influence the FD. Using a sample and an econometric method that allow comparability with previous studies focusing on the IT performances, we develop the existing literature in several directions. First, based on matching techniques applied on a sample of both developing and developed countries, we show that IT adoption significantly improved FD in ITers compared to non-ITers with close observable characteristics. Our result is extremely vigorous, in both sign and magnitude, when performing different robustness tests, including alternative measures of FD, alternative specifications for the computation of *propensity scores*, the use of *conservative* or *default starting* dates for IT adoption, or a wide variety of matching methods. Consequently, we extend the literature focusing on FD as a precondition for IT adoption, by showing that IT adoption exerted a favorable effect on FD. Second, to deal with the possible heterogeneity in our full sample, we investigate the role of IT adoption on FD by considering alternatively developed and developing countries. Contrary to developed countries, where IT adoption does not seem to have significantly improved FD (the effect we display presents the right sign but

with little statistical significance), our results illustrate that developing countries having adopted IT experienced a significant improvement in their fiscal stance. A possible explanation of our findings builds on the idea that, contrary to developed countries, developing countries were forced to improve their FD following IT adoption, in order to send clear signals about their commitment to preserve the IT viability (i.e. the fear of missing the inflation target urged their government to improve fiscal policy), given that at the time of the adoption these developing countries presented unsustainable and/or poor fiscal stance (see, *e.g.*, Amato & Gerlach, 2002; or Batini & Laxton, 2007), and/or less independent and less credible central banks compared to developed countries (see, *e.g.*, Calvo & Mishkin, 2003; or Jonas & Mishkin, 2004).

Finally, we provide an evaluation of the contribution of IT adoption to the improvement in FD. According to our analysis, IT adoption alone led to a statistically significant gap between ITers and non-ITers regarding all considered measures of FD, a gap which we estimate at as high as +1.6 percentage points for the CAPB (+1.5 for the CAB and -9.1 percentage points for the change in the debt-to-GDP ratio) if we consider the full sample, and +3.4 percentage points for the CAPB (+2.8 for the CAB and -24.3 percentage points for the change in the debt-to-GDP ratio) for the group of developing countries.

Our findings are particularly appealing as they may contribute to the discussion regarding the performances of IT regimes, all the more that an impressive number of countries (more than 35, according to Batini et *al.*, 2006, p.8), are currently exploring the possibility of implementing IT frameworks. Indeed, in addition to previous studies having explored only the role of FD as a prerequisite for a credible adoption of IT, our results suggest that the adoption of an IT monetary regime enhances FD. Particularly for developing countries, IT appears as a tool to "tie your own hands", and could allow them to create a sound and stable macroeconomic environment, which is, all the more in the current context of globalizing financial markets, a key prerequisite for strong and sustained economic growth.

This finding that IT, a MP framework (as opposed to a fiscal policy framework) affects fiscal authorities' behaviors, then constitutes a fertile ground for assuming that MP and fiscal policy frameworks should not be considered separately when it comes to assessing their macroeconomic consequences. Their potential interactions need to be taken into account, an issue that we address in the next chapter of the thesis.

Appendices

Appendix 5.1: The list of the ITers, together with their *starting* dates

Countries	Soft IT: *Default starting* dates	Full-Fledged IT: *Conservative starting* dates
Australia#	March 1993	September 1994
Brazil*	June 1999	June 1999
Canada#	February 1991	January 1992
Chile*	January 1991	August 1999
Colombia*	September 1999	October 1999
Czech Republic*	January 1998	January 1998
Finland#	February 1993	January 1994
Hungary*	June 2001	August 2001
Iceland#	March 2001	March 2001
Israel*	January 1992	June 1997
Mexico*	January 1999	January 2001
New Zealand#	March 1990	March 1990
Norway#	March 2001	March 2001
Peru*	January 2002	January 2002
Philippines*	January 2002	January 2002
Poland*	September 1998	September 1998
South Africa*	February 2000	February 2000
South Korea*	April 1998	April 1998
Spain#	January 1995	January 1995
United Kingdom#	October 1992	October 1992
Sweden#	January 1993	January 1995
Switzerland#	January 2000	January 2000
Thailand*	May 2000	May 2000
New ITers (still treated as non-ITers in our study)		
Indonesia*	July 2005	July 2005
Romania*	August 2005	August 2005
Slovak Republic*	January 2005	January 2005
Guatemala*	January 2005	January 2005
Turkey*	January 2006	January 2006
Serbia*	September 2006	September 2006
Ghana*	January 2007	January 2007

Source: Rose (2007) and Roger (2009). Due to lack of data on fiscal discipline, Romania and Serbia do not appear in our sample. *: Developing Countries; #: Developed Countries.

Appendix 5.2: Control group (* Developing Countries; # Developed Countries)

Albania*	Croatia*	Ghana*	Malta*	Sri Lanka*
Algeria*	Cyprus*	Greece#	Malaysia*	Swaziland*
Argentina*	Germany#	Guatemala*	Mauritius*	Trinidad and Tobago*
Austria#	Denmark#	Ireland#	Morocco*	Tunisia*
Azerbaijan*	Dominican Republic*	Iran*	Panama*	Turkey*
Belgium#	Ecuador*	Italy#	Paraguay*	Ukraine*
Bulgaria*	Egypt*	Indonesia*	Portugal#	Uruguay*
Bahrain*	Estonia*	Jamaica*	Russian Federation*	United States#
Bahamas*	Finland#	Jordan*	El Salvador*	Venezuela*
Belarus*	Fiji*	Japan#	Singapore*	
Botswana*	France#	Kazakhstan*	Slovak Republic*	
Cape Verde*	Gabon*	Latvia*	Slovenia*	
Costa Rica*	Georgia*	Lithuania*	Spain#	

Appendix 5.3: Sources and definitions of data

Public Debt (% of GDP)	Gross General government debt, in percentage of GDP	Ali Abbas et *al.* (2010)
Change in the public debt-to-GDP ratio	Difference between current Debt/GDP and lagged Debt/GDP, divided by lagged Debt/GDP.	Authors' calculations
CAPB	Cyclically-Adjusted Primary fiscal Balance, as GDP percentage.	Authors' calculations (see *Appendix 5.5*), based on general government fiscal balances data from WEO (2010)
CAB	Cyclically-Adjusted fiscal Balance, as GDP percentage.	
Full-Fledged or Formal IT (*conservative starting* dates) Soft or Informal IT (*default starting* dates)	Binary variable taking the value 1 if in a given year a country operates formally under IT, zero otherwise. When we use the conservative starting dates of IT, we refer to full-fledged IT. Binary variable taking the value 1 if in a given year a country operates informally under IT, zero otherwise. When we use the default starting dates of IT, we refer to soft IT.	Rose (2007) and Roger (2009)
Real per capita GDP growth rate Real per capita GDP Trade openness	Annual growth rate of real per capita output GDP per capita at constant prices. Proxy for country's level of economic development. Sum of imports and exports divided by GDP	Penn World Table (PWT.6.3)
Inflation rate	Annual growth rate of average CPI	World Economic Outlook (2010)
Fiscal rule dummy	Binary variable taking the value 1 if a country placed, at the national level, a numerical limit on fiscal aggregates (fiscal balance, expenditure, revenue or debt)	Fiscal Rules Database of the IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division (2009)
Domestic credit to the private sector	Credit offered by domestic banks to private sector. Proxy for financial development or credit constraints	World Development Indicators (WDI, 2010)
Governors' Turnover rate	Central Banks Governors Turnover rates. Reverse proxy of central bank independence.	Ghosh et *al.* (2003)
Fixed Exchange rate	Dummy variable taking the value 1 if a country is classified as having a de facto fixed exchange rate regime (hard or soft peg).	Reinhart & Rogoff (2004)

Appendix 5.4: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Full-Fledged IT	1978	0.111	0.314	0.000	1.000
Soft IT	1978	0.121	0.327	0.000	1.000
Inflation rate	1838	41.444	287.306	-11.374	7481.691
CAPB	1512	0.045	3.098	-14.006	21.569
CAB	1587	-0.055	3.546	-24.575	22.274
Debt (% of GDP)	1745	53.905	31.464	3.241	289.554
Change in the debt-to-GDP ratio	1633	0.002	0.205	-0.546	3.331
Fixed Exchange rate dummy	1816	0.572	0.495	0.000	1.000
Trade Openness	1871	80.638	50.651	10.094	456.562
Governor's Turnover Rates	1478	0.245	0.236	0.000	1.200
Real per capita GDP growth rate	1857	2.549	4.735	-26.117	34.175
Log of real per capita GDP	1871	9.275	0.751	7.035	10.787
Fiscal rules Dummy variable	1978	0.257	0.437	0	1
Domestic credit to the private sector	1740	1797.849	15823.220	-72.994	194889.500

Appendix 5.5: Computation of the Cyclically-Adjusted Primary fiscal Balance (CAPB)

For each country i of our sample, the CAPB is computed as the estimated residuals ($\hat{\varepsilon}^i$) of the following country-specific equation (with t the time period)

$$PB_t^i = \alpha + \beta PB_{t-1}^i + \gamma OG_t^i + \delta W_t^i + \varepsilon_t^i, \qquad \forall i, \tag{5.A1}$$

where *PB* denotes the primary fiscal balance[127] in % of GDP, *OG* the output gap and *W* a vector of control variables. As control variables, we include inflation and a time trend. For each country, we compute the output gap as $OG_t = (y_t - \bar{y})/\bar{y}$, where y_t stands for the logarithm of real per capita GDP in the year t, and $\bar{y}$ for the Hodrick-Prescott (HP) filtered trend of y_t. When applying the HP filter, despite a certain consensus for the use of a smoothing parameter of $\lambda = 1600$ for quarterly data (see the seminal paper of Hodrick & Prescott, 1997, for a discussion), the related literature emphasized different values for λ for annual data. According to Ravn & Uhlig (2002), if we consider that quarterly data are of frequency 1, then annual data are of frequency 1/4, and the smoothing parameter for annual data can be computed as $\lambda = (1/4)^n * 1600$, with n an integer. In our computations we follow Ravn & Uhlig (2002), who recommend the value $n = 4$, leading to a smoothing parameter of $\lambda = 6.25$ for annual data (results for $\lambda = 100$, corresponding to $n = 2$, as suggested by Backus & Kehoe, 1992, do not lead to any qualitative change in our results and are available upon request). The coefficient γ measures the cyclical response of fiscal policy to business cycle fluctuations, and the error term ε_t measures the unsystematic component of fiscal policy. The predicted value of this latter captures the part of the primary fiscal balance unexplained by economic conditions, and is our main measure of fiscal discipline (CAPB). Finally, to correct for a potential endogeneity of output gap in equation (5.A1), we use the two stages least squares method (2SLS) estimator, in which we instrumented *OG* with its lagged value and the growth rate of the terms of trade.

[127] The same applies for the Cyclically-Adjusted fiscal Balance (CAB), in which case we consider the overall fiscal balance instead of the primary fiscal balance.

Appendix 5.A: Full Sample, based on *Default* starting dates

Table 5.A.1: *Probit* estimates of the Propensity Scores (Full Sample)

Dependent variable: Inflation Targeting (*Default Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.079***	-0.078***	-0.073***	-0.073***	-0.078***	-0.065***	-0.078***
	(0.010)	(0.009)	(0.009)	(0.012)	(0.010)	(0.010)	(0.010)
Governors' turnover rate	-0.600*	-0.584*	-0.710**	-0.579*	-0.612*	-0.589*	-0.590*
	(0.336)	(0.329)	(0.310)	(0.340)	(0.329)	(0.346)	(0.337)
Debt/GDP (lagged one year)	-0.006***	-0.007***	-0.005***	-0.006***	-0.005**	-0.007***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Real per capita GDP growth rate	0.027*	0.027*	0.014	0.027*	0.023	0.026*	0.026*
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Fixed Exchange rate dummy	-1.507***	-1.535***	-1.448***	-1.486***	-1.461***	-1.470***	-1.507***
	(0.124)	(0.123)	(0.117)	(0.125)	(0.128)	(0.124)	(0.124)
Trade Openness	-0.006***	-0.006***	-0.004***	-0.006***	-0.006***	-0.004***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
CAPB (lagged one year)	0.012			0.012	0.016	-0.001	0.012
	(0.020)			(0.020)	(0.019)	(0.020)	(0.020)
CAB (lagged one year		0.015					
		(0.019)					
Debt Change (lagged one year)			-0.369				
			(0.329)				
Log of real per capita GDP				0.085			
				(0.099)			
Domestic credit to private sector					-2.01e-06		
					(2.22e-06)		
Fiscal rule dummy						0.456***	
						(0.140)	
Constant	1.055***	1.106***	0.848***	0.188	1.037***	0.757***	1.049***
	(0.181)	(0.177)	(0.162)	(1.037)	(0.183)	(0.190)	(0.181)
Number of observations	982	1030	1140	982	923	982	914
Pseudo R^2	0.333	0.343	0.313	0.334	0.331	0.345	0.314

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.
CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Table 5.A.2: The Influence of IT adoption on the Fiscal Discipline (FD) (Full sample)

Dependent Variable : CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *default starting* dates								
[1]: ATT	0.913*	0.450	0.339	0.605**	0.609**	0.553**	0.505*	0.605**
	(0.519)	(0.424)	(0.421)	(0.280)	(0.306)	(0.270)	(0.258)	(0.292)
Number of Treated Obs.	142	142	142	142	142	142	142	142
Number of Controls Obs.	820	820	820	820	820	820	820	820
Total Observations (Obs.)	962	962	962	962	962	962	962	962
Robustness Checks								
Using alternative measures of fiscal discipline (instead of CAPB) as measure of Fiscal Discipline (FD)								
[2]: Using CAB (GDP %)	1.108	1.659***	1.573**	1.182***	1.141***	1.231***	1.003**	1.120***
	(0.850)	(0.608)	(0.738)	(0.453)	(0.402)	(0.358)	(0.433)	(0.414)
[3]: Using the relative Change in the Debt-to GDP ratio	-0.040	-0.043*	-0.055*	-0.058***	-0.058***	-0.059***	-0.056***	-0.058***
	(0.038)	(0.022)	(0.030)	(0.020)	(0.016)	(0.017)	(0.017)	(0.017)
Using CAPB as dependent variable, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	0.949*	0.672*	0.762*	0.475*	0.499*	0.533*	0.434*	0.473*
	(0.549)	(0.354)	(0.451)	(0.250)	(0.262)	(0.281)	(0.221)	(0.241)
[5]: Adding Domestic credit to private sector	0.952	1.265**	1.147*	1.286***	1.445***	1.475***	1.294***	1.400***
	(0.749)	(0.598)	(0.601)	(0.488)	(0.428)	(0.373)	(0.423)	(0.418)
[6]: Adding Fiscal rule dummy	1.517**	0.690	0.704*	0.798**	0.827**	0.877***	0.616**	0.839***
	(0.593)	(0.529)	(0.359)	(0.350)	(0.323)	(0.269)	(0.310)	(0.324)
[7]: No hyperinflation episodes	1.926***	1.621***	1.479**	1.512***	1.507***	1.462***	1.433***	1.514***
	(0.669)	(0.612)	(0.579)	(0.423)	(0.445)	(0.407)	(0.394)	(0.396)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 5.B: *Probit* estimates of the Propensity Scores (*Developed* Countries)

Dependent variable : Inflation Targeting (*Conservative Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.189***	-0.203***	-0.155***	-0.253***	-0.213***	-0.158***	-0.189***
	(0.057)	(0.055)	(0.052)	(0.062)	(0.061)	(0.061)	(0.057)
Governors' turnover rate	-1.612**	-1.688***	-1.471**	-1.536**	-1.574**	-1.771***	-1.612**
	(0.636)	(0.642)	(0.586)	(0.646)	(0.613)	(0.666)	(0.636)
Debt/GDP (lagged one year)	-0.012***	-0.013***	-0.010***	-0.013***	-0.013***	-0.014***	-0.012***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Real per capita GDP growth rate	0.055	0.057	0.034	0.042	0.034	0.048	0.055
	(0.036)	(0.037)	(0.035)	(0.035)	(0.037)	(0.038)	(0.036)
Fixed Exchange rate dummy	-1.078***	-1.082***	-0.970***	-1.340***	-0.949***	-1.053***	-1.078***
	(0.193)	(0.194)	(0.189)	(0.212)	(0.214)	(0.194)	(0.193)
Trade Openness	0.006**	0.006**	0.006**	0.007**	0.009**	0.007**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
CAPB (lagged one year)	-0.031			-0.032	-0.024	-0.066	-0.031
	(0.038)			(0.036)	(0.037)	(0.041)	(0.038)
CAB (lagged one year)		-0.064					
		(0.041)					
Debt Change (lagged one year)			-0.786				
			(1.017)				
Log of real per capita GDP				-1.588***			
				(0.447)			
Domestic credit to private sector					1.63e-06		
					(2.75e-06)		
Fiscal rule dummy						0.650***	
						(0.212)	
Constant	0.883***	0.930***	0.580**	17.37***	0.892***	0.472	0.883***
	(0.302)	(0.297)	(0.285)	(4.713)	(0.332)	(0.346)	(0.302)
Number of observations	354	358	365	354	296	354	354
Pseudo R^2	0.260	0.270	0.223	0.291	0.250	0.288	0.260

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.
CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Appendix 5.C: Developed Countries, based on *Default* starting dates

Table 5.C.1: *Probit* estimates of the Propensity Scores (*Developed* Countries)

Dependent variable: Inflation Targeting (*Default Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.194***	-0.214***	-0.145***	-0.270***	-0.218***	-0.170***	-0.194***
	(0.054)	(0.052)	(0.048)	(0.059)	(0.058)	(0.058)	(0.054)
Governors' turnover rate	-1.692***	-1.723***	-1.394**	-1.636**	-1.656***	-1.844***	-1.692***
	(0.636)	(0.629)	(0.564)	(0.647)	(0.614)	(0.665)	(0.636)
Debt/GDP (lagged one year)	-0.013***	-0.013***	-0.011***	-0.014***	-0.014***	-0.014***	-0.013***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Real per capita GDP growth rate	0.020	0.017	0.010	0.007	0.001	0.011	0.020
	(0.037)	(0.038)	(0.036)	(0.036)	(0.038)	(0.039)	(0.037)
Fixed Exchange rate dummy	-1.071***	-1.081***	-1.012***	-1.402***	-0.946***	-1.046***	-1.071***
	(0.192)	(0.194)	(0.190)	(0.211)	(0.213)	(0.193)	(0.192)
Trade Openness	0.006**	0.007**	0.007***	0.007***	0.009***	0.007**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
CAPB (lagged one year)	-0.074*			-0.075*	-0.065*	-0.108**	-0.074*
	(0.040)			(0.038)	(0.039)	(0.042)	(0.040)
CAB (lagged one year)		-0.094**					
		(0.041)					
Debt Change (lagged one year)			0.848				
			(0.879)				
Log of real per capita GDP				-1.924***			
				(0.455)			
Domestic credit to private sector					1.22e-06		
					(2.70e-06)		
Fiscal rule dummy						0.548***	
						(0.200)	
Constant	1.031***	1.123***	0.621**	21.01***	1.023***	0.702**	1.031***
	(0.293)	(0.289)	(0.274)	(4.785)	(0.320)	(0.336)	(0.293)
Number of observations	354	358	365	354	296	354	354
Pseudo R^2	0.260	0.270	0.215	0.304	0.250	0.280	0.260

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.
CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Table 5.C.2: The Influence of IT adoption on the Fiscal Discipline (FD) (*Developed* Countries)

Dependent Variable : CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *default starting* dates								
[1]: ATT	1.086	1.310	1.401*	1.280*	1.330*	1.178*	1.274*	1.371*
	(0.927)	(1.030)	(0.841)	(0.754)	(0.741)	(0.682)	(0.713)	(0.778)
Number of Treated Obs.	85	85	85	77	77	77	85	77
Number of Controls Obs.	264	264	264	264	264	264	264	264
Total Observations (Obs.)	349	349	349	341	341	341	349	341
Robustness Checks								
Using alternative measures of fiscal discipline (instead of CAPB) as measure of Fiscal Discipline (FD)								
[2]: Using CAB (GDP %)	1.129	1.407*	1.614*	1.569*	1.622*	1.220	0.731	1.564**
	(0.944)	(0.840)	(0.931)	(0.807)	(0.896)	(0.792)	(0.831)	(0.798)
[3]: Using the relative Change in the Debt-to GDP ratio	-0.027	-0.033	-0.033	-0.031	-0.034	-0.025	-0.026	-0.033
	(0.036)	(0.026)	(0.027)	(0.023)	(0.021)	(0.018)	(0.019)	(0.022)
Using CAPB as dependent variable, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	0.410	-0.412	-0.340	0.420	0.0812	0.0775	-0.478	0.0466
	(1.299)	(1.219)	(1.101)	(0.729)	(0.926)	(0.893)	(1.359)	(0.995)
[5]: Adding Domestic credit to private sector	1.506	1.653*	1.980**	1.542**	1.519**	1.385**	1.336	1.529
	(1.055)	(0.999)	(0.856)	(0.728)	(0.749)	(0.687)	(0.986)	(1.017)
[6]: Adding Fiscal rule dummy	0.966	1.949	0.657	0.442	0.407	-0.180	0.295	0.363
	(1.367)	(1.189)	(0.916)	(0.819)	(1.006)	(1.001)	(1.036)	(0.951)
[7]: No hyperinflation episodes	1.086	1.310	1.401	1.280**	1.330*	1.178**	1.274	1.371**
	(0.824)	(0.964)	(0.897)	(0.624)	(0.713)	(0.567)	(0.844)	(0.671)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 5.D: *Probit* estimates of the Propensity Scores (*Developing* Countries)

Dependent variable: Inflation Targeting (*Conservative Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.148***	-0.147***	-0.131***	-0.143***	-0.144***	-0.139***	-0.148***
	(0.020)	(0.020)	(0.017)	(0.019)	(0.020)	(0.020)	(0.020)
Governors' turnover rate	-1.548***	-1.576***	-1.251**	-1.594***	-1.579***	-1.641***	-1.544***
	(0.499)	(0.496)	(0.505)	(0.484)	(0.508)	(0.525)	(0.500)
Debt/GDP (lagged one year)	-0.008**	-0.008**	-0.007**	-0.006*	-0.009**	-0.009**	-0.008**
	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Real per capita GDP growth rate	0.008	0.009	-0.005	0.006	0.010	0.006	0.008
	(0.023)	(0.022)	(0.019)	(0.022)	(0.023)	(0.022)	(0.023)
Fixed Exchange rate dummy	-2.551***	-2.500***	-2.192***	-2.484***	-2.497***	-2.519***	-2.550***
	(0.335)	(0.307)	(0.257)	(0.300)	(0.329)	(0.347)	(0.335)
Trade Openness	-0.012***	-0.012***	-0.008***	-0.014***	-0.013***	-0.011***	-0.012***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
CAPB (lagged one year)	0.102***			0.099***	0.102***	0.094***	0.102***
	(0.030)			(0.030)	(0.031)	(0.031)	(0.030)
CAB (lagged one year)		0.095***					
		(0.030)					
Debt Change (lagged one year)			-0.163				
			(0.287)				
Log of real per capita GDP				0.292			
				(0.242)			
Domestic credit to private sector					0.003		
					(0.002)		
Fiscal rule dummy						0.609***	
						(0.228)	
Constant	2.569***	2.513***	1.759***	-0.129	2.368***	2.280***	2.566***
	(0.430)	(0.400)	(0.307)	(2.113)	(0.447)	(0.421)	(0.431)
Number of observations	628	672	775	628	627	628	560
Pseudo R^2	0.512	0.509	0.459	0.516	0.515	0.526	0.494

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.
CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Appendix 5.E: Developing Countries, based on *Default starting* dates

Table 5.E.1: *Probit* estimates of the Propensity Scores (*Developing* Countries)

Dependent variable: Inflation Targeting (*Default Starting* Dates)							
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7][a]**
Inflation (lagged one year)	-0.119***	-0.119***	-0.096***	-0.112***	-0.112***	-0.112***	-0.119***
	(0.019)	(0.018)	(0.014)	(0.019)	(0.019)	(0.019)	(0.019)
Governors' turnover rate	-0.993**	-1.032**	-0.791*	-1.163**	-1.110**	-1.032**	-0.985**
	(0.486)	(0.487)	(0.439)	(0.453)	(0.487)	(0.494)	(0.489)
Debt/GDP (lagged one year)	-0.008**	-0.009***	-0.006**	-0.004	-0.010***	-0.008**	-0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Real per capita GDP growth rate	0.041*	0.045*	0.023	0.035	0.044*	0.040*	0.041*
	(0.024)	(0.024)	(0.020)	(0.023)	(0.024)	(0.023)	(0.024)
Fixed Exchange rate dummy	-2.654***	-2.678***	-2.282***	-2.546***	-2.592***	-2.613***	-2.652***
	(0.358)	(0.342)	(0.244)	(0.333)	(0.356)	(0.357)	(0.358)
Trade Openness	-0.013***	-0.013***	-0.009***	-0.016***	-0.014***	-0.012***	-0.013***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
CAPB (lagged one year)	0.105***			0.102***	0.112***	0.100***	0.105***
	(0.029)			(0.029)	(0.031)	(0.029)	(0.029)
CAB (lagged one year)		0.106***					
		(0.030)					
Debt Change (lagged one year)			-0.859**				
			(0.402)				
Log of real per capita GDP				0.619**			
				(0.270)			
Domestic credit to private sector					0.006***		
					(0.002)		
Fiscal rule dummy						0.374*	
						(0.223)	
Constant	2.449***	2.479***	1.583***	-3.186	2.123***	2.235***	2.441***
	(0.439)	(0.416)	(0.294)	(2.326)	(0.457)	(0.432)	(0.441)
Number of observations	628	672	775	628	627	628	560
Pseudo R^2	0.511	0.522	0.452	0.530	0.523	0.516	0.492

[a] Excluding hyperinflation episodes. Robust standard errors in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%.
CAPB and CAB refer to the Cyclically-Adjusted Primary, and respectively overall, fiscal Balance, both as GDP percentage.

Table 5.E.2: The Influence of IT adoption on the Fiscal Discipline (FD) (*Developing* Countries)

Dependent Variable : CAPB (GDP %)	Nearest-Neighbor Matching			Radius Matching			Local linear regression matching	Kernel Matching
	$n=1$	$n=2$	$n=3$	$r=0.03$	$r=0.05$	$r=0.10$		
Treatment Effect of IT on CAPB, using the *default starting* dates								
[1]: ATT	**3.738****	**3.036****	**1.975***	**2.295****	**2.287****	**1.524***	**3.227****	**2.394****
	(1.821)	**(1.479)**	**(1.012)**	**(0.903)**	**(1.031)**	**(0.781)**	**(1.490)**	**(1.144)**
Number of Treated Obs.	55	55	55	50	51	55	55	52
Number of Controls Obs.	566	566	566	556	566	566	566	556
Total Observations (Obs.)	621	621	621	606	607	611	621	608
Robustness Checks								
Using alternative measures of fiscal discipline (instead of CAPB) as measure of Fiscal Discipline (FD)								
[2]: Using CAB (GDP %)	1.988	2.646*	2.642**	1.721**	1.685	1.124	1.641*	2.033**
	(1.455)	(1.516)	(1.305)	(0.843)	(1.011)	(0.892)	(0.960)	(0.966)
[3]: Using the relative Change in the Debt-to GDP ratio	-0.175**	-0.174**	-0.146**	-0.178**	-0.166***	-0.141***	-0.139**	-0.162***
	(0.0892)	(0.0784)	(0.0673)	(0.0770)	(0.0578)	(0.0511)	(0.0577)	(0.0597)
Using CAPB as dependent variable, but with alternative specifications of the *probit* model								
[4]: Adding Log of real per capita GDP	1.810	0.927	2.592*	1.355*	1.215*	1.089*	1.514**	1.154*
	(2.044)	(1.703)	(1.471)	(0.702)	(0.687)	(0.555)	(0.731)	(0.588)
[5]: Adding Domestic credit to private sector	5.108***	3.518**	2.771**	3.112***	3.248***	3.041**	4.459**	3.319***
	(1.798)	(1.647)	(1.349)	(1.041)	(1.160)	(1.235)	(1.832)	(1.170)
[6]: Adding Fiscal rule dummy	3.008***	1.521*	1.439*	1.656*	1.644**	1.243	1.304**	1.441**
	(0.823)	(0.865)	(0.784)	(0.847)	(0.768)	(0.969)	(0.631)	(0.681)
[7]: No hyperinflation episodes	3.489**	3.082**	1.975*	2.188**	2.214**	1.456	3.356**	2.376**
	(1.751)	(1.548)	(1.089)	(0.942)	(1.049)	(1.078)	(1.547)	(1.064)

Note: bootstrapped standard errors (via 500 replications) in brackets. *, **, and *** indicate the significance level of 10%, 5%, and 1%, respectively.

Appendix 5.F: The balancing properties of the matched data

Variables	Sample	Mean		**Standardized bias**	**t-test**	
		Treated	Control	**% bias**	**t**	**p>t**
Lagged inflation rate	Unmatched	5,7282	77,205	-23	-1,2	0,23
	Matched	6,5527	13,094	**-2,1**	**-0,29**	**0,774**
Governors' turnover rate	Unmatched	0,14136	0,22773	-44,9	-4,15	0
	Matched	0,14726	0,14616	**0,6**	**0,05**	**0,959**
Lagged debt-to-GDP	Unmatched	42,172	53,83	-45,5	-2,75	0,006
	Matched	45,795	45,779	**0,1**	**0**	**0,997**
Real per capita GDP growth rate	Unmatched	2,0912	2,4583	-8,7	-0,55	0,585
	Matched	2,0701	2,1427	**-1,7**	**-0,07**	**0,945**
Fixed exchange rate	Unmatched	0,10909	0,63748	-130	-7,98	0
	Matched	0,15789	0,14534	**3,1**	**0,15**	**0,881**
Trade openness	Unmatched	71,876	89,364	-35,8	-2,13	0,034
	Matched	71,822	71,959	**-0,3**	**-0,02**	**0,987**
Lagged CAPB	Unmatched	0,02893	-0,055	2,8	0,17	0,867
	Matched	0,17149	0,08663	**2,8**	**0,14**	**0,886**
Log of real per capita GDP	Unmatched	9,2185	8,9563	48,5	3,13	0,002
	Matched	9,018	9,045	**-5**	**-0,23**	**0,818**
Domestic credit to the private sector	Unmatched	75,104	51,591	55,2	4,09	0
	Matched	61,518	61,018	**1,2**	**0,07**	**0,944**
Fiscal rule dummy	Unmatched	0,59848	0,18438	93,5	10,87	0
	Matched	0,57258	0,55682	**3,6**	**0,25**	**0,803**

Chapter 6

Inflation Targeting and Fiscal Rules: Do Interactions and Sequence of Adoption Matter?

6.1. Introduction

This chapter is concerned with filling a gap in the existing literature on the effects of Inflation Targeting (IT) and Fiscal Rules (FR), namely the failure of taking into account the influence of likely interactions between IT and FR when it comes to assessing their respective macroeconomic performances. Indeed, previous studies evaluated the respective effects of IT and FR separately. On the fiscal side, a substantial strand of empirical literature emphasized that FR are effective in delivering fiscal discipline (Alesina & Perotti, 1995; Alesina et *al*., 1999; Debrun et *al*., 2007a; Hallerberg et *al*., 2009; Dabla-Norris et *al*., 2010; or Gollwitzer, 2011). On the monetary side, IT adoption was found successful in bringing down inflation and its volatility, notably in developing countries (Batini & Laxton, 2007; Gonçalves & Salles, 2008; Lin & Ye, 2009; or de Mendonça & de Guimarães e Souza, 2012).

However, a common drawback to both sets of studies is that papers having assessed the fiscal impact of FR (the inflationary impacts of IT) did not take into account the potential effects of IT on fiscal behaviors (of FR on inflation dynamics). On the one hand, the discipline-enhancing effects on the conduct of fiscal policy attributed to FR may also stem partly from IT adoption, as the latter may serve as a catalyst for the implantation of sound fiscal policies. Indeed, Mishkin (2004), Roger (2009) or Freedman & Ötker-Robe (2010) defend the idea that, to prevent the central bank from missing its inflation target due to pressure from the government to monetize the public debt, IT adoption may be sufficiently binding for both the central bank and the government to serve as a good device to ensure fiscal discipline. On the other hand, fiscal discipline has been identified as a key prerequisite for the effectiveness of IT in achieving price stability (Masson et *al.*, 1997; Bernanke & Woodford, 2004; or Sims, 2004). Given that FR adoption is considered as a pivotal element in setting off fiscal discipline, the favorable inflationary effects attributed to IT in the literature may also be partly related to the presence of FR, rendering more credible the IT framework regarding the private sector's inflation expectations.

Consequently, there are good arguments for assuming that studying the effects of IT and FR respectively on inflation and on fiscal balances without taking into account the influence of interactions between them can lead to misleading conclusions. Such a reasoning is all the more welcomed that IT (or FR) was sometimes adopted as part of broader reforms aiming at strengthening macroeconomic stability; for instance, IT adoption sometimes went along with

the introduction of bold fiscal reforms, including the establishment of FR, to support the IT framework (for example in Brazil, Norway, New Zealand or Sweden). In some countries (for instance in Brazil, Chile, Israel, Norway, Poland, Romania, or United Kingdom), legislation measures prohibiting monetization of public debt, which are a form of FR, were adopted to ensure the credibility of the commitment to the inflation target, while in other countries (such as Australia, Canada, Czech Republic, Ghana, Indonesia, New Zealand, Philippines, South Africa, or Turkey), the inflation target is jointly defined by the central bankers and the government, to clearly signal to the financial markets that both fiscal and monetary authorities are committed to hit the inflation target. Altogether, these arguments point out that the effectiveness of IT and FR in affecting inflation and the fiscal stance may depend on whether IT (FR) is implemented alone or jointly with the introduction of FR (IT). Put differently, interactions between these rule-based policy frameworks seem to matter on their individual inflationary and fiscal effects.

An additional motivation for our analysis stems from the fact that both IT and FR are rule-based policy frameworks with the same ultimate goal, namely conferring credibility to macroeconomic policies in general, as stressed out by Kopits (2001); as such, they may act complementarily in achieving that common ultimate goal, all the more that both frameworks experience concomitantly a growing popularity since the early nineties. Furthermore, both IT and FR display many similarities in their nature, as they are defined in the form of numerical targets on macroeconomic aggregates, namely on inflation for IT and on fiscal variables for FR, with the goal of constraining the discretion of monetary and fiscal authorities, respectively.[128]

Given this marked parallelism in the implementation of both frameworks, it is reasonable to explore the likely role of their interactions when it comes to isolating their respective causal effects on inflation dynamics and fiscal behaviors. From a broader viewpoint, the influence of the interactions between IT and FR can be linked to the bourgeoning literature on the price level determinacy, inspired by the seminal paper by Sargent & Wallace (1981), or the more recent fiscal theory of the price level (Woodford, 1994). This literature (see, *e.g.*, Aiyagari & Gertler, 1985; Sims, 1988; Leeper, 1991; Benhabib et *al.*, 2001; Uribe, 2006; or Sims, 2011)

[128] In addition, IT and FR equally display similarities in their institutional parameters, as illustrated in the comparative description of their main features (see *Appendix 6.1*). Indeed, as pointed out by Kopits (2001), the new wave of FR, started in New Zealand in 1994, is backed up by institutional parameters which are also present in IT frameworks, such as transparency and accountability mechanisms.

is interested in disentangling the relative importance of MP *versus* fiscal policy when it comes to providing the nominal anchor to the economy. Accordingly, by pointing out that fiscal (monetary) policy may alter the way monetary (fiscal) policy affects inflation dynamics, these authors laid the foundations for taking into account the role of the interactions between monetary and fiscal policies regarding their respective macroeconomic effects.[129]

In light of this literature, we question in this chapter, the interactions between IT and FR in terms of their effects on inflation and fiscal balances, by focusing on two issues. First, we explore if the joint effects of IT and FR on inflation and fiscal balances are larger compared to their isolate effects. Second, we investigate the role of the sequence (or timing) of IT and FR adoption, namely do interactions between IT and FR influence differently inflation and/or fiscal balances depending on whether a country adopts IT before introducing FR, or inversely?[130] To this end, we perform System-GMM estimations, which properly address the likely endogeneity in the adoption of both IT and FR and in their interactions and sequence of adoption, and account for the inertia in the inflation dynamics and in the budget process, on a panel of 152 developed and developing countries over the period 1990-2009. First, we find that adopting both IT and FR improves fiscal balances and brings down average inflation more than compared to the cases where only FR or only IT are adopted. Second, we highlight the dominance of the sequence which consists of introducing first FR before adopting IT with respect to the opposite sequence, regarding their fiscal and inflationary performances.

The rest of the chapter is organized as follows. Section 2 presents the dataset and displays some stylized facts. Section 3 discusses the methodology and the estimation technique. Section 4 illustrates the main results and their robustness, and section 5 concludes.

[129] To characterize cases in which fiscal policy, rather than MP, may provide the nominal anchor to the economy, Sargent & Wallace (1981) distinguish two policy regimes, namely "*monetary dominance*" and "*fiscal dominance*" (these regimes are sometimes called "*Ricardian*" and "*non-Ricardian*" respectively, or "*active*" (*passive*) fiscal policy and "*passive*" (active) monetary policy respectively, see, Leeper, 1991, or Woodford, 1994). Under a *fiscal dominance* regime, the primary fiscal balance evolves independently of the public debt, causing the equilibrium level of price to raise in order to ensure government's fiscal solvency; in this case, the nominal anchor is provided by fiscal policy, meaning that a restrictive MP may even result in higher inflation if the main source of government funding is seigniorage, and if the primary fiscal balance is not adjusted after seigniorage receipts collapse. On the contrary, under *monetary dominance* the primary fiscal balance evolves consistently with government's fiscal solvency, so that the equilibrium price level is determined according to the traditional way, namely through the interaction between the supply and the demand for money.

[130] A comparable strategy was adopted for exploring the complementarities and the optimal order of financial liberalization reforms (see, *e.g.*, Dewatripont & Roland, 1995; or de Macedo & Martins, 2008) or political liberalization *versus* economic liberalization reforms (see Giavazzi & Tabellini, 2005).

6.2. Data and Stylized Facts

We built upon a wide panel of 152 countries, covering both developed and developing countries, over the period 1990-2009 (see *Appendix 6.2* for the list of countries). The number of countries in the sample is limited exclusively on the basis of data availability, especially regarding outcome variables, namely fiscal balances (primary or overall) and the inflation rate.[131] Regarding the time coverage, the sample starts in 1990 because reliable fiscal data exist only from 1990, all the more in developing countries, which are largely present in our sample.

6.2.1. Variables of interest: Inflation Targeting and Fiscal Rules

IT is measured by a binary variable equaling one if at a given year a country uses IT as its framework for the conduct of MP, and zero otherwise. Data on the *starting* dates of IT come from Rose (2007), and were updated from Roger (2009) for recent experiences of IT adoption, namely between 2005 and 2009. Rose (2007) distinguishes two kinds of dates, namely *default starting* years and *conservative starting* years.[132] For robustness issues, we perform our analysis on both dates in the following sections. Among the 152 countries in the sample, 29 experienced IT by the end of 2009 (see the first column of *Appendix 6.3* for the list of the 29 ITers along with their *starting* dates).[133]

We measure FR by a binary variable taking the value one if at a given year a country placed a numerical constraint on fiscal aggregates (budget balance, spending, revenue or debt) at the national level. Data on the *starting* dates of FR come from the new Fiscal Rules Database (IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division, 2009), providing a comprehensive overview on FR experiences around the world. Among the 152 countries in the sample, 51 enacted Fiscal Rules (FRers) by the end of 2009 (see the second column of *Appendix 6.3* for the list of 51 FRers and their *starting* dates).[134]

[131] Note that the panel is unbalanced because of missing observations.
[132] The *conservative starting* dates refer to a form of IT termed "FFIT" while the *default* ones refer to "soft" IT. See Chapter 1, *section 1.2.1* for further discussion on this issue.
[133] Serbia adopted IT in 2006, but due to lack of data on fiscal balance, this country is dropped from the sample. Remark that three countries, namely Finland, Spain and Slovak Republic, adopted IT in 1993, 1995 and 2005 respectively, but the first two abandoned IT to join the Euro area in 1999, while the third did so in 2009. Consequently, we consider them as ITers only from their IT adoption date to their entrance date to the Euro area.
[134] Armenia, Comoros, Hong Kong, Liberia, and Timor-Leste enacted FR in 2008, 2001, 1997, 2004 and 2005 respectively, but due to lack of data on fiscal balances and/or inflation they are dropped from our sample.

6.2.2. The interaction between IT and FR and the sequence of adoption

To explore the potential impact of the *interaction* between IT and FR and of the *timing* (sequence) of adoption of IT and FR, we build the five following dummy variables (see columns three to seven of *Appendix 6.3*):

(i) A binary variable, called IT_only, equaling one after IT adoption in countries having *adopted only IT* (these countries should have not adopted FR throughout the entire time coverage of the sample, namely 1990-2009), and zero otherwise. For example, South Africa adopted IT in 2000 and did not experience FR at all over 1990-2009; accordingly, for South Africa, IT_only equals zero for 1990-1999, and one for 2000-2009;

(ii) A binary variable, called FR_only, equaling one after FR adoption in countries having *only enacted FR* (these countries should have not adopted IT throughout the entire time period of the sample, namely 1990-2009), and zero otherwise. For example, India adopted FR in 2004 and did not experience IT at all over 1990-2009; accordingly, for India, FR_only equals zero for 1990-2003, and one for 2004-2009;

(iii) A binary variable, called IT_&_FR, equaling one after the adoption of the *first regime* in the countries having adopted *both* IT and FR, and zero otherwise. This dummy variable captures the effect of the first regime and is pivotal (altogether with the two following dummies) for identifying the strategic interaction (complementarity/substitutability) of adopting both IT and FR. For example, Australia adopted both IT and FR, the former in 1993 (*default starting* date) and the latter in 1998; accordingly, for Australia, IT_&_FR equals zero for 1990-1992 and one for 1993 to 2009. Similarly, Poland adopted both frameworks, but introduced FR first in 1997 and then IT in 1998; accordingly, for Poland, IT_&_FR equals zero for 1990-1996 and one for 1997-2009.

(iv) A binary variable, called IT_after_FR, capturing the *sequence of adoption*, equaling one after IT adoption by countries having enacted FR first and then adopted IT, and zero otherwise. For example, Poland enacted FR in 1997 before adopting IT in 1998; accordingly, for Poland, IT_after_FR equals zero for 1990-1997 and one for 1998-2009;

(v) A binary variable, called FR_after_IT, capturing the *sequence* of adoption, equaling one after FR adoption by countries having adopted IT first and then enacted FR, and zero otherwise. For example, Australia adopted IT in 1993 an then FR in 1998; accordingly, for Australia, FR_after_IT equals zero for 1990-1997 and one for 1998-2009.

Remark that the United States (US) introduced FR in 1990, but abandoned it in 2002, so as Belgium in 1992 and 1999 respectively. Consequently, we consider the US as a FRer for the 1990-2002 period and Belgium as a FRer for the 1992-1999 period.

6.2.3. Outcome variables

We consider three outcome measures, two to capture the performances related to fiscal authorities, namely the Primary Fiscal Balance and the Overall Fiscal Balance, and the third to seize the performances of monetary authorities, namely the annual inflation rate. The overall fiscal balance (FB) is the difference between General Government revenues and expenditures, while the primary fiscal balance (PFB) is the FB minus interest payments. The inflation rate (Inflation) is defined as the annual growth rate of the average Consumer Price Index. *Appendices 6.4* and *6.5* provide definitions and descriptive statistics of variables.

6.2.4. Stylized Facts

Let us have a closer look at these variables by exploring descriptive statistics. Among the full sample of 152 countries, 92 countries (60.53%) did not commit to neither IT nor FR. Within the 29 ITers, 9 countries (31.03%) adopted only IT (*i.e.* they did not enact FR in addition to IT), while 31 out of the 51 FRers (60.78%) enacted only FR. As a result, from the 60 countries having adopted either IT or FR, 20 countries (33.33%) opted for both IT and FR (*Appendix 6.3* presents a detailed classification of each category of countries).

Before setting out the econometric analysis, we present in the following simple correlations between the five above-defined dummies and the outcome variables, namely fiscal balances and inflation. *Figure 6.1* below displays the evolution of the PFB in Norway, which adopted both IT and FR in 2001, and in Austria, which enacted only FR in 1999. According to *Figure 6.1*, Norway experienced a sustained improvement in its PFB in the years following the *starting* date of both regimes, while Austria's PFB remained almost constant just after its FR adoption. These trends may indicate the presence of complementarity between IT and FR in shaping fiscal behaviors, as adopting both frameworks (IT and FR) is associated with more durable primary fiscal surpluses than adopting only one framework. A similar conclusion emerges from *Figure 6.2*, which displays the evolution of Inflation in Peru, which adopted FR in 2000 and IT in 2002, and in Philippines, which adopted only IT in 2002. According to *Figure 6.2*, adopting both frameworks leads to better inflationary performances on average, compared to countries having adopted only one framework (since the beginning of its first regime in the early 2000s, average inflation in Peru is 2.58, namely 2.91 percentage points lower compared to Philippines).

Figure 6. 1: IT_&_FR vs. FR_only (PFB)

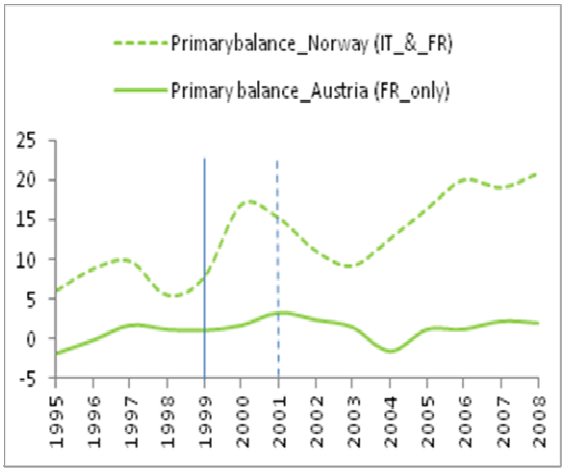
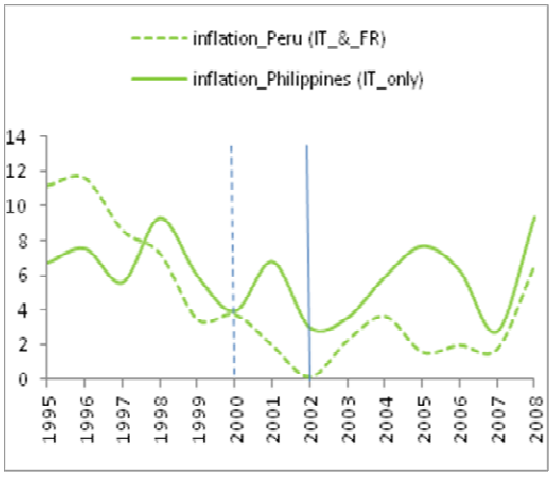


Figure 6. 2: IT_&_FR vs. IT_only (Inflation)



We turn now our attention to the issue of the sequence of adoption. According to *Figure 6.3*, the Slovak Republic, which enacted FR in 2002 before committing to IT in 2005, ran larger primary fiscal surpluses since the beginning of its first regime compared to Hungary, which adopted IT in 2001 first before enacting FR in 2007. The likely dominance of the IT_after_FR sequence over to the FR_after_IT sequence equally emerges when considering *Inflation* as the outcome variable. As illustrated by *Figure 6.4*, Peru, which enacted FR in 2000 before adopting IT in 2002, presents lower inflation rates since the beginning of the first regime compared to Mexico, which opted for the opposite sequence, namely IT adoption in 2001 before enacting FR in 2006.

Figure 6. 3 : IT_after_FR vs. FR_after_IT (PFB)

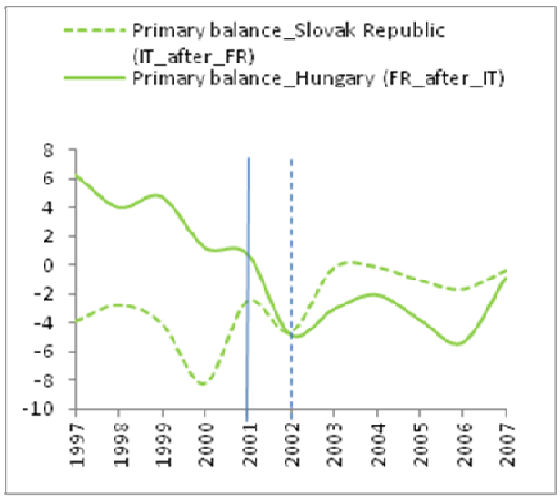
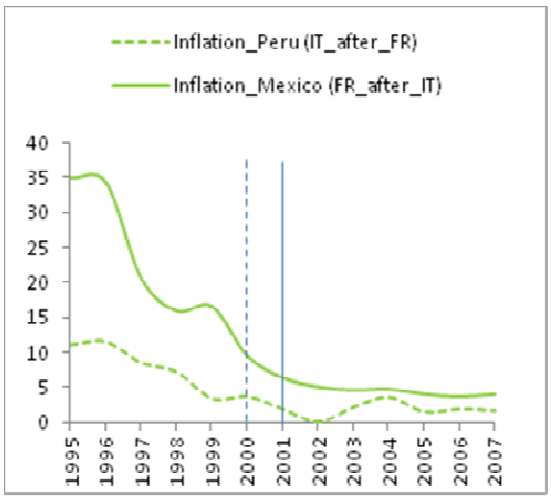


Figure 6. 4: IT_after_FR vs. FR_after_IT(Inflation)



To summarize, these simple stylized facts do not go against (i) a potential complementarity between IT and FR regarding their effects on fiscal balances and inflation, and (ii) a potential importance of the timing of adoption of the two frameworks. Consequently, we investigate in the next sections the existence of these relationships using a more robust econometric setup.

6.3. Methodology

As previously acknowledged, we aim at exploring the influence of interactions between IT and FR and of the sequence of adoption of IT and FR in shaping fiscal behaviors and inflation dynamics. To this end, let us consider the following general model dealing with the isolate effect of IT (or FR) on the *outcome* variables

$$PFB_{it} = \alpha + \beta\, PFB_{it-1} + \lambda_1 IT_{it} (\, or \lambda_1 FR_{it}\,) + \delta_1 Debt_{it-1} + \phi X_{it} + v_i + n_t + \varepsilon_{it}, \quad (6.1a)$$

$$Inflation_{it} = \alpha + \beta\, Inflation_{it-1} + \lambda_1 IT_{it} (\, or \lambda_1 FR_{it}\,) + \phi X_{it} + v_i + n_t + \varepsilon_{it}, \quad (6.1b)$$

where IT and FR stand for the inflation targeting and fiscal rules dummy respectively, X_{it} is a vector of control variables, v_i and n_t denote country and time fixed effects respectively, and ε_{it} is the error term. Relation (6.1a) captures the effect of IT (or FR) on the primary fiscal balance (through the presence of IT or FR in the equation) and is adapted from the standard Bohn's (1998) model, which links country's primary fiscal balance to the past level of its government debt, the business cycle fluctuations and to a set of politico-institutional variables.[135] As control variables, we therefore include the lagged value of the PFB (to account for the persistence in the budget process), the lagged government debt (to control for the sensitivity of the PFB to past debt developments, consistently with the need for fiscal solvency), the output gap (to seize the effect of business cycle fluctuations) and government stability (to control for the politico-institutional context). We also control for trade openness and the growth rate of terms of trade (to account for the effects of external shocks), and the logarithm of real per capita GDP (to account for country's status of development).[136]

Relation (6.1b) models the inflationary effects of IT (or FR) and includes almost the same determinants than (6.1a), except the inclusion of the lagged value of inflation instead of the lagged PFB (to seize the persistence in inflation dynamics), and the absence of lagged government's debt in the equation.[137]

[135] Remark that relation (6.1a) employs alternatively IT and FR as variable of interest, each case corresponding to a test of the discipline-enhancing effect of IT and FR, respectively. The same applies to relation (6.1b) which models the inflationary effect of IT and FR, respectively.
[136] Sources, definitions and descriptive statistics of all variables are presented in *Appendices 6.4* and *6.5*.
[137] Controlling for government debt may not make sense in that it might capture entirely the effect of FR on Inflation for instance. Indeed, one of the main channels through which FR may affect Inflation is government

As outlined above, the inclusion of IT (or FR) in equations (6.1a) aims at capturing the ability of IT regimes or (rules-based fiscal policy frameworks) to rule-out the so-called *deficit bias*, namely the tendency of governments to run permanently fiscal deficits due to their willingness to manipulate fiscal policy for electoral purposes (see, for example, Fatás & Mihov, 2003; or Debrun et *al.*, 2007a). The coefficient of interest is captured by λ_1, which measures the effect of IT (or FR) on the outcome variable. With respect to our hypothesis that IT and FR adoption has a discipline-enhancing effect on the conduct of fiscal policy, we expect λ_1 to be positive when using the PFB or the FB as outcome variable (equation (6.1a)). On the contrary, given the hypothesis that IT and FR allow tackling the inflationary bias inherent to the so-called time inconsistency problem, we expect λ_1 to be negative when using *Inflation* as the outcome variable (equation (6.1b)).

Starting from the general setup (6.1a-b), we explore the role of interactions between IT and FR, and of the sequence of adoption of IT and FR on our outcome variables using the following model

$$\begin{aligned} PFB_{it} = {} & \alpha + \beta\, PFB_{it-1} + \lambda_1 IT\_only_{it} + \lambda_2 FR\_only_{it} + \lambda_3 IT\_\&\_FR_{it} \\ & + \lambda_4^1 IT\_after\_FR_{it} + \lambda_4^2 FR\_after\_IT_{it} + \delta_1 Debt_{it-1} + \phi X_{it} + v_i + n_t + \varepsilon_{it} \end{aligned} \tag{6.2a}$$

$$\begin{aligned} Inflation_{it} = {} & \alpha + \beta\, Inflation_{it-1} + \lambda_1 IT\_only_{it} + \lambda_2 FR\_only_{it} + \lambda_3 IT\_\&\_FR_{it} \\ & + \lambda_4^1 IT\_after\_FR_{it} + \lambda_4^2 FR\_after\_IT_{it} + \phi X_{it} + v_i + n_t + \varepsilon_{it} \end{aligned}. \tag{6.2b}$$

Compared to equations (6.1a-b), equations (6.2a-b), in addition to the isolate effects of IT and FR, focus not only on their joint effects by analyzing the role of the interactions between them, but also on the influence of the timing of their adoption. This is captured by the inclusion of the five dummy variables emphasized above, representing all the different possible scenarios of IT and FR adoption. By so doing, we disaggregate the effect of IT and FR adoption from equations (6.1a-b) in three levels. First, coefficients λ_1 and λ_2 from regressions (6.2a-b) measure the effects of IT and FR adoption *exclusively* for the ITers not having enacted FR (coefficient λ_1) and the FRers not having adopted IT (coefficient λ_2).[138]

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debt, consistently with a *credibility-signaling* effect with regard to financial markets' expectations (see Roger, 2009; or Freedman & Ötker-Robe, 2010).

[138] For comparison, in equations (6.1a-b), coefficient λ_1 measures the effect of IT (or FR) adoption for the ITers (or the FRers) *irrespective* of the decision to have adopted or not FR (IT). In addition, notice that we cannot draw upon the definition of usual interactive variables, namely IT*FR, to measure interactions, since the product of our two dummy variables IT and FR equals either IT or FR.

Second, the sum between λ_3 (which captures the effect of the first regime) and alternatively λ_4^1 *or* λ_4^2 measures the contribution of the interaction between IT and FR to the effect of IT and FR adoption on our outcome variables. For example, to see if interactions between IT and FR provide better outcome compared to IT (FR) adoption alone we compare λ_1 (λ_2) to the sum $\lambda_3 + \lambda_4^1$ or $\lambda_3 + \lambda_4^2$. Finally, λ_4^1 and λ_4^2 measure the contribution of the *timing of adoption* on our outcome variables, by accounting for differences between countries having adopted IT after FR (coefficient λ_4^1) and countries having enacted FR after IT (coefficient λ_4^2).

A key issue in isolating the causal effects in equations (6.1) and (6.2) is to address the likely endogeneity of the variables of interest, namely IT or FR in (6.1) and the five interaction and sequence variables in (6.2). The standard approach commonly used in the literature draws upon the impact analysis techniques, namely the *differences-in-differences* estimator (DID, see Ashenfelter & Card, 1985).[139] However, as stressed out by Bertrand, Duflo & Mullainathan (2004), running DID estimations in the presence of serial dependence in both the dependent variable (both fiscal balances and inflation are persistent over time, as reflected by the significant coefficients of the lagged variables in equations (6.1) and (6.2)) and in the *treatment* variable (no country did abandon IT due to economic duress yet, for example), leads to misleading standard errors and is therefore inappropriate.[140]

Accordingly, we focus on the other major approach dealing with endogeneity issues, namely the use of instrumental variables. The performances of this technique are intimately related to the ability of finding valid instruments for the variable of interest. However, given the difficulties in finding time-varying valid instruments for IT or FR, a reasonable compromise is to resort to the Generalized Method of Moments (GMM). In addition to tackle the endogeneity of the variable of interest,[141] the use of the GMM estimator is particularly appropriate for our study involving dynamic panel models (see (6.1) and (6.2)).

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[139] An alternative technique often used is *matching on the propensity scores* (PS, see Rosenbaum & Rubin, 1983); however, this method is not appropriate here and especially for the estimation of equation (6.2), since (6.2) involves five *treatment* variables, instead of a unique *treatment* variable as required by the PS technique.

[140] For a recent discussion on the uncertainties associated with the use of DID, see Donald & Lang (2007).

[141] We use the two-step System GMM developed by Blundell & Bond (1998), with Windmeijer (2005) small sample robust correction. This method combines two instrumentations: first, it instruments the first differences (which eliminates the time-invariant country-specific effects) of the equation of interest with their lagged (one period or more) values in levels, assuming that the errors terms in the equation in levels are not serially correlated. Second, it uses the first difference of variables, lagged one or several periods, to instrument the variables in levels.

6.4. Results

We perform our estimations on the full sample for the period 1990-2009,[142] on five non-overlapping four-year periods to avoid an over-fit of the instruments due to a large number of periods relative to the number of countries.[143] We treat the output gap, IT, FR, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT as endogenous and instrument them with their lagged values of two and three periods. Lagged outcome variables (PFB, FB or Inflation), lagged debt/GDP, trade openness and government stability are treated as predetermined, and instrumented with their lagged values of one period, while the growth rate of terms of trade and time effects are considered as exogenous. To assess the validity of the instrumentation, we present in each table, standard diagnosis statistics, namely the second-order autocorrelation test AR(2) and the Hansen's overidentification test.

6.4.1. The effects of IT and FR adoption on fiscal performances (PFB, FB)

Table 6.1 below depicts estimation results with the primary fiscal balance (PFB) as the dependent variable. First, remark that p-values for diagnostic tests are above the 10% threshold, supporting the absence of second-order autocorrelation for the error terms and the orthogonality between the instruments and the error term. Second, the coefficient of lagged PFB is statistically significant, confirming that the design and the implementation of fiscal policy exhibit persistence over time. In addition, the positive and significant estimated coefficient of the lagged government debt reveals that our fiscal policy reaction function fits well Bohn (1998)'s model, namely that the PFB is sensitive to the level of government debt. Finally, regarding control variables, the estimated coefficient of the output gap is not significant, suggesting that fiscal policy is acyclical for countries in our sample. In addition, the positive and significant effect of the growth rate of the terms of trade indicates that favorable external shocks are a significant source of government resources, and that more

[142] We explored the possibility of accounting for the likely heterogeneity between countries by carrying out the estimations on developed and developing countries subsamples. However, due to lack of sufficient variability in the experiences of IT and FR adoption, particularly regarding the sequence of IT and FR adoption, we were forced to consider the full sample. Nevertheless, we use the status of development to control for heterogeneity.

[143] Averaging data over non overlapping four-year periods is a sensible compromise between giving enough time for the sluggish responses of macro variables and separating the effects of the variables of interest from the effects of other events occurring in close proximity (see Brito & Bystedt, 2010). If a country adopts IT or FR between the first and the last year of the four-year sub-period we consider this sub-period as the *starting* date of the framework, while if it adopts a framework in the last year of the four-year sub-period we consider the next sub-period as the *starting* date of the framework.

politically stable countries present better fiscal balance (the coefficient of the variable government stability is significant in several regressions).

Table 6. 1: Effects of IT, FR, and their interactions, on the Primary Fiscal Balance (PFB)

Dependent Variable: Primary Fiscal Balance	**[1]**	**[2]**	**[3]**	**[4][a]**
Lagged Primary fiscal balance	0.246***	0.293***	0.371***	0.389***
	(0.079)	(0.056)	(0.074)	(0.059)
Lagged Debt/GDP	0.013*	0.015*	0.026***	0.020**
	(0.007)	(0.009)	(0.010)	(0.008)
Inflation Targeting (IT) Dummy	**2.420*** **			
	(0.856)			
Fiscal Rule (FR) Dummy		**1.349****		
		(0.682)		
IT_only			**3.005*** **	**1.996*** **
			(1.086)	**(0.744)**
FR_only			**1.609*** **	**1.569*** **
			(0.569)	**(0.436)**
IT_&_FR			**2.993***	**4.260****
			(1.623)	**(1.891)**
IT_after_FR			**6.558****	**3.444***
			(3.106)	**(1.812)**
FR_after_IT			**-1.417**	**-2.553**
			(1.836)	**(2.145)**
Output Gap	16.758	8.699	-9.791	-8.847
	(14.864)	(7.807)	(8.485)	(7.600)
Trade Openness	-0.014	-0.010	-0.006	-0.006
	(0.014)	(0.008)	(0.008)	(0.006)
Growth Rate of Terms of Trade	9.721**	7.487**	5.949	2.571
	(4.972)	(3.624)	(3.884)	(3.687)
Government Stability	0.480	0.468**	1.109***	1.044***
	(0.400)	(0.239)	(0.218)	(0.227)
Logarithm of real per capita GDP	0.179	0.170	0.879	0.623
	(0.701)	(0.630)	(0.763)	(0.522)
Time Effects	Yes	Yes	Yes	Yes
Number of Observations	341	341	341	341
Arellano-Bond test for AR(2): p-value	0.147	0.299	0.427	0.459
Hansen test for over-identification: p-value	0.581	0.179	0.443	0.358

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged primary fiscal balance, lagged debt/GDP, trade openness and government stability are treated as predetermined, while time effects and the growth rate of terms of trade are considered as exogenous. Constant included (but not reported). [a]: estimations carried out using the *conservative*, instead of default, *starting* dates of IT.

Let us now focus on our variables of interest. According to the first two columns of *Table 6.1*, which consider alternative specifications of equation (6.1a) with IT and FR as the variables of interest respectively, IT and FR adoption exert a positive and significant effect on the PFB. In particular, our results confirm the discipline-enhancing effect of FR previously emphasized in the literature (see, *e.g.*, Alesina & Perotti, 1995; Alesina et *al*., 1999; Debrun et *al*., 2007a;

Hallerberg et *al*., 2009; Dabla-Norris et *al*., 2010; or Gollwitzer, 2011). According to our estimations, countries having adopted IT improved their PFB by almost 2.42 percentage points of GDP, while enacting FR is found to have improved the PFB by 1.35 percentage points of GDP.

However, the results emphasized in the first two columns of *Table 6.1* suffer from an important shortcoming, namely they do not account for interactions between IT and FR; for example, the variable IT regroups all ITers, irrespective of the fact that they have adopted or not FR. We tackle this issue by presenting in column [3] estimations based on equation (6.2a).

Our results show that countries having adopted only IT improved their PFB by roughly 3 percentage points of GDP (the coefficient of IT_only), while countries having enacted only FR improve their PFB by roughly 1.6 percentage points of GDP. For countries having adopted both frameworks, namely IT and FR, two cases emerged. On the one hand, countries that enacted FR prior to IT adoption improved their PFB by roughly 9.5 percentage points of GDP (the sum of the coefficients of variables IT_&_FR and IT_after_FR). On the other hand, those that enacted FR after IT adoption improved their PFB by roughly 3 percentage points of GDP (the sum of the coefficients IT_&_FR and FR_after_IT, the latter being non significant).

Based on these figures, our findings are the following. First, interactions between IT and FR adoption do exert an effect on the PFB. On the one hand, countries having adopted IT after enacting FR, improve their PFB by almost 8 percentage points on average compared to countries having adopted only FR (2.993+6.558 vs. 1.609); this number measures the contribution of adopting IT in addition to enacting FR.[144] On the other hand, namely when FR are enacted after IT adoption, the performances in terms of PFB are not statistically different for countries having adopted both frameworks compared to countries having adopted only IT (the estimated coefficients are 2.993 and 3.005 respectively, and the equality tests do not reject the null hypothesis of statistically identical coefficients, as the P-value associated with

[144] It is worth noting that the equality tests reject the null hypothesis of statistically identical coefficients, as the P-value associated with that null hypothesis is 0.52%, clearly below the critical threshold of 10%. This suggests that the sum (2.993+6.558) is much larger than 1.609. Similarly, countries having adopted IT after enacting FR improve their PFB by 6.5 percentage points on average compared to countries having adopted only IT (2.993+6.558 vs. 3.005, with a P-value of 2.64% for the equality tests, much below the critical threshold of 10% for the null hypothesis associated with that test). This number measures the contribution of enacting FR prior to IT adoption to the effect of IT adoption on PFB.

that null hypothesis is 30.93, namely clearly above the critical threshold of 10%).[145] Second, the timing of adoption matters. According to our results, countries having adopted FR before IT improve their PFB by 6.5 percentage points (the coefficient of IT_after_FR) compared to countries having adopted FR after IT adoption which do not experience a significant improvement (the coefficient of FR_after_IT is not significant).

We check the robustness of our results in two ways. First, regarding the IT *starting* date: compared to column [3] based on *default* IT *starting* dates, we present in column [4] estimations based on *conservative* IT *starting* dates. Remark that not only IT and FR adoption still exert a positive and significant effect on PFB (the coefficients of variables IT_only and FR_only equal 1.996 and 1.569 respectively), but also the interaction and the timing of IT and FR adoption still significantly affect PFB. On the one hand, the PFB improvement in countries having adopted both IT and FR lies between 4.260 (for countries having enacted FR after IT) and 7.704 (for countries having adopted IT after FR, namely 4.260+3.444) percentage points of GDP, namely above the PFB improvement associated with the adoption of IT or FR only (namely 1.996 and 1.569 respectively). On the other hand, we find, yet again, that only the timing which consists of adopting IT after FR has a significant effect on PFB (the coefficient of IT_after_FR equals 3.444).

The second robustness analysis focuses on the overall fiscal balance (FB), instead of the PFB, as measure of fiscal performance. Using the FB allows seizing country's fiscal performance from a broader standpoint, as this measure, in addition to the fiscal outcome achieved by current fiscal policymakers, namely the PFB, accounts for fiscal performances attributable to past fiscal authorities (by adding the interest payments). Estimations based on the FB are illustrated in *Appendix 6.6*, and confirm our results obtained for the PFB.[146] Indeed, columns [1]-[2] show that IT and FR adoption significantly improve the FB. Moreover, according to column [3] in *Appendix 6.6*, countries that adopted both IT and FR present better FB compared to countries that adopted only one of the two frameworks. Indeed, the joint effect of IT and FR is an increase of FB by at least 3.163 percentage points of GDP (when FR are

[145] However, PFB is increasing by almost 1.4 points in countries having enacted FR after adopting IT compared to countries having adopted only FR (the estimated coefficients are 2.993 and 1.609 respectively); this number measures the contribution of adopting IT prior to FR to the effect of enacting FR on PFB.

[146] Remark that that p-values for diagnostic tests support, yet again, the absence of second-order autocorrelation for the error terms and the orthogonality between the instruments and the error term, while control variables that were previously found as significantly influencing the PFB, namely the lagged debt-to-GDP ratio, the growth rate of terms of trade and the measure of government stability, equally affect the FB. In addition, the coefficient of lagged FB is positive and significant, supporting the presence of time persistence of the FB.

enacted after IT) and up to 6.561 percentage points of GDP (when IT is adopted after FR, namely 3.163+3.398); for comparison, this favorable effect equals only 2.816 (1.260) percentage points for countries having adopted only IT (FR). In addition, the timing of the adoption is not neutral, since only the strategy consisting of adopting IT after enacting FR leads to a significant improvement in FB, by roughly 3.4 percentage points. Finally, these results subsist when considering *conservative*, instead of *default*, *starting* dates in column [4] of *Appendix 6.6*.

Consequently, a country that aims at adopting both IT and FR should carefully design the implementation of the two frameworks, since their effects on fiscal performance are not neutral. According to our estimations, performed alternatively on different measures of fiscal performance, namely the PFB or the FB, and different IT adoption *starting* dates, namely *default* and *conservative*, the strongest improvement in fiscal outcomes is associated to a strategy which consists of enacting FR before adopting an IT monetary framework.

6.4.2. The effects of IT and FR adoption on inflation

Let us now focus on the other major outcome measure of our study, namely *Inflation*. To mitigate the influence of outliers due to hyperinflation episodes, we followed previous studies (see, for example, Mishkin & Schmidt-Hebbel, 2002) and normalized the inflation rate as *Inflation*/(1+*Inflation*). *Table 6.2* reports the estimation results using normalized inflation as the dependent variable.

Irrespective of the considered regression, the p-values associated with the diagnostic tests support our strategy to correct for the endogeneity bias (see *Table 6.2*). In addition, the coefficient of the lagged inflation rate is strongly significant, confirming the persistence in inflation and thus our estimation strategy. Moreover, as expected, during periods of economic expansion, inflation is rising, as emphasized by the coefficient of output gap, while countries with better institutions present lower inflation (see the negative and significant coefficient of government stability).

Regarding our main results, columns [6] and [7] reveal that IT and FR are effective in bringing down average inflation, by amplitude of 4.2 and 3.1 percentage points respectively.

However, these results do not account for a possible effect of the interaction and/or the timing of adopting IT and FR on inflation; we address this shortcoming in column [8].

Table 6. 2: Effects of IT, FR, and their interactions, on Inflation

Dependent Variable: Inflation Rate	**[6]**	**[7]**	**[8]**	**[9][a]**
Lagged Inflation Rate	0.450***	0.456***	0.465***	0.361***
	(0.149)	(0.145)	(0.057)	(0.049)
Inflation Targeting (IT) Dummy	**-0.042****			
	(0.019)			
Fiscal Rule (FR) Dummy		**-0.031***		
		(0.016)		
IT_only			**-0.022****	**-0.032***
			(0.009)	**(0.020)**
FR_only			**-0.012**	**-0.018**
			(0.008)	**(0.013)**
IT_&_FR			**-0.026****	**-0.040***
			(0.013)	**(0.023)**
IT_after_FR			**-0.013***	**-0.029***
			(0.008)	**(0.017)**
FR_after_IT			**0.013**	**0.036**
			(0.011)	**(0.024)**
Output Gap	0.602*	0.751**	0.214*	0.016
	(0.359)	(0.354)	(0.117)	(0.120)
Trade Openness	-0.00003	-0.00008	-0.101	0.0002
	(0.0002)	(0.0002)	(0.070)	(0.0002)
Terms of Trade Growth Rate	-0.042	-0.030	-0.011***	-0.084
	(0.108)	(0.108)	0.214*	(0.067)
Government Stability	-0.018**	-0.018**	(0.117)	-0.016***
	(0.008)	(0.008)	(0.003)	(0.004)
Logarithm of Real per capita GDP	-0.004	-0.008	-0.008*	-0.010
	(0.011)	(0.012)	(0.005)	(0.007)
Time Effects	Yes	Yes	Yes	Yes
Number of Observations	500	500	500	500
Arellano-Bond test for AR(2): P-value	0.981	0.828	0.969	0.823
Hansen test for over-identification: P-value	0.136	0.105	0.227	0.186

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Standard errors are in brackets. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. * $p < 0.11$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged Inflation, trade openness and government stability are treated as predetermined, while Time effects and terms of trade growth rate are considered as exogenous. Inflation rate is normalized (inflation/1+inflation) to mitigate the influence of hyperinflation episodes. Constant included (but not reported). a: estimations carried out using the *conservative starting* dates of IT.

Estimations show that the adoption of an IT monetary regime significantly reduces the inflation rate; countries having adopted only IT experienced a drop in their average inflation rates by 2.2 percentage points, in addition to presenting better fiscal balances (see *Table 6.1* and *Appendix 6.1*). Contrary to their positive effect on PFB (or FB), enacting only FR is not found to significantly act on inflation performances (the coefficient of FR_only has the

expected negative sign but is not significant), suggesting that the adoption of FR alone is not sufficiently binding to reduce inflation.

Moreover, we provide an evaluation of the effect of the interaction and the timing between IT and FR regarding inflationary performances. It appears that countries having adopted both IT and FR experienced a larger decrease in their inflation rates, compared to countries having adopted only IT. Indeed, adopting both IT and FR yields better inflationary results relative to adopting only IT. Compared to the countries that adopted only IT, who see their inflation decrease by 2.2 percentage points, the decrease in inflation is stronger for countries having adopted both frameworks, amounting to 3.9 and 2.6 percentage points for those who enacted FR first before adopting IT and those having adopted IT first before enacting FR, respectively.[147] Consequently, there is evidence that not only IT and FR act complementarily to bring down average inflation, but also that timing of adoption matters, as a strategy which consists of adopting IT after enacting FR is conducive to better inflationary results than is the reverse strategy.

Finally, to assess the robustness of our results, we present in column [9] estimations that consider the *conservative starting* dates of IT (instead of *default starting* dates in [8]). Recall that *conservative starting* dates, who offer a more restrictive measure of the beginning of an IT regime regarding the fulfillment of reforms, are located after the *default starting* dates of IT for all the countries in our sample for which there exist such different dates. Consequently, we expect inflation to decrease more in response to the adoption of IT and FR frameworks, compared to the results based on *default starting* dates.

In this line, observe first that adopting only IT not simply decreases inflation, but the inflation decrease is stronger compared to the case of *default* IT *starting* dates (the coefficients are -0.032 and -0.022 respectively); in addition, adopting FR only has still no effect on inflation. Second, when using *conservative starting* dates, the adoption of both IT and FR is always better for inflation compared to adopting IT only. In the worst case, namely when FR are enacted after IT, the adoption of the two frameworks decreases inflation by 4.0 percentage points (the sum of the coefficients of IT_&_FR and of FR_after_IT, the latter being not significant), which is larger than the decrease in inflation associated with adopting IT only

[147] Remark that the P-value associated with the equality tests (3.9=2.2; and 2.6=2.2) are 17.67% and 0.88%, suggesting that at the critical threshold of 10%, the null hypothesis (3.9=2.2) is rejected while it is not for (2.6=2.2).

(3.2 percentage points). However, in the best case, namely when IT is adopted after FR, the decrease in inflation is as high as 6.9 percentage points (the sum of the coefficients of IT_&_FR and of IT_after_FR), compared to the 3.2 percentage points decrease for adopting IT only. Finally, accounting in regression [9] for conservative, instead of default *starting* IT dates in [8], slightly improves the effects on inflation of both coefficients that account for the timing of IT and FR adoption. On the one hand, the coefficient of FR_after_IT still is not significant. On the other hand, the coefficient of IT_after_FR still is negative but of higher magnitude in [9] (namely -0.029), compared to its value in [8] (namely -0.013). Consequently, accounting for *conservative* instead of *default starting* IT dates improves the estimated effects of the timing variables, in the sense that their contribution to reducing inflation is stronger when IT and FR are jointly at work.

6.5. Concluding remarks and Policy implications

We explored in this chapter, the fiscal and inflationary effects of Inflation Targeting (IT) and national-level fiscal rules (FR). This is the first study which accounts explicitly for the role of the interactions between IT and FR and of the sequence of adoption of the two frameworks regarding inflation and fiscal performances. We performed our analysis on a wide panel of 152 developed and developing countries over the period 1990-2009, using a System GMM estimator to account for the persistence in inflation dynamics and in fiscal policy, and for the endogeneity of IT and FR adoption. Our major results are: (i) the interaction between IT and FR does matter for their effects on fiscal balances and on inflation, suggesting that some complementarity between these two rules-based policy frameworks is at work, consistently with the literature on the unpleasant monetarist arithmetic (Sargent & Wallace, 1981); (ii) the timing of adoption of IT and FR is not neutral regarding their fiscal and inflationary effects.

Important policy implications follow our findings. First, IT, in addition to its primary usefulness for achieving price stability, is a good device for improving fiscal performances. Second, FR is a credible instrument for improving fiscal performance, but not sufficiently constraining for the central bank to rule-out the *inflation bias* and bring down average inflation. Third, adopting both IT and FR leads always to remarkably better fiscal and inflationary performances compared to enacting either only IT or only FR. Nevertheless, adopting both IT and FR may leave policymakers with not enough room for smoothing the

economy in case of a contractionary shock. In other terms, introducing both frameworks may constrain inappropriately policymakers, leaving them with insufficient flexibility for running countercyclical macroeconomic policies to cushion the adverse effects of temporary shocks hitting the economy. Such a concern arose during the recent global recession and financial crisis, and needs therefore to be carefully addressed in future research. Fourth, when considering the prospect of adopting both IT and FR, it is preferable for countries to *introduce FR first before adopting IT* than *adopting IT first before enacting FR*, as the fiscal and inflationary performances associated with the former strategy outweigh those associated with the latter strategy.

Finally, our finding sheds a new perspective on the classical Barro & Gordon (1983) game between the Government and the Central Bank, which focuses independently on fiscal and monetary goals respectively. According to our analysis, which accounts for possible interactions between the policies of the two institutions, namely FR and IT adoption, both the Government and the Central Bank can find incentives in implementing their policies on a cooperative basis, since the strategy which consists of first letting the Government enact FR and then allowing the Central Bank adopting an IT monetary regime dominates, in terms of fiscal and monetary performances, all alternative strategies, namely the reversed timing or corner strategies consisting of only one policy (IT only or FR only).

Appendices

Appendix 6.1: Comparative description of IT and FR institutional parameters

	Inflation Targeting (IT)	**Fiscal Rules (FR)**
***Starting* dates**	Early 1990s, namely in 1990 in New Zealand.	The new wave of FR started in the early 1990s, namely in 1994 in New Zealand.
Nature	Numerical targets on inflation.	Numerical targets on fiscal aggregates.
Targets Horizon	Annual, Medium term, or Over the business cycle, etc.	Annual, Medium term, or Over the business cycle, etc.
Statutory basis (or legal origin)	Institutional commitment to price stability as the primary objective of monetary policy (Enshrined in the Constitution in some countries; regular explanations by central bankers) in the National Parliament).	FR adoption needs to be accompanied by a strong institutional infrastructure, either enshrined in the Constitution, or in a Fiscal Responsibility Law, or resulting from a political commitment.
Transparency	Regular communications with the public regarding policy objective, orientation, decisions and results (publication of inflation reports, inflation projections, minutes of monetary policy meetings, etc.).	Mandatory publication of regular reports that must contain multiyear fiscal projections and other pre-determined disclosures; Transparency Law.
Accountability	Greater accountability of central bankers in achieving the inflation target; Public explanation of target breach and measures taken to bring inflation within the target; In New Zealand for example, the Governor can be dismissed by Minister of Finance if he is proved to be accountable for missing the target.	Monitoring mechanisms, including the establishment of independent fiscal agencies (or councils); Fiscal responsibility Laws; Internal and external audit systems.
Escape clauses	Revision of target path under "Exceptional circumstances" (major oil price shocks, natural disasters, unusual events provided they do not cause general inflationary pressures); Use of core inflation targets.	"Exceptional circumstances clause" that allows a temporary deviation from the rule in the face of a rare shock, or even to deal with the fiscal impact of major structural reforms (e.g., civil service reform); Use of cyclically-adjusted balances rules.
Sanctions	Formal sanctions (dismissal of the central bank governor); Reputation cost: loss of credibility.	Formal sanction (credit restrictions, and personal fines, dismissal, and penal prosecution); Reputation cost (loss of credibility).

Sources: Mishkin & Schmidt-Hebbel (2002), Roger & Stone (2005), Roger (2009) for IT, and Debrun et *al.* (2008) and IMF (2009) for FR.

Appendix 6.2: Country List

Albania, Algeria, Angola, Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bolivia, Botswana, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Rep., Chad, Chile, China, Columbia, Congo Democratic Rep., Congo Rep., Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Rep., Denmark, Dominica, Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Finland, France, Germany, Gabon, Gambia, Georgia, Ghana, Greece, Grenada, Guatemala, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italia, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Rep., Kuwait, Kyrgyz Rep., Lao PDR, Latvia, Lesotho, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Seychelles, Singapore, Slovak Rep., Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Rep., Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Yemen Rep., Zambia.

Appendix 6.3: Countries having adopted IT and FR along with their *starting* dates (*Default starting* dates / *Conservative starting* dates)

ITer	FRer	IT_only	FR_only	IT_&_FR	IT_after_FR	FR_after_IT
Australia (1993/1994)	Angola (2005)		Angola (2005)	Australia (1993/1994)		
Brazil (1999/1999)	Argentina (2000)		Argentina (2000)	Brazil (1999)		
Canada (1991/1992)	Australia (1998)			Canada (1991/1992)		Australia (1998/1998)
Chile (1991/1999)	Austria (1999)		Austria (1999)	Chile (1991/1999)		Chile (2000/2000)
Columbia (1999/1999)	Belgium^{+} (1992)	Columbia (1999/1999)	Belgium (1992)			
Czech Republic (1998/1998)	Botswana (2003)		Botswana (2003)	Czech Republic (1998/1998)		
Finland* (1993/1994)	Brazil (2000)			Finland* (1993/1994)		Brazil (2000/2000)
Ghana (2007/2007)	Bulgaria (2003)	Ghana (2007/2007)	Bulgaria (2003)			
Guatemala (2005/2005)	Canada (1998)	Guatemala (2005/2005)				Canada (1998/1998)
Hungary (2001/2001)	Cape Verde(1998)		Cape Verde(1998)	Hungary (2001/2001)		
Iceland (2001/2001)	Chile (2000)			Iceland (2001/2001)		
Indonesia (2005/2005)	Costa Rica (2001)		Costa Rica (2001)	Indonesia (1967/1967)	Indonesia (2005/2005)	
Israel (1992/1997)	Czech Republic (2005)			Israel (1992/1992)	Israel (1992/1997)	Czech Republic (2005/2005)
Korea, Rep (1998/1998)	Denmark (1992)	Korea, Rep (1998/1998)	Denmark (1992)			
Mexico (1999/2001)	Ecuador (2003)		Ecuador (2003)	Mexico (1999/2001)		
New Zealand (1990/1990)	Equatorial Guinea (2007)		Equatorial Guinea (2007)	New Zealand (1990/1990)		
Norway (2001/2001)	Estonia (1993)		Estonia (1993)	Norway (2001/2001)	Norway (2001/2001)	Norway (2001/2001)
Peru (2002/2002)	Finland (1995)			Peru (2000/2000)	Peru (2002/2002)	Finland (1995/1995)
Philippines (2002/2002)	France (1998)	Philippines (2002/2002)	France (1998)			
Poland (1998/1998)	Germany (1972)		Germany (1972)	Poland (1997/1997)	Poland (1998/1998)	
Romania (2005/2005)	Hungary (2007)	Romania (2005/2005)				Hungary (2007/2007)
Slovak Republic* (2005/2005)	Iceland (2004)			Slovak Republic* (2002/2002)	Slovak Republic * (2005/2005)	Iceland (2004/2004)
South Africa (2000/2000)	India (2004)	South Africa (2000/2000)	India (2004)			
Spain* (1995/1995)	Indonesia (1967)			Spain* (1995/1995)		
Sweden (1993/1995)	Israel (1992)			Sweden (1993/1995)		
Switzerland (2000/2000)	Ireland (2000)		Ireland (2000)	Switzerland (2000/2000)		
Thailand (2000/2000)	Japan (1947)	Thailand (2000/2000)	Japan (1947)			
Turkey (2006/2006)	Kenya (1997)	Turkey (2006/2006)	Kenya (1997)			
United Kingdom (1992/1992)	Lithuania (1997)		Lithuania (1997)	United Kingdom (1992/1992)		

Appendix 6.3 (continued): Countries having adopted IT and FR along with their *starting* dates (*Default starting* dates / *Conservative starting* dates)

ITer	FRer	IT_only	FR_only	IT_&_FR	IT_after_FR	FR_after_IT
	Luxembourg (1990)		Luxembourg (1990)			
	Madagascar (2006)		Madagascar (2006)			
	Mauritius (2008)		Mauritius (2008)			
	Mexico (2006)		Namibia (2001)			Mexico (2006/2006)
	Namibia (2001)		Nigeria (2004)			
	Netherlands (1994)		Netherlands (1994)			
	New Zealand (1994)					New Zealand (1994/1994)
	Nigeria (2004)					
	Norway (2001)					
	Pakistan (2005)		Pakistan (2005)			
	Panama (2002)		Panama (2002)			
	Peru (2000)					
	Poland (1997)					
	Portugal (2002)		Portugal (2002)			
	Slovak Republic (2002)					
	Slovenia (2000)		Slovenia (2000)			
	Spain (2002)					Spain (2002/2002)
	Sri Lanka (2003)		Sri Lanka (2003)			
	Sweden (1996)					Sweden (1996/1996)
	Switzerland (2003)					Switzerland (2003/2003)
	United Kingdom (1997)					United Kingdom (1992/1992)
	United States of America^{+} (1990)		United States of America^{+} (1990)			

*: Finland, Spain and Slovak Republic abandoned their IT to join the Euro Area respectively in 1999 (Finland and Spain) and 2009. $^{+}$: The United States of America enacted FR in 1990 but abandoned it in 2002, so as Belgium in 1992 and 1999 respectively. Norway adopted IT and FR in the same year, 2001, so we set variables IT_&_FR, IT_after_FR and FR_after_IT simultaneously equal to 1 after both IT and FR adoption (in 2001). Armenia, Comoros, Hong Kong, Liberia, and Timor-Leste also adopted FR but due to lack of available fiscal and/or inflation data (which constitute one of our dependent variables), they are not included in our sample. Serbia adopted IT in 2006, but due to lack of data on fiscal balance, this country is dropped from the sample.
Data Sources: Rose (2007) and Roger (2009) for IT *starting* dates, and IMF (2009) for FR *starting* dates.

Appendix 6.4: Sources and definitions of data

Inflation rate	Annual growth rate of average CPI	World Economic Outlook (2010)
Primary fiscal balance (PFB)	Difference between general government revenue and expenditure (excluding interest payments), as GDP percentage.	
Overall fiscal balance (FB)	Difference between general government revenue and expenditure, as GDP percentage.	
Full-Fledged or Formal IT (conservative *starting* dates)	Binary variable taking the value 1 if in a given year a country operates formally under IT, zero otherwise. When we use the conservative *starting* dates of IT, we refer to full-fledged IT.	Rose (2007) and Roger (2009)
Soft or Informal IT (default *starting* dates)	Binary variable taking the value 1 if in a given year a country operates informally under IT, zero otherwise. When we use the default *starting* dates of IT, we refer to soft IT.	
Fiscal rule dummy (FR)	Binary variable taking the value 1 if a country placed, at the national level, a numerical limit on fiscal aggregates (fiscal balance, expenditure, revenue or debt)	Fiscal Rules Database of the IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division (2009)
Trade openness	Sum of imports and exports divided by GDP	Penn World Table (PWT.6.3)
Real per capita GDP	Real per capita GDP at constant prices. Proxy for a country's stage of development.	
Public Debt (% of GDP)	Gross General government debt, in percentage of GDP	Ali Abbas et *al.* (2010)
Government stability	Index ranging from 0 to 12 and measuring the ability of government to stay in office and to carry out its declared program(s).The higher the index, the more stable the government is.	International Country Risk Guide (ICRG, 2009)
Output gap	Difference between the logarithm of real GDP and the logarithm of a Hodrick-Prescott filtered trend of real GDP (with 100 as smoothing parameter).	Authors' calculations, based on data from WDI (2010)
Growth Rate of Terms of Trade	Annual relative change in the terms of trade	

Appendix 6.5: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Inflation Targeting Dummy (IT)	4,925	0.063	0.244	0	1
Fiscal Rule Dummy (FR)	4,725	0.118	0.323	0	1
IT_only	4,925	0.015	0.120	0	1
FR_only	4,925	0.073	0.261	0	1
IT_&_FR	4,925	0.053	0.224	0	1
IT_after_FR	4,925	0.011	0.106	0	1
FR_after_IT	4,925	0.033	0.178	0	1
Inflation rate	3,641	50.728	645.854	-17.640	24,411.03
Normalized inflation: Inflation/(1+Inflation)	3,641	0.100	0.152	-0.214	0.996
Overall fiscal balance (GDP %)	2,997	-2.143	7.522	-151.309	121.838
Primary fiscal balance (GDP %)	2,783	0.742	7.304	-147.492	123.181
Debt (GDP %)	3,719	69.524	65.306	0.318	2,092.922
Trade openness	3,969	82.788	48.722	1.086	456.562
Terms of Trade Growth Rate	3,883	0.017	0.382	-0.942	17.921
Output Gap	2,789	-0.004	0.054	-0.620	0.238
Real per capita GDP	3,969	9,946.41	11,187.57	153.16	88,292.58

Appendix 6.6: The effects of IT, FR, and their interactions, on the FB

Dependent Variable: Overall Fiscal Balance	**[1]**	**[2]**	**[3]**	**[4][a]**
Lagged Overall fiscal balance	0.334***	0.307***	0.317***	0.374***
	(0.060)	(0.090)	(0.078)	(0.052)
Lagged Debt/GDP	0.015*	0.015*	0.009*	0.022***
	(0.009)	(0.009)	(0.006)	(0.008)
Inflation Targeting (IT) Dummy	**2.170*** **			
	(0.644)			
Fiscal Rule (FR) Dummy		**1.266****		
		(0.646)		
IT_only			**2.816*** **	**2.144****
			(0.862)	**(0.838)**
FR_only			**1.260****	**0.646***
			(0.573)	**(0.340)**
IT_&_FR			**3.163***	**1.577***
			(1.836)	**(0.830)**
IT_after_FR			**3.398***	**4.043***
			(1.788)	**(2.128)**
FR_after_IT			**-1.367**	**-0.449**
			(1.774)	**(1.942)**
Output Gap	17.254**	21.691*	13.034	-2.650
	(8.022)	(11.416)	(8.594)	(13.038)
Trade Openness	-0.004	-0.001	0.001	-0.001
	(0.009)	(0.011)	(0.009)	(0.008)
Growth Rate of Terms of Trade	13.589***	13.450**	7.991*	10.157**
	(3.942)	(5.361)	(4.396)	(4.027)
Government Stability	0.882***	0.908***	1.324***	1.158***
	(0.264)	(0.320)	(0.291)	(0.236)
Logarithm of real per capita GDP	-0.009	-0.211	0.295	0.611
	(0.514)	(0.592)	(0.669)	(0.577)
Time Effects	Yes	Yes	Yes	Yes
Number of Observations	351	351	351	351
Arellano-Bond test for AR(2): P-value	0.186	0.169	0.351	0.259
Hansen test for over-identification: P-value	0.172	0.193	0.306	0.103

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Standard errors are in brackets. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. * $p < 0.11$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged fiscal balance, lagged debt/GDP, trade openness and government stability are treated as predetermined, while Time effects and Terms of Trade growth rate are considered as exogenous. Constant included (but not reported). a: estimations carried out using *conservative starting* dates of IT.

Chapter 7

Policy Mix Coherence and Monetary Policy in West Africa

7.1. Introduction

This chapter extends the analysis on the interplay between monetary and fiscal policymakers to the Economic Community of West African States (ECOWAS). Created in 1975 by the Treaty of Lagos, ECOWAS regroups 15 countries and constitutes the regional organization providing the framework for the integration process now underway in West Africa.[148] Eight of these fifteen countries – Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo – belong to a smaller regional sub-group, the West African Economic and Monetary Union (WAEMU). Although the WAEMU's creation in 1994 followed that of the ECOWAS, internal coordination within the WAEMU has proceeded more quickly than within the ECOWAS. The common currency shared by WAEMU members, the CFA Franc, issued by Central Bank of West African States is the key factor behind this gap in the pace of integration. Gambia, Ghana, Guinea, Nigeria and Sierra Leone have decided in 2000 to create a second common currency zone called West African Monetary Zone (WAMZ) within the ECOWAS.

The ultimate goal of this zone (ECOWAS) is to achieve both monetary and fiscal integration for all these 15 countries, the latter objective being a corollary, if not a prerequisite of the first one. A merger between the two currency zones (the WAEMU and the WAMZ) is thus the long-term target. The institutional framework guiding ECOWAS policies is essentially twofold: the fiscal integration and the common currency project. ECOWAS's fiscal integration framework is a set of benchmarks that promote fiscal governance. Similar to the standards criteria set out in the WAEMU's Growth, Convergence and Stability Pact, ECOWAS's economic convergence rules[149] intend to consolidate both public finances and overall macroeconomic environment, creating the orderly and positive context needed for a successful transition to an ECOWAS-wide common currency. The plan for a common West African currency has existed since the establishment of the ECOWAS. Today, the basic pattern that shapes the various economic policies in the region consists of two phases:

[148] The 15 ECOWAS member countries are Benin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

[149] These rules are also ranked in two groups. The four criteria in the top group are as follows: fiscal deficit less than 4%; inflation rate lower than 5%; net reserves to cover at least three months' exports, and central bank loans to revenue of not more than 10% of the previous year's fiscal revenue. In the second set of criteria, six guidelines: no new arrears are permitted, and all existing arrears must be cleared; fiscal revenue equivalent to 20% of GDP; wage bill of maximum 35% of total fiscal revenue; government investment equivalent to at least 20% of total fiscal revenue; and stable exchange rates as well as positive levels of real interest rates maintained by each country.

strengthen monetary integration within the WAEMU and achieve the creation of the WAMZ. Next, merge the two unions to obtain full monetary integration for ECOWAS. This monetary integration was planned for 2004, but awaits the creation of the WAMZ, which has been delayed by the inability of expected WAMZ members to meet the convergence criteria, either because of short-term arbitrage with higher economic growth reasons, or due to political economy restrictions. However, a number of obstacles including divergent national economic structures have hampered this project. Given the broad diversity of the national economies involved, it seems not evident for a common central bank to introduce a MP that is appropriate for each national context.

Indeed, a substantial strand of the literature stressed out the importance of monetary and fiscal policy coordination mechanisms. First, a number of studies conducted outside the context of monetary unions have emphasized the pivotal role of coordinated policies in macroeconomic stabilization (Alesina & Tabellini, *al.*, 1987; Villieu et *al.*, 1998; and Beetsma & Bovenberg, 2001). In the case of currency unions, studies have demonstrated that consistency in policy mix is even more important given that the survival of the union is at stake. With regard to the European monetary union, Fatas & Mihov (2002) and Gali & Perotti (2003) show that the need for increased coherence between national fiscal policies and the objective of a common currency led to enhanced fiscal discipline immediately prior to and after the launch of this currency. However, the short-lived nature of this corrective effect threatens the survival of the Union (Klein & Marion, 1997). With respect to monetary unions in Africa, Guillaume & Stasavage (2000) show that under certain conditions, monetary unions can enhance the credibility of government fiscal commitments. Debrun et *al.* (2002), in a study of the effects of monetary unions on fiscal discipline, conclude that the survival of an ECOWAS monetary union project can only be achieved by establishing rules, institutions and mutual monitoring processes that will give the union the role of a fiscal policy control agency. Ary Tanimoune et *al.* (2008) and Ary Tanimoune & Plane (2005), focusing on the WAEMU, highlighted respectively the cohesion among member countries and the presence of non-linear effects of fiscal policy within the union. Hefeker (2010) demonstrates that fiscal reform efforts made by monetary union countries are dependent on its level of asymmetry. Consequently, if the perspective of merging WAEMU and WAMZ takes place, the need for fiscal reform would become even clearer. This would make it more essential than ever an assessment of the impact of policy mix coherence on economic activity.

The primary goal of this article is thus to examine the degree of influence exerted by policy mix coherence on the effects of MP on economic activity. More specifically, this article tests the hypothesis that increased coherence between monetary and fiscal policies in ECOWAS countries would promote economic growth. The main contributions of this chapter, derived from data provided by a 12-member ECOWAS panel, are twofold. First, through an interactive variable between the monetary conditions index (MCI) and the primary structural fiscal balance representing respectively the MP trajectory and the fiscal policy trajectory, we highlight complementarity between the effects of MP and the impacts of fiscal policy on economic activity. Second, we demonstrate that this influence of policy mix coherence can be differentiated not only based on the economy's position within the four possible policy mix arrangements, but also relative to the two ECOWAS subsamples, namely the countries which already share a common currency in WAEMU on the one hand and the non-WAEMU countries on the other hand. Our results remain robust to alternative specifications used to calculate the MCI.

The rest of the chapter is organized as follows: Section 2 presents the variables used to assess policy mix considerations in ECOWAS. The econometric modeling is exposed in Section 3, and the results are displayed and discussed in Section 4. Section 5 consists of a brief conclusion and economic policy recommendations.

7.2. Natures of Policy mix

In this section, we present the interactive variable of the policy mix and its different natures. We first present the variable as the proxy of MP, the monetary conditions index. Then, we discuss the nature of the indicator of fiscal policy, the primary structural fiscal balance. Finally, on the basis of these two variables, we discuss the monetary and fiscal coordination-types regimes.

7.2.1. Monetary Conditions Index

Let us consider the Monetary Conditions Index (MCI) as a proxy of MP orientation.[150] As defined in the literature, MCI is the weighted sum of the difference between the logarithm of

[150] See Duguay (1994), Eika et *al.* (1996), Ericsson et *al.* (1998) and Aubert (2003). Also see Diarisso & Samba Mamadou (2000) for WAEMU.

the Central Bank real discount rate and its value of base year, and the difference between the logarithm of the real effective exchange rate (REER) and its value of the base year.[151] The MCI is given by equation (7.1),

$$MCI_{it} = \theta_{ir}\left(r_{it} - r_{it}^{base}\right) + \theta_{ie}\left(e_{it} - e_{it}^{base}\right) \tag{7.1}$$

The indices *i* and *t* refer respectively to country i and time period t. *r* represents the logarithm of the real discount rate and e, the logarithm of the real effective exchange rate. The MCI yields a synthetic indicator of MP orientation, since it provides an evaluation of the joint effects of interest rate and exchange rate policies on aggregate demand. Given that an increase in real discount rate and REER represents respectively a restrictive Central Bank credit conditions and a real appreciation of the exchange rate, thus a higher MCI indicates a restrictive MP.

One of the challenges in calculating MCI is the choice of the base year. In the absence of an objective reference (such as equilibrium level), average values for considered analysis period are conventionally used as reference value (Diarisso & Samba Mamadou, 2000). The MCI is then a summary measure of MP stance compared to the period average. The other major difficulty in calculating MCI is identifying the weight of each parameter. The method used by the central banks of Canada, France, and the West African states consists of deducting θ_{ir} and θ_{ie} from the estimation of the aggregate demand, which represents the link between real GDP variations (Δy_{it}) and MP instruments (r and e).[152] The aggregate demand function is such,

$$\Delta y_{it} = \alpha_{i1} r_{it} + \alpha_{i2} e_{it} + \eta_i + \varepsilon_{it} \tag{7.2}$$

η_i denotes the time invariant features specific to each country and ε_{it} the error term.[153] Estimated coefficients $\hat{\alpha}_{i1}$ and $\hat{\alpha}_{i2}$ are used to compile the respective weights to be used in the logarithm of the real discount rate and the REER (θ_{ir} *et* θ_{ie}),

[151] Since the real discount rate contains both negative and positive values, log (r) is replaced by log (1+r).
[152] Other central banks such as New Zealand's make use of aggregate demand function in which the dependent variable is the output gap (difference between the actual and the potential GDP).
[153] For robustness, we use an alternative specification that allows us to control for specific effects by country, by using homogenous coefficients between countries (α_1 and α_2). The calculated MCI values related to choice whether or not to use homogenous from the aggregate demand function are not markedly different: the indicators resulting from both variations are highly correlated at about 0.878 (see *Appendix 7.3*).

$$\theta_{ir} = \frac{\hat{\alpha}_{i1}}{\hat{\alpha}_{i1} + \hat{\alpha}_{i2}} \text{ and } \theta_{ie} = \frac{\hat{\alpha}_{i2}}{\hat{\alpha}_{i1} + \hat{\alpha}_{i2}}.$$

7.2.2. Primary structural fiscal balance

The cyclically-adjusted primary fiscal balance, also known as primary structural balance, is used as an indicator of the nature of the fiscal policy. It is calculated as the estimated residual of the equation linking the primary fiscal balance (SBS_{it}) to the difference between effective and potential GDP (*output gap* : OG_{it}):[154]

$$SBS_{it} = \delta_{it} OG_{it} + w_{it} \tag{7.3}$$

i refers to country i and *t* to time period t. w_{it} is the error term; it represents the portion of the primary fiscal balance not derived from the economic cycle. As such, w_{it} is considered as primary structural fiscal balance.[155]

7.2.3. Monetary and fiscal coordination-type regimes

Policy mix is the joint orientation of monetary and fiscal policies. Interactions between monetary authorities and governments take the form of coordination for maximizing economic activity. A policy mix is said coherent when that interaction is in the same direction. For example, in a Keynesian perspective, an expansionary MP should be implemented when fiscal policy is expansionary too. Similarly, in a perspective of coherence, it is expected that the monetary and fiscal policies are both restrictive. However, these patterns are not the only ones expressing the policy mix. Typically, it may be that MP is accommodative while fiscal policy is restrictive, or vice versa.

Let consider SBS a proxy of the fiscal policy; MCI a proxy of the nature of the MP and $SBS * MCI$ an interactive variable of the policy mix. In order to distinguish between MP

[154] The output gap is calculated as the difference between the logarithm of real GDP and its trend. The trend is obtained using the Hodrick-Prescott filter, with a smoothing parameter of 100. We also conducted estimations with a smoothing parameter of 6.25, but the results were not significantly different.

[155] We have used the primary structural fiscal balance instead of overall fiscal balance excluding grants (the principal criterion of fiscal convergence in ECOWAS) due to the lack of data over long enough periods for all countries.

effects, we have disaggregated the MCI into a combination of two indicators: *MCI_sup* that represents *restrictive* MP "regime" and *MCI_inf,* the *expansionary* MP "regime". For each country, we have set *MCI_sup* as equal to MCI if MCI is equal or greater than *median* value of MCI (MCI_{median}) for that country, and 0 otherwise. At the opposite, *MCI_inf* is equal to MCI if MCI is lower than MCI_{median} and 0 otherwise:[156]

$$MCI\_\sup = \begin{cases} MCI \text{ if } MCI \geq MCI_{median} \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad MCI\_\inf = \begin{cases} MCI \text{ if } MCI < MCI_{median} \\ 0 \text{ otherwise} \end{cases}$$

In a similar way, the primary structural fiscal balance is also disaggregated into two indicators: *SBS_sup* to sketch a restrictive fiscal "regime" and *SBS_inf* for an expansionist fiscal "regime". For each country, *SBS_sup* is equal to SBS if SBS is equal to or greater than 0 (level of a balanced SBS), and *SBS_sup* is equal to 0 otherwise; *SBS_inf* is equal to SBS if SBS is lower than 0 and *SBS_inf* is equal to 0 otherwise:[157]

$$SBS\_\sup = \begin{cases} SBS \text{ if } SBS \geq 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad SBS\_\inf = \begin{cases} SBS \text{ if } SBS < 0 \\ 0 \text{ otherwise} \end{cases}$$

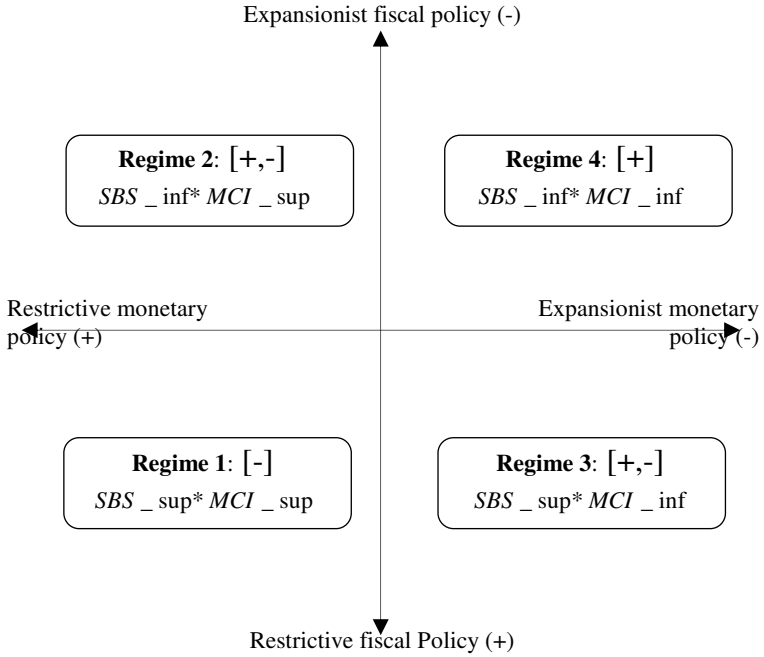
In order to determine the (non)coherent-type of policy mix regime, we have divided the policy mix indicator into four interactive variables that can be classified in two groups. On the one hand, we have the coherent regimes with $SBS\_sup * MCI\_sup$ a restrictive policy mix regime; $SBS\_inf * MCI\_inf$ an expansionary policy mix regime. On the other hand, it remains the non-coherent (or *indeterminate*) policy mix regimes, that is to say $SBS\_sup * MCI\_inf$ and $SBS\_inf * MCI\_sup$. Note that the sum of these four interactive variables is equal to the single interactive variable ($SBS * MCI$).[158] The four policy mix regimes and their expected signs on economic activity from a Keynesian perspective are represented in the quadrant (Figure 7.1), below.

[156] Note that $MCI\_sup + MCI\_inf = MCI*Dummy[1| MCI \geq MCI_{médian}] + MCI* Dummy[1| MCI < MCI_{médian}] = MCI$

[157] Note that $SBS\_sup + SBS\_inf = SBS*Dummy[1| SB \geq 0] + SBS*Dummy[1| SBS<0] = SBS$.

[158] After factorizing and given that (*MCI_sup+MCI_inf*)=MCI and (*SBS_sup+SBS_inf*)=SBS, the sum is equal to *MCI*SBS*.

Figure 7. 1: Policy mix regimes



7.3. Modelling policy mix and data

In this section, we introduce the econometric models followed by the presentation of data.

7.3.1. Econometric models

One of our objectives is to underline the influence of policy mix coherence on economic activity. We proceed in two steps. First, we estimate a "basic" equation as follows,

$$\Delta y_{it} = \alpha_i + \gamma_1 SBS_{it} + \gamma_2 MCI_{it} + \lambda SBS_{it} * MCI_{it} + \phi X_{it} + \mu_{it} \quad (7.4)$$

Δy_{it} is the real GDP growth rate of country i in year t, and X_{it} is a vector of control variables including external debt, terms of trade volatility, institutional quality as reflected in the control of corruption, political stability and official development assistance. α_i represents country fixed effects, while μ_{it} is the error term.

Given the possible different policy mix regimes as discussed previously, a negative sign of λ is not sufficient to conclude to a Keynesian hypothesis of a coherence-type complementarity between for example an expected recessionary effect of restrictive fiscal and monetary

policies ($\gamma_1 < 0$ and $\gamma_2 < 0$). Indeed, a closer analysis of the effects resulting from different combinations of SBS and MCI is somewhat needed. The second step consists of estimating a "refined" model that includes the different policy mix regimes. Thus, the equation to estimate becomes,

$$\begin{aligned}\Delta y_{it} = {} & \alpha_i + \gamma_1 SBS_{it} + \gamma_2 MCI_{it} + \lambda_1 (SBS\_sup_{it} * MCI\_sup_{it}) + \lambda_2 (SBS\_inf_{it} * MCI\_sup_{it}) \\ & + \lambda_3 (SBS\_sup_{it} * MCI\_inf_{it}) + \lambda_4 (SBS\_inf_{it} * MCI\_inf_{it}) + \phi X_{it} + \mu_{it}\end{aligned} \tag{7.5}$$

Still in a Keynesian perspective (which also underlies the calculations of the MCI in section 7.2), we expect $\gamma_1 < 0$, $\gamma_2 < 0$, $\lambda_1 < 0$, $\lambda_2 < 0$, $\lambda_3 < > 0$ and $\lambda_4 > 0$.[159] We estimate equations (7.4) and (7.5) using the panel Method of Fixed Effects with bootstrapped standard errors (given that two explaining variables, namely the MCI and SBS have been derived from previous estimated equations).

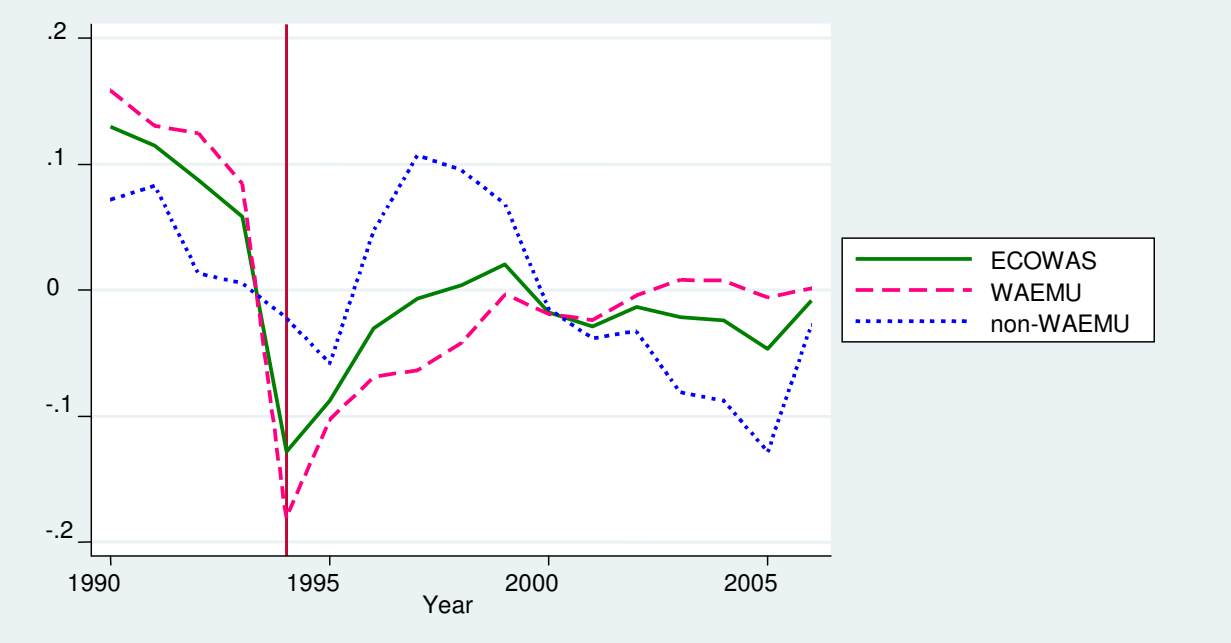
7.3.2. Data

The analysis covers ECOWAS countries (except Cape Verde, Liberia and Sierra Leone) from 1990 to 2006 due to availability of data. The Central Bank discount rate data are taken from *International Financial Statistics* (*IFS, 2007*). The real effective exchange rate data are from the *Centre d'Etudes et de Recherches sur le Développement International* database (*CERDI, 2007*). The primary fiscal balance data are those of the *World Economic Outlook* (*WEO, 2009*) and real GDP growth rate are from *World Development Indicators* (*WDI, 2010*).[160]

From the evolution of the monetary conditions index presented below in *Figure 7.2*, it appears a major break in 1994 for WAEMU countries. This break represents the devaluation of the CFA franc, a typical measurement of restrictive MP. This is probably why the rupture is less pronounced in the non-WAEMU countries. On the side of the nature of fiscal policy, represented by the primary structural fiscal balance, no clear pattern emerges from *Figure 7.3*.

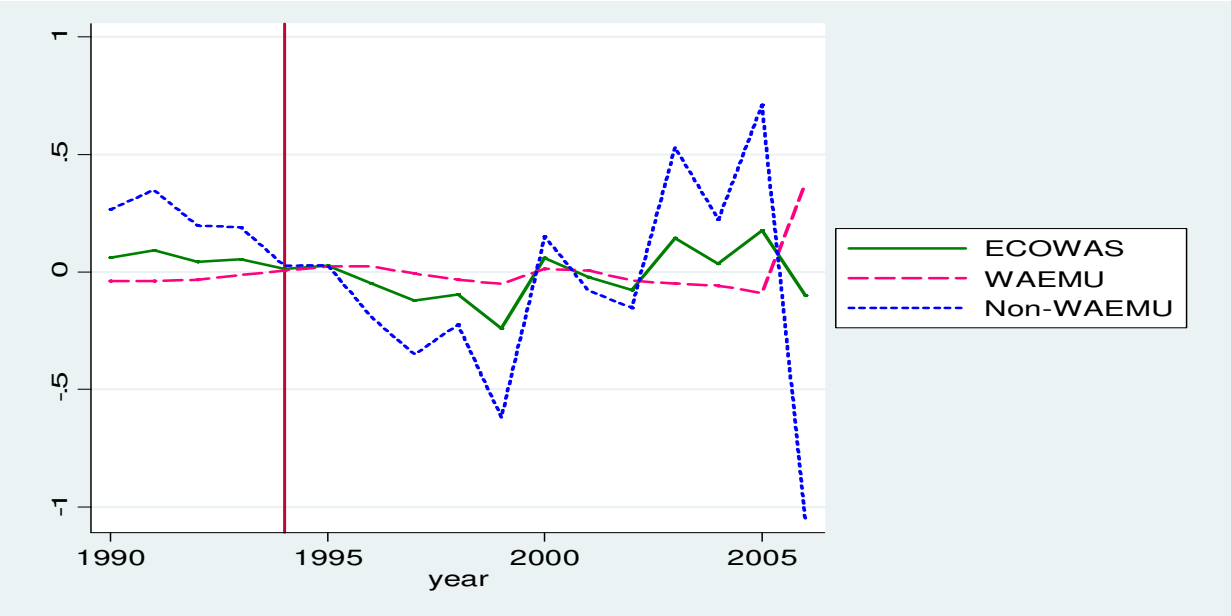
[159] See *Appendix 7.4* for a detailed analysis of the expected signs associated with the variables of interest.
[160] Further information on the definitions and descriptive statistics of these variables can be found in *Appendices 7.1* and *7.2* respectively.

Figure 7. 2: Monetary Conditions Index in ECOWAS countries: 1990-2006*



*: Based on heterogeneous coefficients in the aggregate demand. Sources: Authors' calculations, based on IFS (2007) and CERDI (2007).

Figure 7. 3: Primary Structural Fiscal Balance in ECOWAS countries: 1990-2006



Sources: Authors' calculations based on WEO (2009) data.

7.4. Results and discussion

Table 7.1 below shows the results of the basic model estimation. The MCI in this instance was obtained using a specific weight for each country. Given that MCI and SBS, the variables of interest, were calculated using parameters from a prior estimation of equations, the estimation of equations (7.4) and (7.5) with the simple Fixed Effects estimator would result in

biased standard errors (Pagan, 1984). To remedy this problem, the regression standard errors were bootstrapped with 500 iterations.

Table 7. 1: Influence of Policy mix coherence in ECOWAS over 1990-2006 (basic model)

Dependent Variable : Real GDP Growth	**ECOWAS countries**	**WAEMU countries**	**Non-WAEMU[1] countries**
	(1)	**(2)**	**(3)**
Monetary Conditions Index (MCI)	-1.109***	-0.905***	-1.525***
	(0.202)	(0.217)	(0.342)
Structural Primary Fiscal Balance (SBS)	-0.069	-0.260**	-0.062
	(0.071)	(0.124)	(0.082)
MCI*SBS	**-1.325****	**-4.583****	**-1.383*****
	(0.579)	**(2.269)**	**(0.483)**
External Debt/GDP	0.056*	0.129***	0.043
	(0.032)	(0.050)	(0.034)
Instability of Terms of Trade	-0.010***	-0.010**	-0.009*
	(0.002)	(0.004)	(0.005)
Control of Corruption	0.101***	0.070**	0.156
	(0.038)	(0.033)	(0.123)
Political Stability	0.015	0.021	0.007
	(0.012)	(0.017)	(0.021)
Public Aid/GDP	0.470	0.770	-0.545
	(0.532)	(0.754)	(0.537)
Country Fixed Effects	Yes	Yes	Yes
Number of observations	187	119	68
R^2	0.400	0.307	0.597
Wald Test (MCI=0, SBS =0, MCI*SBS =0): Chi-Square [P-value]	36.37 [0.000]	18.46 [0.000]	31.67 [0.000]

[1]: Except Cape Verde, Liberia and Sierra Leone. Bootstrapped (via 500 replications) standard errors in bracket. *** p<0.01, ** p<0.05, * p<0.1. Constant included (but not reported).

Column [1] of *Table 7.1* shows the results for all 12 ECOWAS countries: the estimated coefficients of MCI and SBS have the expected signs. The MCI seems to have a negative and significant impact on the economic growth rate: a one-point increase in the MCI lowers the economic growth rate by 1.11 percentage points in ECOWAS countries. However, the structural budget balance seems not to affect significantly economic growth. The control variables also appear with the expected signs: external debt coefficient is positive. That seems to demonstrate that debt in ECOWAS countries is contained within sustainable limits with no negative impact on economic activities. Also, the quality of institutions, as approximated by control of corruption, favorably impacts economic activity. The estimated coefficients of political stability and official development assistances, while appearing with the expected positive signs, seem to be not statistically significant. At the opposite, the terms of trade volatility seems to burden heavily economic activities in ECOWAS. Column [2] in *Table 7.1* illustrates the results from WAEMU. The estimated MCI coefficient remains negative; the fiscal balance now has a significant negative impact on economic activity. The last column of *Table 7.1* shows results for non-WEAMU members of ECOWAS. These results are very close

to those in the full sample in both qualitative and quantitative terms. From all three columns, it appears that the policy mix $(MCI * SBS)$ coefficient has the expected negative sign and is significantly different from zero, indicating that restrictive MP and restrictive fiscal policy feed positively on each other to undermine economic activity.[161] In particular, for WAEMU countries, that coefficient is almost three times greater than the one estimated for all ECOWAS and even the non-WAEMU countries. These results seem to highlight the expected fact that policy mix coherence has an influence on the individual effect of monetary (MCI) or fiscal (SBS) policy on economic activity, especially in the WAEMU where monetary integration is more advanced. Nevertheless, as indicated at the previous section, an estimated negative coefficient of the interactive variable is not relevant to assess the total impact of monetary or fiscal policy on economic activity. Estimations based on disaggregated policy mix variables are thus carried out. The results are depicted in *Table 7.2*.

Two important results emerge from the first column of *Table 7.2*. Firstly, when policy mix is coherent, that is to say either in restrictive $(MCI\_sup * SBS\_sup)$ or expansionary $(MCI\_inf * SBS\_inf)$ regime, the total marginal effect of restrictive monetary conditions seems to be recessionary in ECOWAS. Specifically, in the regime of "coherent-restrictive" policy mix, the recessionary effect of a restrictive MP seems to appear even more marked than fiscal policy is also restrictive. This is typically a Keynesian effect. On the other side, in the case of "coherent-expansionist" policy mix, an expansionist fiscal policy seems to strengthen the recessionary effect of a restrictive MP. That may be explained by the fact that a restrictive MP implemented in an undisciplined fiscal context leads to a growing debt burden. As a result, there would be an increased inflationary pressure due to private sector anticipation of monetization of the government deficit, consistently with the unpleasant monetarist arithmetic (Sargent & Wallace, 1981). The second main result is that when the policy mix is *incoherent* $(MCI\_sup * SBS\_inf$ or $MCI\_inf * SBS\_sup)$, the marginal effect of MP sends an ambivalent signal, since the recessionary effect of restrictive monetary conditions can be offset by the expansionist fiscal policy.[162]

[161] The Wald test for the joint significance of the coefficients of variables MCI, SBS and *MCI*SBS* also shows that these three coefficients are jointly significant.

[162] For a detailed analysis of the disaggregation of the marginal effects of MP according to policy mix regimes, see *Appendix 7.4*.

Table 7. 2: Influence of Policy mix coherence in ECOWAS (refined model)

Dependent Variable : Real GDP Growth	**ECOWAS countries**	**WAEMU countries**	**Non-WAEMU[1] countries**
	(1)	**(2)**	**(3)**
Monetary Conditions Index (MCI)	-0.890***	-1.210***	-1.066*
	(0.214)	(0.399)	(0.624)
Structural Primary Fiscal Balance (SBS)	-0.053	-0.089	-0.026
	(0.090)	(0.170)	(0.101)
MCI_sup*SBS_sup	**-1.720***	**6.651**	**-1.942***
	(0.877)	**(7.974)**	**(0.991)**
MCI_sup*SBS_inf	**-2.043***	**-11.08*****	**-1.905***
	(1.042)	**(4.227)**	**(0.972)**
MCI_inf*SBS_sup	**-0.680**	**1.690**	**-0.436**
	(2.001)	**(7.330)**	**(3.340)**
MCI_inf*SBS_inf	**3.532***	**-2.812**	**3.268**
	(1.802)	**(8.209)**	**(3.588)**
External Debt/GDP	0.046*	0.134***	0.037
	(0.027)	(0.044)	(0.034)
Terms of Trade Volatility	-0.009***	-0.009**	-0.007
	(0.003)	(0.004)	(0.005)
Control of Corruption	0.088***	0.067*	0.071
	(0.031)	(0.037)	(0.115)
Political Stability	0.018*	0.025	0.006
	(0.011)	(0.019)	(0.016)
Public Aid/GDP	0.601	0.764	-0.448
	(0.578)	(0.683)	(0.498)
Country fixed effects	Yes	Yes	Yes
Number of observations	187	119	68
R^2	0.442	0.327	0.665
Wald Test (MCI=0; SBS=0; MCI_sup*SBS_sup=0; MCI_sup*SBS_inf=0; MCI_inf*SBS_sup=0; MCI_inf*SBS_inf=0):			
Chi-Square [P-value]	53.32 [0.000]	18.89 [0.004]	23.72 [0.000]

[1]: Except Cape Verde, Liberia and Sierra Leone. Bootstrapped (500 replications) standard errors in bracket. *** p<0.01, ** p<0.05, * p<0.1. Constant included (not reported)

Column 2 in *Table 7.2* illustrates the effects based on differentiated policy mix regimes in WAEMU. These results show that inconsistent policy mix situations are the only ones that have a significant influence on the effect of monetary conditions on economic activity. However, the marginal impact of MP in these situations is undetermined. By contrast, in the cases of coherent policy mix, the effects of MP seem not to have a relevant link with the nature of the fiscal policy, probably because of the prevailing coordination provided by the WAEMU Economic and Growth Stability Pact implemented within the union.

In order to test the validity of results for the specification used, an alternative specification of the estimation of the aggregated demand equation was substituted. The MCIs were then calculated based on estimations equation of the aggregated demand using equal weights for each country. The results are quantitatively and qualitatively similar to those noted above,

except for the estimated coefficient of $MCI\_sup * SBS\_inf$ that then becomes statistically significant, whereas that of $MCI\_sup * SBS\_sup$ becomes insignificant.[163]

7.5. Concluding remarks and Policy implications

In this chapter, we have highlighted the role of policy mix coherence on economic activity in ECOWAS from 1990 to 2006. In ECOWAS, little has been said about the coherence of policy mix. Our contribution to the literature on policy mix coherence in monetary unions is twofold.

First, based on monetary conditions index and the structural primary fiscal balance (used to assess the orientations of monetary and fiscal policies in ECOWAS, respectively), we have shown that a "coherent-restrictive" policy mix amplifies the recessionary effect on economic activity of monetary and fiscal policies separately considered. Second, we have identified heterogeneities regarding monetary impacts on economic activity influenced by different regimes of policy mix. Indeed, the disaggregation of the policy mix interactive variable into four possible combinations of monetary-fiscal policies orientation allowed us to demonstrate that the total marginal effect of MP is conditional to (none-)coherence-type of the policy. Our results corroborate the idea that the influence of coordinated policy mix is more pronounced in monetary unions, as illustrated by the WAEMU sub-sample. When policy mix in these countries is coordinated, the effect of MP is no longer dependent on fiscal policy. This effect becomes ambivalent, or even unintended, in the absence of coordination.

These results, which remained robust to alternative specifications used to calculate the MCI, have major policy implications for a potential transition to a common currency within ECOWAS. A common currency signals the end of national control over MP. To minimize the potential negative impacts on growth resulting for such a scenario, coordination between national fiscal policies must be ensured. Otherwise, the policy mix is likely to be incoherent, exerting unintended influence on the effects of MP on economic activity, and undermining or even offsetting the positive effects expected from the common currency. This scenario would seriously erode momentum toward monetary integration or threaten the survival of an existing one.

[163] The robustness test for both the basic model and the refined model appear in *Appendix 7.5*.

Appendices

Appendix 7.1: Sources and Definitions of Data

Variables	Definition	Sources
Real discount rate	Central bank discount rate adjusted for inflation	IFS (2007)
Real effective exchange rate (REER)	Weighted mean of bilateral exchange rates adjusted for inflation differential between 2 countries. The weights used are those of the top 10 trading partners (import + export)	CERDI (2007)
Primary structural fiscal balance (SBS)	Cyclically-adjusted primary fiscal balance, as GDP percentage.	Authors' calculations based on WEO (2009)
Monetary conditions index (MCI)	Weighted mean of the difference between the logarithm of the real discount rate and its historic mean and the difference between the REER logarithm and its historic mean. The weights come from the estimations of the aggregated demand.	Authors' calculations
SBS_sup	Restrictive fiscal *regime*. Variable equal to SBS if SBS ≥ 0, and 0 otherwise	Authors' calculations
SBS_inf	Expansionist fiscal *regime*. Variable equal to SBS if SBS < 0, and 0 otherwise.	Authors' calculations
MCI_sup	Restrictive monetary *regime*. Variable equal to MCI if MCI $\geq MCI_{médian}$, and 0 otherwise	Authors' calculations
MCI_inf	Expansionist monetary *regime*. Variable equal to MCI if MCI < $MCI_{médian}$, and 0 otherwise	Authors' calculations
Real GDP growth rate	Annual GDP (at constant prices) variation rate	WDI (2010)

Appendix 7.2: Descriptive statistics

Variable	Obs.	Mean	Standard error	Min	Max
ECOWAS					
Monetary conditions index (MCI)	204	-6.8e-09	0.1029	-0.3161	0.3719
MCI (model with homogenous coefficients)	204	3.65e-09	0.1008	-0.2836	0.3847
Primary structural fiscal balance (SBS)	204	2.4e-09	0.6013	-6.0112	2.6907
Real effective exchange rate (REER)	204	85.885	34.953	45.881	359.27
Real discount rate	204	0.0208	0.0946	-0.3429	0.1957
Primary fiscal balance	204	-0.0677	1.0121	-12.738	2.6482
Output gap	204	-0.0186	0.1319	-0.9577	0.4008
Real GDP Growth rate	204	1.0440	0.7164	0	4.3491
External Debt/GDP	204	-0.086	1.403	-16.580	1.935
Public Aid/GDP	204	0.1353	0.1132	0.0037	0.7400
Terms of Trade Volatility	204	12.712	8.467	0.363	39.388
Political Stability	187	7.603	2.209	2.333	11.000
Control of Corruption	187	2.429	0.833	0	4.000

Appendix 7.3: Partial correlation between the two methods of MCI calculation

	MCI (with heterogeneous coefficients)	MCI (with homogenous coefficients)
MCI (with heterogeneous coefficients)	1.0000	
MCI (with homogenous coefficients)	0.8786*	1.0000

Appendix 7.4: Signs of MCI subject to policy mix regimes (Keynesian perspective)

	Regime 1: *MCI_sup*SBS_sup*	Regime 2: *MCI_sup*SBS_inf*	Regime 3: *MCI_inf*SBS_sup*	Regime 4: *MCI_inf*SBS_inf*
Marginal effect MCI in a case of balanced fiscal balance (SBS=0)	-	-	-	-
Expected sign of *MCI*SBS:* (A)	-	-	?	+
Expected sign of SBS: (B)	+	-	+	-
Expected sign of (A*B)	-	+	?	-
Total marginal effect of *MCI*	- -	- +	- ?	- -

Appendix 7.5: Robustness Checks (basic Model)

Dependent Variable : Real GDP Growth	**ECOWAS countries**	**WAEMU countries**	**Non-WAEMU[1] countries**
	(1)	**(2)**	**(3)**
Monetary Conditions Index (MCI)	-1.010***	-0.618***	-1.590***
	(0.190)	(0.239)	(0.306)
Structural Primary Fiscal Balance (SBS)	-0.072	-0.223*	-0.078
	(0.083)	(0.126)	(0.097)
MCI*SBS	**-1.437****	**-4.189***	**-1.723*****
	(0.664)	**(2.404)**	**(0.561)**
External Debt/GDP	0.064*	0.132***	0.050
	(0.037)	(0.049)	(0.044)
Instability of Terms of Trade	-0.010***	-0.010**	-0.009*
	(0.003)	(0.004)	(0.005)
Control of Corruption	0.080**	0.057*	0.162
	(0.040)	(0.034)	(0.155)
Political Stability	0.022*	0.027*	0.016
	(0.011)	(0.016)	(0.024)
Public Aid/GDP	0.553	0.912	-0.252
	(0.527)	(0.728)	(0.574)
Country Fixed Effects	Yes	Yes	Yes
Number of observations	187	119	68
R^2	0.342	0.271	0.528
Wald Test (MCI=0, SBS =0, MCI*SBS =0):			
Chi-Square [P-value]	34.82 [0.000]	8.33 [0.039]	27.92 [0.000]

[1]: Except Cape Verde, Liberia and Sierra Leone. Bootstrapped (via 500 replications) standard errors in bracket. *** p<0.01, ** p<0.05, * p<0.1. Constant included (but not reported)

Appendix 7.6: Robustness Checks (Refined Model)

Dependent Variable : Real GDP Growth	**ECOWAS countries**	**WAEMU countries**	**Non-WAEMU[1] countries**
	(1)	**(2)**	**(3)**
Monetary Conditions Index (MCI)	-0.760***	-0.812*	-1.125**
	(0.198)	(0.449)	(0.492)
Structural Primary Fiscal Balance (SBS)	-0.038	-0.158	-0.019
	(0.139)	(0.229)	(0.160)
MCI_sup*SBS_sup	**-2.740***	**5.605**	**-2.903**
	(1.398)	**(9.031)**	**(4.245)**
MCI_sup*SBS_inf	**-1.931***	**-9.115***	**-2.096***
	(.985)	**(5.220)**	**(1.069)**
MCI_inf*SBS_sup	**-0.658**	**-2.553**	**-0.317**
	(2.289)	**(8.582)**	**(3.722)**
MCI_inf*SBS_inf	**5.203***	**-0.601**	**4.899***
	(2.976)	**(12.23)**	**(2.499)**
External Debt/GDP	0.051*	0.143**	0.039
	(0.026)	(0.062)	(0.051)
Instability of Terms of Trade	-0.009***	-0.009**	-0.005
	(0.003)	(0.004)	(0.006)
Control of Corruption	0.069**	0.058*	0.054
	(0.034)	(0.035)	(0.141)
Political Stability	0.024*	0.033*	0.013
	(0.012)	(0.018)	(0.019)
Public Aid/GDP	0.664	0.888	-0.259
	(0.530)	(0.747)	(0.518)
Country fixed effects	Yes	Yes	Yes
Number of observations	187	119	68
R^2	0.392	0.286	0.616
Wald Test (MCI=0; SBS=0; MCI_sup*SBS_sup=0; MCI_sup*SBS_inf=0; MCI_inf*SBS_sup=0; MCI_inf*SBS_inf=0):			
Chi-Square [P-value]	31.66 [0.000]	14.81 [0.022]	17.70 [0.007]

[1]: Except Cape Verde, Liberia and Sierra Leone. Bootstrapped (via 500 replications) standard errors in bracket. *** p<0.01, ** p<0.05, * p<0.1. Constant included (not reported)

GENERAL CONCLUSION

Inflation Targeting (IT) and Fiscal Rules (FRs) are gaining considerable popularity among policymakers and academia since the early 1990s. To date, around 30 and 80 countries, in the developed as well as in the developing world use them to frame the conduct of monetary and fiscal policies, respectively. As rules-based policy frameworks, both IT and FRs share the common ultimate goal of conferring credibility to macroeconomic policies. As such, they aim to ensuring macroeconomic stability, which is a key precondition for achieving strong and balanced long term economic growth, and in turn for reducing poverty and improving living standards. Besides the lack of alternative credible frameworks for guiding the conduct of macroeconomic policies, one of the main explanations underlying this impressive number of countries seduced by one or other of these regimes lies on the alleged macroeconomic benefits associated with their implementation. For illustration, on the one hand, although a little controversial, the existing literature argues that IT adoption has been followed by a downward trend in inflation dynamics, interest rates levels and exchange rates pass-through, and without an increase in output volatility or harmful effects on output growth, notably in developing countries. On the other hand, if well designed and implemented with strong institutional supportive procedures, FRs have also been found to be conducive to more fiscal discipline and more countercyclical fiscal policies.

The present thesis is concerned with both these rules-based macroeconomic policy frameworks and has developed the existing literature in several directions. First of all, the thesis, in its first chapter, started with a broad description of the conceptual framework of both IT and FRs and then reviewed widely their existing experiences around the world, along with the existing evidence on their main macroeconomic consequences. It appears that both regimes display many similarities with regard to the design of their institutional parameters, except on the recipient authorities to which their constraining properties apply (namely central bankers and governments, respectively). Both frameworks also differ on the length of time during which their constraining feature applies to policymakers. Indeed, while it has been shown that the favorable inflationary effects of IT get reinforced with the time length since its adoption, the disciplinary effect of FRs tends to vanish over time, suggesting that *reputation-building* and *credibility-signaling* mechanisms are central to their discipline-enhancing effects, respectively.

Then Chapters 2 to 4 of the thesis, relying on this elucidation of the conceptual framework and the wide survey of the existing literature, focused on highlighting new evidence on the

macroeconomic effects of IT and FRs. Chapter 2 addressed the FDI-conducive effect of IT. In this regard, we found that IT adoption helps attracting more FDI inflows in developing countries, suggesting that even though IT is not directly concerned with FDI, it may however enhance FDI inflows through a side-effect, namely by rendering more stable and predictable the macroeconomic environment. Such an effect is consistent with the classical FDI *pull* factors literature, for which institutional quality is a legitimate part, an ingredient also potentially influenced by IT adoption. The third Chapter of the thesis is devoted to examining the likelihood of such a quality-enhancing effect of IT on economic institutions. This chapter built upon a simple theoretical model to demonstrate that IT adoption provides strong incentives, from a public finance stance viewpoint, for governments to undertake reforms designed to improve the quality of institutions, as IT constrains government discretion when it comes to raising seigniorage revenue. This theoretical postulate is thereafter supported by a rigorous and robust econometric setup. Last but not the least, Chapter 4, filled a gap in the existing literature by re-appraising more formally the discipline-enhancing role of FRs. More precisely, this Chapter took advantage of the recently-developed *propensity scores-matching* methods to account for the first time, for the *self-selection* problem in FRs adoption while assessing their budgetary performances. It turned out that FRs do really improve fiscal discipline in developing countries, as measured by the cyclically-adjusted primary fiscal balances. Interestingly, this effect varies with the type of rules: while Budget Balance Rules and Expenditure Rules have significant discipline-enhancing effects, the effect of Debt Rules appears mixed and not significantly different from zero. Furthermore, this discipline-enhancing effect of FRs was found to differ according to countries' characteristics: number of FRs in place, time length since FRs adoption, presence of supranational FRs, government fractionalization and government stability.

The novelty of the thesis also lies on the analysis of the role of the interplay between monetary and fiscal policymakers for inflationary and fiscal outcomes, an issue that we addressed in the last three chapters of the thesis. In this regard, the fifth Chapter of the thesis showed that the adoption of IT, a MP framework, proved to be also sufficiently binding for fiscal authorities to providing them with strong incentives for more fiscal discipline, notably in developing countries. Such a result is entirely novel in the existing literature which considered rather fiscal discipline just as a precondition for IT adoption, not as its possible consequence. This finding that IT, a MP regime, can serve as a good device for shaping fiscal behaviors therefore constituted a fertile ground for further exploration on the role of the

interplay between monetary and fiscal authorities. Chapter 6 was devoted to this task. It shed light on the influence of the interactions between IT and FRs, as well as that of the timing of their adoption, for inflation dynamics and fiscal behaviors. Relevant conclusions emerged from this chapter. First, some complementarity is at work in the effectiveness of IT and FRs, as adopting both IT and FRs leads to better results in terms of running fiscal surpluses and in terms of bringing down average inflation than adopting only one of these two frameworks. Interestingly, this chapter also highlighted the dominance of the sequence which consists of introducing FRs first before adopting IT, with respect to the opposite sequence, regarding their fiscal and inflationary effects.

The thesis ends up the exploration on the role of the interplay between monetary and fiscal authorities, with a particular focus on a regional cooperation Area in Africa, namely the Economic Community of West African States (ECOWAS). In line with the literature on the coordination mechanisms of economic policy in Monetary Unions, this last chapter (Chapter 7) found evidence showing that better coherence between monetary and fiscal policies yields higher economic growth in ECOWAS. Consequently, this chapter highlighted formally for the first time, the existence of coherence-type complementarities between MP and fiscal policy with regard to their effects on economic activity. The influence of the coherence of policy mix on the effect of MP was also found to differ according to the stance of the economy within the four possible regimes of policy mix, mostly in the West African Economic and Monetary Union (WAEMU), where integration is deeper than in the non-WAEMU ECOWAS countries, thanks to the common currency (the CFA Franc) they share.

Policy Implications and Avenues for Future Research

Relevant policy messages emerge from these seven chapters of the thesis. First, **IT is a legitimate part of the policy toolkit available to policymakers in developing countries in their competition to attract more FDI inflows**. This is particularly important, since not only it is well-known that FDI is the most stable external capital flowing into developing countries, allowing them to close their domestic saving gaps and finance the development agenda, but also exhibit growth-promoting effects through the transfers of technology, knowledge and managerial skills. Second, **the introduction of rules-based fiscal policy frameworks (FRs) remains a credible remedy for governments in developing countries against fiscal indiscipline.** This is particularly important in the current context, where the implementation

of massive stimulus plans has eroded fiscal positions in many countries, which commands to undertake credible measures to put back public finances on a sustainable path.

Nevertheless, it is important to keep in mind that the **simple adoption of IT or FRs is not sufficient to attract more FDI or guarantee fiscal discipline.** For a full operation of the virtues of both these rules-based policy frameworks, policymakers need to account carefully for some points while designing or implementing them. Regarding FRs, their introduction must be accompanied with a set of **other measures, such as fiscal transparency, fiscal responsibility, enforcement mechanisms, sanctions and independent fiscal institutions (fiscal councils).** Countries must also ensure democratization and stability of the political process, and to some extent, resort to political systems oriented toward more centralization in the budget process, including *inter alia* the adoption of majority voting rules and presidential systems, to reap the best of the disciplinary effects of FRs. More broadly, for both IT and FRs, **countries need to fulfill some key preconditions before adopting them, notably in developing countries**, where structural weaknesses may hamper the credibility of MP or fiscal policy announcements, and subsequently threaten the viability of IT or FRs. These include the presence of fiscal dominance, the substantial proportion of seignoriage as a source of government financing, vulnerability to swings in external capital flows, weakness of the banking system, weakness of institutional quality and the lack of sophisticated forecasting infrastructures. Countries should remove or at least mitigate these bottlenecks before committing fully to IT or FRs.

In this light, it is worth recalling that most current ITers or FRers did not meet the aforementioned prerequisites at the beginning of IT or FRs, but after their adoption, the fear of missing their announced targets for inflation or fiscal aggregates urged them to undertake bold reforms aiming at fulfilling these precondition-gaps. Particularly for this thesis, the better budgetary outcomes and institutional quality found to have followed the implementation of IT regimes are striking illustrations of such scenarios. Consequently, fiscal discipline and institutional quality should not be viewed only as preconditions for a credible adoption of IT, but also as its possible consequences, notably in developing countries. To some extent, this suggests that **IT can serve as a good device for delivering fiscal discipline or institutional quality in the developing world**, but beyond a minimum threshold level of these variables. Undoubtedly, identifying such threshold effects constitutes and open avenue for future research.

Another related policy message is that **it appears desirable for countries to adopt IT gradually, implementing first a "soft" version of the regime, in which they mitigate the output costs of the disinflation process, before switching to Full-Fledged IT subsequently**, when the disinflation process is over and the main preconditions are met. Besides, while designing the institutional parameters to support the IT framework, policymakers need to consider options aimed at **striking the right balance between credibility and flexibility**. Put simply, while anchoring inflation expectations, a particular attention should be paid to conferring enough room to central bankers to expand the economy in the face of contractionary shocks, all the more when the risk of deflation outweighs the risk of recession, a point that have been re-put at the forefront of the policy agenda during the recent global recession and financial crisis. The definition of ex-ante escape clauses and the consideration of longer term horizons for the targeted variables are other relevant parts of the solution in this regard. The same also applies to FRs, where **the "cycle-friendly" feature of FRs needs to be taken into account while designing their institutional parameters**. **But tough transparency requirements should accompany the design of such parameters to avoid their misuse for discretionary purposes.**

Interestingly, this thesis recalls the necessity for higher coordination between monetary and fiscal authorities when it comes to designing and implementing macroeconomic policies. On the one hand, with regard to West Africa, an obvious relevant policy recommendation emerging from this thesis refers to the current project of an ECOWAS-wide monetary union, for which **better policy mix coherence sounds like a pivotal prerequisite. Indeed, given the heterogeneity in the economic structure of its members States, more policy mix coherence seems necessary to avoid unexpected impacts of MP on economic activity.** The member States of this regional organization should thus work toward a better harmonization of their macroeconomic policies and the establishment of strong regulation and supervision mechanisms before engaging fully into a common currency. In this regard, the current difficulties faced by the Eurozone, mainly led by the Sovereign debt crisis centered in Greece, but also present across the southern Euro Area (Italy, Portugal and Spain) and Ireland, are highly instructive. From this crisis, it emerged that a common currency Area needs to rely on strong institutional arrangements that actually work, capable of providing all member States with credible incentives for conducting sound fiscal and economic policies, with the ultimate goal of preserving the viability of the monetary union. The establishment of such institutional arrangements also needs to be accompanied with tough transparency and sanction

mechanisms, preferably monitored by independent fiscal agencies, to avoid the development of "hidden accounting" practices. Besides, it is worth mentioning that the introduction of the "*Golden Rule*" by the German Chancellor Merkel while other countries, including France, are reluctant to move in the same direction constitutes a factor which is likely to weaken the confidence of the financial markets with regard to the soundness of the Area. For sure, Eurozone countries need to act in unison and have a common vision of the future. A key message in this regard is that the survival of a monetary union requires having a centralized fiscal entity capable of acting in a crisis on behalf of the common Area as a whole. This requires among others the transfer of sovereignty from individual member states to a supranational authority. Put differently, the monetary integration must be accompanied with fiscal and political integration/or harmonization. This opens a related issue regarding the relevance of common Bonds, with reference to the (nonconsensual) proposition of the so-called "*Eurobonds*" as a solution for the Eurozone debt crisis. Indeed, on the one hand, the proponents of these common Bonds argue that this will lower the financing costs for ailing countries, consistently with the costs-sharing criteria of an Optimum Currency Area. On the other hand, their opponents not only defend the idea that the introduction of these Eurobonds would not reduce the costs of the current sovereign debt crisis but simply redistribute them, but also would weaken incentives for prudent and sustainable fiscal policies without offering a long-term crisis resolution. To the extent that the Eurozone is (or want to be) an Optimum Currency Area, a reasonable compromise seems to be the road toward *fiscal federalism*, in that the creation of common Bonds is relevant provided that strong governance reforms of the Area are undertaken. This includes notably the outright sovereignty transfers to the supranational level. Future research should therefore focus on shedding light on the relevance and/or political feasibility of such an approach, and on identifying the key parameters necessary for its effectiveness. West African policymakers should therefore inspire from these Eurozone painful experiences and adapt them carefully to their specific contexts in their ECOWAS-wide common currency union project.

On the other hand, this thesis taught us that adopting both IT and FRs seems a better strategy than adopting only IT or enacting only FRs, regarding their inflationary and budgetary outcomes. Put differently, IT and FRs act complementarily, *i.e.* they feed positively on each other to affect inflation dynamics and shape fiscal behaviors. Consequently, **it is advisable for countries to implement jointly IT and FRs to reap the best of their isolate discipline-enhancing virtues on the conduct of MP and fiscal policies.** Furthermore, when

considering the prospect of introducing both IT and FRs, countries need to care about the timing of adoption. In this light, **the sequence, consisting of *introducing FRs before adopting IT* appears superior to the opposite sequence, regarding their inflationary and budgetary outcomes**. Indeed, introducing first FRs allows driving away all forms of fiscal dominance or strengthening the fiscal stance, which then constitutes a fertile ground for implementing credibly IT. This may explain the better macroeconomic consequences associated with this sequence of adoption. Undoubtedly, a major question arising from the prospect of adopting both IT and FRs relates to the extent to which such an adoption strategy affects the stabilization function of monetary and fiscal policies. Indeed, enacting both IT and FRs may constrain inappropriately policymakers and result either in significant output costs associated with their implementation or less flexibility to cope temporally with the contractionary shocks hitting the economy. Accordingly, further discussion seems well warranted around this issue in the future.

In the same vein, it is worth noting that even though IT and FRs are conducive to macroeconomic stability, they are however not sufficient for achieving balanced long term economic growth and hence reducing poverty and improving living standards. Indeed, thanks to the recent global recession and financial crisis, **macroeconomic stability has been found to be insufficient for guaranteeing financial stability**. This sparked the growing debate regarding the role of MP in the face of assets price fluctuations, as summarized by the two following views, namely "leaning against the wind" *versus* "cleaning up the mess when the bubble bursts" (see, *e.g.*, Cúrdia & Woodford, 2009; and Bernanke, 2010). In this regard, the question relative to the usefulness of IT for financial stability should be deserved further attention, so as the influence of macroprudential regulations on the conduct of MP more broadly. The debate on the superiority of IT over Price Level Targeting or *vice-versa* when it comes to anchoring inflation expectations while providing enough room to central bankers to escape the *Zero Lower Bound* also remains an open issue that needs to be carefully addressed in future research, as raised by Walsh (2011). Regarding FRs, the current Eurozone Sovereign Debt crisis, driven to some extent by "hidden accountings" practices has renewed the attention that should be paid to the fight against the "creative accounting practices" in the budget process. To this end, **the creation of independent fiscal bodies (fiscal agencies or councils), capable of constituting a depoliticized force for monitoring the budget process on the basis of more reliable and realistic forecasts seems to be, in addition to the establishement of strong transparency and accountability procedures, the ultimate**

"firewall" for preserving the usefulness of FRs as credible device for ensuring permanently fiscal credibility and fiscal discipline. A comprehensive coverage of all public sectors and fiscal aggregates by the rules seems also desirable to avoid these "creative accounting" practices.

Finally, it is worth emphasizing that the macroeconomic effects found to be associated with IT or FRs in this thesis or in the existing literature may have been underestimated. Indeed, most of their pivotal institutional supportive parameters, such as transparency and accountability requirements have spread worldwide, thus affecting definitely modern central banking and fiscal policymaking, including in the countries where these regimes are not officially in place. Consequently, this is likely to strengthen the view that **flexible rules-based policy frameworks, such as IT and FRs do constitute credible solutions for ensuring macroeconomic stability, which, if judiciously combined with appropriate macroprudential regulation measures, should be conducive to strong and balanced long term economic growth, and in turn to poverty reduction an improvement of living standards.**

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Abstract:

This thesis is concerned with the role of Inflation Targeting (IT) and Fiscal Rules (FRs), as well as of their interactions, on macroeconomic environment. After laying the conceptual and empirical backgrounds of both these rules-based policy frameworks (**Chapter 1**), the dissertation highlights new evidence on their macroeconomic consequences. First, IT adoption does help attracting more Foreign Direct Investment into Developing Countries (**Chapter 2**). Second, in these countries, IT adoption provides strong incentives for governments to undertake reforms designed to improve the quality of institutions (**Chapter 3**). Third, the introduction of national-level numerical FRs does stand as a credible remedy against fiscal indiscipline in these countries, all the more in politically stable economies and where the number of FRs in place is important. But this discipline-enhancing effect of FRs decreases with the time length since their adoption, and is weakened in the presence of supranational rules and in countries with more fragmented government. Interestingly, this effect varies with the type of rules: while Budget Balance Rules and Expenditure Rules have significant discipline-enhancing effects, the effect of Debt Rules proved not significantly different from zero (**Chapter 4**). The last three chapters of the thesis focus on the role of the interaction between IT and FRs, and to a broader extent, on the interplay between monetary and fiscal authorities. The first result that emerges is that IT, which is a framework for conducting monetary policy, proves also sufficiently binding for fiscal authorities to providing them with strong incentives for improving fiscal discipline, notably in developing countries (**Chapter 5**). In addition, on the one hand, IT and FRs act complementarily, as adopting both IT and FRs leads to better results in terms of running fiscal surpluses and in terms of bringing down average inflation than adopting only one of these two frameworks. On the other hand, the sequence which consists of introducing FRs first before adopting IT yields better inflationary and fiscal performances than the opposite sequence (**Chapter 6**). Finally, better Policy Mix coherence, that is, better coordination between monetary and fiscal policies, is conducive to higher economic growth in the Economic Community of West African States (ECOWAS) (**Chapter 7**).

Keywords: Inflation Targeting, Fiscal Rules, Rules-based Policy Framework, Foreign Direct Investment, Institutional Quality, Fiscal Discipline, Inflation, Interactions, Sequence, Policy Mix Coherence, Developing Countries, ECOWAS.

Résumé:

Cette thèse s'intéresse au rôle du Ciblage d'inflation (CI) et des règles budgétaires (RBs), ainsi qu'à celui de leurs interactions, sur l'environnement macroéconomique. Après avoir posé les bases conceptuelles et empiriques de ces deux cadres de politique basés sur des règles (**Chapitre 1**), la thèse met en évidence de nouveaux résultats relatifs à leurs conséquences macroéconomiques. Premièrement, l'adoption du CI permet d'attirer plus d'investissements directs étrangers dans les pays en développement (**Chapitre 2**). Deuxièmement, dans ces pays, l'adoption du CI incite fortement les gouvernements à entreprendre des réformes destinées à améliorer la qualité des institutions (**Chapitre 3**). Troisièmement, l'introduction des RBs numériques au niveau national constitue un remède crédible contre l'indiscipline budgétaire, surtout dans les pays politiquement stables et avec un grand nombre de RBs en place. Mais cet effet disciplinaire des RBs diminue avec la durée de temps consécutive à leur adoption et est affaibli en présence de RBs supranationales et dans les pays à gouvernement fragmenté. Plus intéressant, cet effet varie en fonction du type de règles : tandis que les règles de solde budgétaire et les règles de dépense exercent un effet disciplinaire sur la conduite de la politique budgétaire, l'effet des règles de dette s'avère statistiquement non significatif (**Chapitre 4**). Les trois derniers chapitres de la thèse analysent le rôle de l'interaction entre le CI et les RBs, et dans une plus grande mesure de l'interaction entre les autorités monétaires et budgétaires. Le premier résultat qui en découle est que le CI, qui est un cadre de conduite de la politique monétaire, s'avère aussi suffisamment contraignant pour les autorités budgétaires de sorte à les inciter fortement à améliorer la discipline budgétaire, notamment dans les pays en développement (**Chapitre 5**). Par ailleurs, d'une part, le CI et les RBs agissent de façon complémentaire, puisqu'adopter à la fois le CI et les RBs conduit à de meilleurs résultats budgétaires et inflationnistes qu'adopter seulement l'un ou l'autre de ces deux cadres de politique. D'autre part, la séquence qui consiste à introduire d'abord les RBs avant d'adopter le CI produit de meilleures performances inflationnistes et budgétaires que la séquence inverse (**Chapitre 6**). Finalement, une meilleure cohérence du Policy-Mix, c'est-à-dire une meilleure coordination des politiques monétaire et budgétaire conduit à une plus grande croissance économique dans la Communauté Economique des Etats de l'Afrique de l'Ouest (CEDEAO) (**Chapitre 7**).

Mots clés : Ciblage d'inflation, règles budgétaires, cadre de politiques basé sur des règles, investissements directs étrangers, qualité institutionnelle, discipline budgétaire, inflation, interactions, séquence, cohérence du policy mix, pays en développement, CEDEAO.