ABSTRACT

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This dissertation addresses the issues of capital controls and informal economy. Both subjects have evoked considerable interest in both academic environments and policy circles, especially given their importance for developing countries. The dissertation is structured as follows. Chapter 1 analyzes how exchange rate regimes influence fiscal discipline. This important question has typically been addressed using models assuming perfect capital mobility, even though capital controls are pervasive in developing countries. This chapter analyzes the effects of capital controls on fiscal performance by focusing on dual exchange rate regimes. In a model in which fiscal policy is endogenously determined by a non-benevolent fiscal authority, the paper shows that capital controls induce impatient politicians to have looser fiscal policies than under fixed and flexible regimes operating under perfect capital mobility. While capital controls enable politicians to enjoy the same temporarily low inflation as fixed regimes (since the commercial exchange rate is assumed to be fixed) lax fiscal policies also result in a temporary consumption boom which is regarded as desirable

by impatient politicians. The consumption boom occurs because, as households attempt to get rid of unwanted real money balances, the real domestic interest rate falls. Empirical analysis confirms that capital controls lead to larger primary deficits than fixed and flexible regimes. The study considers a dynamic panel data specification and controls for endogeneity by using a standard instrumental variables approach and natural disaster events to evaluate the response of fiscal policies under diverse regimes. Chapter 2 estimates the size of the informal economy for the Eastern Caribbean Currency Union (ECCU) countries and 26 mainly Latin American countries in the early 2000s, being the first study to address this issue for the ECCU economies and many other Central American and Caribbean countries. Using a structural equation modeling approach we find that a stringent tax system and regulatory environment, higher inflation and dominance of the agriculture sector are key factors in determining the size of the informal economy. The results also confirm that a higher degree of informality reduces labor unionization, the number of contributors to social security schemes and enrollment rates in education.

ESSAYS ON CAPITAL CONTROLS AND THE INFORMAL ECONOMY.

By

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Dedication

This dissertation is dedicated to my wife, Vanesa, to whom I have been married for almost five years. Thank you for the many sacrifices you have made in order for me to complete this lengthy project. You love me unconditionally, in spite of all my mood swings. Since the first day you constantly supported me and encouraged me to pursue my goals. I am indebted to you for being always there. To my parents, Elinor and Raul, thanks for instilling in me the importance of a good education, hard work and perseverance and for being always enthusiastic despite the distance. To my in-laws, Micaela and Marcelino, who always believed in me and supported Vanesa and me since we started dating almost ten years ago.

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Chapter 1

Exchange Rate Regimes and Fiscal Discipline: The Role of Capital Controls

1.1 Introduction

The influence of exchange rate regimes on fiscal discipline has long been debated in both academic environments and policy makers' circles, especially given the importance of this relationship for emerging and developing countries. There is a vast theoretical literature addressing this issue and an inconclusive and relatively scarce empirical literature.

The theoretical literature discusses the influence of exchange rate regimes on fiscal discipline exploiting the classic dichotomy of "fixed vs. flexible". Conventional wisdom –represented by papers like Aghevli et al. (1991), Frenkel et al. (1991) and Giavazzi and Pagano (1988)– emphasizes the strong disciplinary properties of fixed regimes by stressing the deterrent effect that the fear of fixed exchange rate collapse has over fiscal authorities. However, a more recent and widely cited paper by Tornell and Velasco (1998) takes issue with the previous perspective by considering political economy arguments. Tornell and Velasco find that lax fiscal policies have political costs in terms of inflation under both regimes. The difference is the intertemporal distribution of these costs: under flexible regimes they manifest immediately through the exchange rate, while under fixed regimes, they become evident only when the exhaustion

of reserves makes the fixed regime collapse. If the fiscal authority is impatient, flexible regimes provide more fiscal discipline by forcing the cost to be paid up-front.

Both conventional wisdom and Tornell and Velasco assume perfect capital mobility, even though capital controls are pervasive in emerging and developing countries. Capital controls, in their diverse forms, have been a common phenomenon in many emerging and developing countries during the 70s and 80s. While less dominant in the 90s and early 2000s, unrestricted capital flows seem to be the exception rather than the rule. Some recent examples of capital controls include Malaysia in 1998, Argentina in 2002 and Venezuela in 2003. One specific type of capital control commonly implemented in emerging and developing countries is the *dual regime*. A dual regime is an exchange rate arrangement in which a market-determined exchange rate, typically applying to financial transactions (financial exchange rate), coexists with one or more fixed exchange rate(s) for current account transactions (commercial exchange rate). In other words, a dual regime is equivalent to a fixed regime with capital controls. Using the Reinhart-Rogoff (2002) exchange rate regime classification for 23 emerging markets, we find that more than 60 percent of this sample had dual regimes during the 70s and 80s and about 20 percent still had them in the 90s and early 2000s.

In this paper we analyze both theoretically and empirically the influence of capital controls on fiscal discipline. We develop a standard optimization

model with price flexibility, and a political economy framework and structure similar to that employed by Tornell and Velasco, but allowing for capital controls modeled as dual regimes.[1] The economy is inhabited by a representative private agent blessed with perfect foresight and a government composed of a fiscal authority and a central bank. The model does not analyze the choice of exchange rate regimes; it only compares fiscal performance under alternative monetary and capital flows policies. The central bank can precommit to follow a particular exchange rate regime only for a finite period of time; after that, regimes are abandoned and the central bank must adjust inflation to ensure that the government's budget constraint is satisfied, similar to Sargent and Wallace (1981) and Drazen (1985). This setup captures the idea that stabilization plans are subject to "temporariness" or "imperfect credibility" as described in Calvo (1986, 1991) and Drazen and Helpman (1987). The private agent chooses how much to consume and how much money to hold. The fiscal authority decides the level of net fiscal transfers that the public receives in a lump sum manner. The fiscal authority has the proclivity to spend more than socially desirable, possibly because such spending provides political power, prestige and/or greater chances of reelection. The politician in charge of the budget also internalizes the private agent's objective function, but might discount the future at a different rate. We show that capital controls induce looser fiscal policies than fixed and flexible regimes operating under perfect capital mobility in the periods before the stabilization plan reaches its end. The theoretical argument is quite simple:

[1] Hereafter the terms "dual regimes" and "capital controls" will be used interchangeably.

- Under *fixed* regimes, weak fiscal policies lead to a fall in reserves or an increase in debt. Only when the situation gets unsustainable, the exchange rate collapses and the inflation cost becomes tangible. Policymakers can enjoy lax fiscal policies and low inflation today, at the cost of high inflation in the future.

- Under *flexible* regimes, lax fiscal behavior augments future expected monetization, creating an increase in current prices as in Sargent and Wallace (1981) and Drazen (1985). This occurs because the desire to reduce money holdings in the future creates pressures on the exchange rate market today, which in the absence of central bank intervention effectively increases the current exchange rate and the price level. Any fiscal misconduct is paid for with current and future inflation.

- Under *capital controls*, unsound fiscal policies also increase future anticipated monetization and, consequently, reduce the desired future money holdings. The latter change creates excess demand for bonds which, due to the presence of capital controls, increases the financial exchange rate and reduces the current domestic real interest rate. This last factor increases today's consumption, augmenting the current account deficit. That is to say, capital controls enable the same temporarily low inflation as fixed regimes, since the commercial exchange rate is assumed to be fixed, but they also boost current consumption as private agents attempt to reduce their real balances because of the expected inflation tax. Politicians can enjoy the benefits of a lax fiscal stance, low inflation and a *consumption party* today, at the cost of high inflation

and a *consumption hangover* in the future.

The basic point of Tornell and Velasco's paper is that if inflation is costly for the fiscal authorities, flexible regimes provide tighter fiscal discipline than fixed regimes by forcing the costs to be paid up-front. We argue that capital controls induce even looser fiscal policies than fixed regimes while the stabilization plan lasts. This occurs because capital controls enable free-spending politicians to enjoy the same temporarily low inflation as fixed regimes, as well as a temporary consumption boom which is regarded as desirable by impatient politicians. This temporary consumption boom induce politicians to engage in looser fiscal policies before the stabilization plan collapses. Therefore, while the anticipated reaction of the exchange rate market moderates fiscal behavior under flexible rates, under capital controls it encourages loose fiscal policies.

Using a sample of 23 emerging markets for the period 1970-2001 and the *de facto* Reinhart-Rogoff classification, we confirm that capital controls lead to larger primary deficits than fixed and flexible regimes operating under unified rates. Our findings also support Tornell and Velasco's core prediction that fixed regimes induce less discipline than flexible arrangements. Consistent with our model, we test the main theoretical implications considering only relatively "tranquil" times. For this reason, we exclude observations associated with the Reinhart-Rogoff exchange rate regime category "free falling", which includes episodes with an annual inflation higher than 40 percent. We obtain such results considering a dynamic panel data specification, and we address previous studies'

limitations related to the potential endogeneity of the exchange rate regime. We distinguish three main potential sources of endogeneity and propose different ways to control for them:

- *Regime classification endogeneity.* Since the Reinhart-Rogoff classification categorizes regimes based upon the evolution of the market-determined exchange rate, it is likely that countries experiencing poor fiscal performance would tend to have more flexible regimes ex post, while countries experiencing sound fiscal policies would increase their chance of sustaining fixed regimes or capital controls. Therefore, this source of endogeneity tends to generate the appearance of tighter fiscal performance in fixed and dual regimes than in flexible arrangements. Since the empirical results do not show this pattern, accounting for this source of endogeneity would strengthen our results.

- *Endogeneity due to regime choice under stress.* Countries experiencing persistent fiscal deficits or other financial and debt difficulties could adopt fixed regimes as a stabilizing device, or impose capital controls to avoid the effects of a depreciation on domestic prices while maintaining some degree of control over capital outflows and international reserves. Therefore, this source of endogeneity tends to generate the appearance of looser fiscal performance in fixed and dual regimes than in flexible arrangements. In order to reduce the likelihood of this type of endogeneity we use only observations that are at least two years distant from "free falling" events, and we control for regressors that are symptoms of macroeconomic and financial distress, such as episodes of debt default, bank

crisis and the presence of IMF programs.

- *Endogeneity due to government type.* As in Tornell and Velasco, we assume in our model that the central bank's monetary and capital flows policies are exogenous and are not the result of any optimization problem. However, it seems reasonable to think that, to the extent that the regime's choice affects fiscal discipline, the fiscal authority will try to influence the central bank to choose the type of exchange rate regime that suits the policymaker better. Therefore, in line with the theoretical predictions, free-spending politicians would be more likely than conservative politicians to attempt to persuade the central bank to choose fixed regimes or impose capital controls. For this reason, this source of endogeneity tends to generate the appearance of looser fiscal performance in fixed and dual regimes than in flexible arrangements. We control for this source of endogeneity by using instrumental variables for the exchange rate regime and by exploiting the randomness of natural disaster events to evaluate the response of fiscal policies under diverse exchange rate regimes.

This paper is at the crossroads of two main strands of the literature: the literature on capital controls and the literature on the influence of exchange rate regimes on fiscal discipline. Existing models of capital controls focus on the implications of capital controls for a myriad of variables, but treat fiscal activity as exogenously given (see for example, Calvo (1981, 1989), Obstfeld (1984), Guidotti and Végh (1992)). In contrast, the model proposed in this paper endogenously determines fiscal policy by including an optimizing fiscal

authority. Previous studies that analyze the influence of exchange rate regimes on fiscal behavior use models with endogenous fiscal determination, but assume perfect capital mobility (see for example Tornell and Velasco (1998) and Sun (2003)). Instead, we analyze the fiscal incentives under capital controls.

This paper is also related to the literature that documents and analyzes the consumption party and subsequent hangover observed under temporary stabilization programs (see Calvo (1986), Kiguel and Liviatan (1992), Végh (1991), Calvo and Végh (1993) and Reinhart and Végh (1995)).

The rest of the paper is structured as follows. In Section 2 we present the model, in section 3 we show the empirical results and in Section 4 we make some final remarks.

1.2 The Model

In this section we develop a theoretical model with a political economy framework and structure similar to that employed by Tornell and Velasco, but allowing for capital controls modeled as dual exchange rate regimes. For comparison purposes, we also reproduce Tornell and Velasco's results under fixed and flexible regimes operating under perfect capital mobility. The rest of this section is organized as follows. First, we describe the main features of the model, including the agents involved and their sequence of actions and budget constraints. We also explain the behavior of the real interest rate under capital controls by examining the uncovered interest parity condition. Secondly, we

solve the model and show the intuition and some numerical examples confirming that capital controls induce looser discipline than fixed and flexible regimes during the periods *before the stabilization plan reaches its end.*

1.2.1 Set up

The economy is inhabited by a government, consisting of a fiscal authority (FA) and a central bank (CB), and a representative private agent (PA) blessed with perfect foresight. We consider a small endowment economy that lasts three periods -periods 0, 1 and 2- with either perfect capital mobility or capital controls modeled as a dual exchange rate. For simplicity we also assume that the world real interest rate r remains constant.

There is one tradable good which is used as the numeraire. Assuming that the law of one price holds and normalizing the foreign price level at one, we obtain that the nominal exchange rate (the *commercial* rate under dual regimes) is equal to the domestic price level, i.e. $E_t = P_t$.[2] Hence inflation and nominal devaluation rates are[3]

$$\pi_t \equiv \frac{P_t - P_{t-1}}{P_t} = \frac{E_t - E_{t-1}}{E_t}. \tag{1}$$

The *financial* exchange rate operating under capital controls is denoted as Q_t. For notational purposes, variables in capital letters are expressed in terms

[2] Throughout this paper, the exchange rate is defined as units of domestic currency per unit of foreign currency.

[3] We specify the inflation and devaluation rates so that they are constraint between 0 and 1.

of the domestic currency (i.e. nominal terms), while small letters are used for variables expressed in terms of the numeraire (i.e. real terms). There exist two assets: domestic currency, denoted by M_t, and internationally traded bonds held by both the PA , f_t, and the government, b_t. We also assume that assets are chosen at the end of period t and carried over into period t+1.

1.2.1.1 Sequence of Actions

In period 0 the CB announces its monetary and capital flows policies and, subsequently, the FA announces the net fiscal transfers that will occur in the future, τ_1 and τ_2.[4] Right after this news, the PA attempts to rearrange her portfolio from (m_{0-}, f_{0-}) to (m_0, f_0).[5] While she can achieve such rearrangement under perfect capital mobility, she cannot alter her portfolio composition under capital controls (i.e. $m_0 = m_{0-}$ and $f_0 = f_{0-}$) because under capital controls the commercial exchange rate cannot jump (i.e. $E_0 = E_{0-}$), the private capital account is closed and the CB does not intervene in the financial market. Lastly, the government transfers to the PA the gain (loss) it made as a result of movement in the exchange rate during period 0.

During period 1 the PA selects c_1 and m_1, her desired real balances for period 2. The FA does not make any decision in periods 1 or 2.[6]

When period 2 arrives, the government repays its outstanding debt, the

[4] These net transfers equal expenditures minus revenues. Hence, they could be either negative or positive.

[5] m_{0-} and f_{0-} refer to the initial asset conditions.

[6] We assume that the FA can commit to the announcements made in period 0 to avoid well known inconsistency issues, which are not the main argument of the paper. See Sun (2003) for a treatment of this subject.

CB redeems the value of outstanding real balances, and the PA uses all her accumulated wealth and income to consume c_2 and pay the inflation tax.

1.2.1.2 The Central Bank's Alternative Monetary and Capital Flows Policies

As in Tornell and Velasco, we assume that the CB's monetary and capital flows policies are exogenous, and are not the result of any optimization problem.[7]

We assume that the CB can precommit to an independent monetary policy that ignores the behavior of the FA only for a finite period of time, periods 0 and 1 in our model:[8]

- Under *fixed* regimes, the CB sets the nominal devaluation rates of period 0 and period 1 equal to zero (i.e. $\pi_0 = \pi_1 = 0$), and the nominal money supplies M_0 and M_1 become endogenous.[9]

- In a *flexible* regime the CB sets the growth rate of nominal money in period 0 and period 1 equal to zero (i.e. $\mu_0 \equiv (M_0 - M_{0-})/M_0 = 0$ and $\mu_1 \equiv (M_1 - M_0)/M_1 = 0$), and the exchange rates E_0 and E_1 become endogenous.[10]

- Under *capital controls* the CB sets the nominal devaluation rate of the commercial exchange rate for period 0 and period 1 equal to zero (i.e. $\pi_0 = \pi_1 =$

[7] One interesting extension of the paper would be to include such an optimization process and to see how it affects the choice of the exchange rate regime.

[8] The assumption of finite precommitment to an independent monetary policy is not based on the idea that CBs are independent of government's influence. It aims to capture the idea that stabilization plans are subject to "temporariness" or "imperfect credibility" problems as described in Calvo (1986, 1991) and Drazen and Helpman (1987).

[9] Similar qualitative results hold if devaluation rates differ from zero. See Tornell and Velasco for details.

[10] Similar qualitative results hold if the growth rate of nominal money differs from zero. See Tornell and Velasco for details.

0), and the PA is prohibited from freely transacting in the world capital markets. The CB does not intervene in the financial market; however, it sells (buys) foreign bonds for (with) money for current account purposes. As previously discussed, this implies that the PA cannot change her portfolio in period 0 (i.e. $M_{0-} = M_0$, $m_{0-} = m_0$ and $f_0 = f_{0-}$). The financial exchange rate, real domestic interest rates and M_1 become endogenous.

In period 2, as in Sargent and Wallace (1981) and Drazen (1985), inflation must adjust to ensure that the government's budget constraint is satisfied. We also assume that capital controls are abandoned (i.e. $Q_2 = E_2$). Therefore, it makes no difference what the exchange rate regime is in period 2.

In other words, period 0 and 1 can be thought of as the interval of time in which the stabilization plan is sustained, and period 2 as the time in which the *bomb explodes* and the stabilization plan reaches its end. For this reason, and since all regimes *explode* in period 2, we effectively observe the performance of each regime as such only under relatively "tranquil" conditions, in periods 0 and 1. This issue is very important not only from a theoretical point of view but also from an empirical perspective as we will remark later.

1.2.1.3 Uncovered Interest Parity Condition

One crucial implication of abandoning the perfect capital mobility assumption is that the real domestic interest rate ρ_t does not necessarily coincide with the world real interest rate r. Specifically, under perfect foresight and capital

controls, the uncovered interest parity condition and the Fisher equation lead to the following well-known condition for the real domestic interest rate:

$$1 + \rho_t = \frac{q_{t+1}}{q_t}(1 + r), \tag{2}$$

where $q_t \equiv Q_t/E_t$.[11] Thus, the return on bonds in the domestic economy also includes capital gains associated with the depreciation of the financial exchange rate relative to the commercial one.

Since we assume $Q_2 = E_2$ we can use equation (2) to write ρ_1 as

$$\rho_1 = \frac{E_1}{Q_1}(1 + r) - 1. \tag{3}$$

Therefore, $\rho_1 = r$ when $Q_1 = E_1$ and $\rho_1 < r$ ($\rho_1 > r$) when $Q_1 > E_1$ ($Q_1 < E_1$). In other words, a positive (negative) exchange rate premium is associated with a real domestic interest rate lower (higher) than r. As will become clear later, this is the key element driving our results under imperfect capital mobility.

1.2.1.4 The Private Agent's Budget Constraints and Objective Function

We assume that the PA receives an exogenous endowment income y of tradable goods in periods 1 and 2, and that she has an initial stock of internationally traded bonds f_{0-} and a stock of money M_{0-}. Then the PA's

[11] We assume that interest income is repatriated at the financial exchange rate. The expression for the real domestic interest rate would be slightly different if the commercial rate was used.

budget constraint for period 0 under perfect capital mobility is[12]

$$f_0 - f_{0-} = m_{0-} - m_0, \tag{4}$$

while under capital controls it is[13]

$$\frac{Q_0}{E_0}\left(f_0 - f_{0-}\right) = m_{0-} - m_0. \tag{5}$$

The PA's budget constraint for period 1 under perfect capital mobility is

$$(1+r)f_0 + m_0 + y + \tau_1 = c_1 + \pi_1 m_0 + m_1 + f_1, \tag{6}$$

[12] As discussed in Tornell and Velasco in the context of perfect capital mobility, and more generally as considered in Auernheimer (1974), in order to make a consistent comparison across exchange rate regimes, it is necessary to offset the government's extra revenue capacity that occurs in period 0 as a result of any unanticipated jump in the exchange rate. This circumstance only arises under flexible regimes.

Under *fixed* regimes, the PA buys (sells) domestic currency from (to) the CB changing her nominal stock of domestic currency from M_{0-} to M_0. Since the nominal exchange rate E_0 cannot move under fixed regimes (i.e. $E_0 = E_{0-}$), the portfolio rearrangement is obtained through the following operation at the CB: $(M_0 - M_{0-})/E_0 = m_0 - m_{0-} = b_0 - b_{0-}$. After the PA rearranges her portfolio, the government net assets are $b_0 - m_0 = b_{0-} - m_{0-}$. Consequently, there is no transfer of wealth between the PA and the government in period 0 as a result of the announcements.

Under *flexible* regimes the CB does not intervene in the foreign exchange market (i.e. $M_{0-} = M_0$). Therefore, the market only clears as a result of an exchange rate movement in period 0. Since $m_0 = (1-\pi_0)m_{0-}$, with $\pi_0 \equiv (E_0 - E_{0-})/E_0$, the PA experiences a capital loss (gain) of $\pi_0 m_{0-}$ that implies an equivalent gain (loss) for the government. Following Tornell and Velasco we assume that at the end of period 0 the government gives a rebate to the PA equal to $s_0 = \pi_0 m_{0-}$. Since m_0 is all the real domestic balances the PA wishes to hold, she uses the government transfer to buy bonds, hence $f_0 = f_{0-} + s_0$. After these operations occur in period 0, the government net assets are $b_0 - m_0 = b_{0-} - m_{0-} + \pi_0 m_{0-} - s_0 = b_{0-} - m_{0-}$, the same as under fixed regimes.

[13] Under *capital controls* the CB does not intervene in the financial exchange market and the commercial exchange rate cannot jump (i.e. $M_{0-} = M_0$ and $E_{0-} = E_0$). For this reason the exchange rate market only clears as a result of a movement in the financial exchange rate in period 0. Since $(Q_0/E_0)(f_0 - f_{0-}) = m_{0-} - m_0$, the PA experiences a capital loss (gain) of $(1 - E_0/Q_0)(m_{0-} - m_0)$ that implies an equivalent gain (loss) for the government. However, for the reasons explained in Section 1.2.1, $m_{0-} = m_0$ and $f_0 = f_{0-}$ and, consequently, there are no effective transfers between the government and the PA. For this reason, the government net assets at the very end of period 0 are $b_0 - m_0 = b_{0-} - m_{0-}$, the same as under fixed and flexible regimes.

while under capital controls it is

$$\frac{Q_1}{E_1}(1+r)f_0 + m_0 + y + \tau_1 = c_1 + \pi_1 m_0 + m_1 + \frac{Q_1}{E_1} f_1. \tag{7}$$

For period 2, the budget constraint is the same under both perfect capital mobility and capital control because we assume $Q_2 = E_2$:

$$(1+r)(f_1 + m_1) + y + \tau_2 = c_2 + (r + \pi_2)m_1. \tag{8}$$

Combining equations (4), (6) and (8) we obtain the PA's intertemporal budget constraint under perfect capital mobility:

$$(1+r)(f_{0-} + m_{0-}) + y\left(\frac{2+r}{1+r}\right) + \tau_1 + \frac{\tau_2}{1+r} = c_1 + (r + \pi_1)m_0 + \frac{c_2 + (r+\pi_2)m_1}{1+r}, \tag{9}$$

which has the usual interpretation that the present value of expenditures must equal the present value of income.

Combining equations (5), (7) and (8) we obtain the intertemporal budget constraint under capital controls:

$$\frac{(1+r)^2}{1+\rho_1} f_{0-} + (1+\rho_0)m_{0-} + y\left(\frac{2+\rho_1}{1+\rho_1}\right) + \tau_1 + \frac{\tau_2}{1+\rho_1} = c_1 + (\rho_0 + \pi_1)m_0 + \frac{c_2 + (\rho_1 + \pi_2)m_1}{1+\rho_1}. \tag{10}$$

The PA's objective is to maximize

$$ln(c_1) + \left(\frac{\epsilon}{\epsilon - 1}\right) m_0^{\frac{\epsilon-1}{\epsilon}} + \left(\frac{1}{1+r}\right)\left[ln(c_2) + \left(\frac{\epsilon}{\epsilon - 1}\right) m_1^{\frac{\epsilon-1}{\epsilon}}\right], \qquad (11)$$

where $\epsilon \in (0, 1)$ to guarantee that the economy is always on the upward-sloping side of the Laffer curve.[14] Note that the objective function involves m_0 and m_1 instead of m_1 and m_2, because the former notation refers to real money balances prevailing in periods 1 and 2 respectively.

1.2.1.5 The Government's Budget Constraints and Objective Function

We present the consolidated accounts of both the FA and CB. The government has an initial total stock of net foreign assets b_{0-} and monetary liabilities M_{0-}. In period 1, the FA transfers a net amount τ_1 to the PA, financed with interest income rb_0, monetary revenue $(M_1 - M_0)/E_1 = (m_1 - m_0) + \pi_1 m_0$ (which includes both seigniorage and the inflation tax) and by changing its total net asset position. Under capital controls the FA also receives revenues if there is a positive (negative) exchange rate premium and private capital inflows (outflows).[15] In period 2, the government makes a transfer τ_2 and pays back its real debt and money balances, using only the inflation tax. The government's budget constraint for period 0 under perfect capital mobility is

[14] This assumption guarantees that inflation tax revenue is increasing in inflation.

[15] Similar qualitative results would be obtained if a separate institution that deals with the purchase and sale of internationally traded bonds rebated all revenues to the PA at the end of the respective period, as long as this behavior is not internalized by the PA.

$$b_{0-} - b_0 = m_{0-} - m_0, \tag{12}$$

while under capital controls it is

$$\frac{Q_0}{E_0}\Big(b_{0-} - b_0\Big) = m_{0-} - m_0. \tag{13}$$

The government's budget constraint for period 1 under perfect capital mobility is

$$b_1 + \tau_1 = (1+r)b_0 + m_1 - m_0 + \pi_1 m_0, \tag{14}$$

while under capital controls it is

$$b_1 + \tau_1 = (1+r)b_0 + m_1 - m_0 + \pi_1 m_0 + \left(\frac{Q_1}{E_1} - 1\right)\big(f_1 - f_0(1+r)\big). \tag{15}$$

Given the assumption $Q_2 = E_2$ the budget constraint for period 2 is the same under perfect capital mobility and capital controls:

$$m_1 + \tau_2 = (1+r)b_1 + \pi_2 m_1. \tag{16}$$

Combining equations (12), (14) and (16) the government's intertemporal budget constraint under perfect capital mobility is

$$\tau_1 + \frac{\tau_2}{1+r} = (1+r)(b_{0-} - m_{0-}) + m_0(r + \pi_1) + \frac{m_1(r+\pi_2)}{1+r}, \tag{17}$$

which has the usual interpretation that the present value of expenditures must equal the present value of revenues.

Combining equations (13), (15) and (16) the government's intertemporal budget constraint under capital controls is

$$\tau_1 + \frac{\tau_2}{1+r} = (1+r)(b_{0-} - m_{0-}) + m_0(r+\pi_1) + m_1\frac{(r+\pi_2)}{1+r} + (1+r)\left(\frac{Q_0}{E_0} - 1\right)(f_0 - f_{0-}) + \left(\frac{Q_1}{E_1} - 1\right)\big(f_1 - f_0(1+r)\big). \quad (18)$$

The FA's objective is to maximize

$$\alpha\Big[\upsilon(\tau_1) + \beta\upsilon(\tau_2)\Big] + (1-\alpha)\left[ln(c_1) + \left(\frac{\epsilon}{\epsilon-1}\right)m_0^{\frac{\epsilon-1}{\epsilon}} + \beta\left[ln(c_2) + \left(\frac{\epsilon}{\epsilon-1}\right)m_1^{\frac{\epsilon-1}{\epsilon}}\right]\right], \quad (19)$$

where $\upsilon'(\tau) > 0$, $\upsilon''(\tau) < 0$, β is the FA's subjective discount factor, $\beta \in (0,1)$, and $\alpha \in (0,1)$. It is worth making two points about this function. First, government transfers give utility, possibly because they provide political power, prestige and/or greater chances of reelection. This factor carries a weight of α in the FA's objective function. Second, the FA also internalizes the PA's objective function with a weight $(1-\alpha)$, but the FA's discount factor β does not necessarily match that of the PA, which equals $1/(1+r)$. Hence, an impatient FA with direct incentives to engage in fiscal transfers (i.e. $\alpha > 0$ and $\beta < 1/(1+r)$) would not only be delighted to have a *fiscal party* but would also like the PA to have a *consumption party*.[16]

[16] The term *fiscal party* (*consumption party*) refers to an intertemporal profile in which the level of fiscal transfers (consumption) in period 1 is bigger than in period 2.

Combining equations (9) and (17) or (10) and (18) we obtain the economy's resource constraint under perfect capital mobility and capital controls:

$$(1+r)(b_{0-}+f_{0-})+y\left(\frac{2+r}{1+r}\right)=c_1+\frac{c_2}{1+r}. \tag{20}$$

Given that the government consumes nothing, the present value of consumption simply equals the present value of national income, including the initial net foreign assets of the economy.

1.2.2 Solution to the Private Agent's Problem

Now we solve the PA's problem under perfect capital mobility and capital controls.

1.2.2.1 Solution to the PA's Problem: The Perfect Capital Mobility Case

The PA optimizes with respect to c_1, c_2, m_0 and m_1 to maximize (11) subject to (9), taking as given τ_1, τ_2, π_1 and π_2. The optimal conditions under perfect capital mobility (pcm) are

$$c^*_{1,pcm}=c^*_{2,pcm}, \tag{21}$$

$$m^*_{0,pcm}={c^*_{1,pcm}}^{\epsilon}\,(r+\pi_1)^{-\epsilon}, \tag{22}$$

$$m^*_{1,pcm}={c^*_{2,pcm}}^{\epsilon}\,(r+\pi_2)^{-\epsilon}. \tag{23}$$

Condition (21) implies that consumption is constant across both periods. Combining this last equality with (20), consumption equals permanent income $\bar{c}$ for both periods, where

$$\bar{c} = \left[\frac{(1+r)^2}{2+r}\right](b_{0-} + f_{0-}) + y. \tag{24}$$

1.2.2.2 Solution to the PA's Problem: The Capital Controls Case

The PA optimizes with respect to c_1, c_2, m_0 and m_1 to maximize (11) subject to (10), taking as given τ_1, τ_2, π_1, π_2, ρ_0 and ρ_1. The optimal conditions under capital controls (cc) are

$$\frac{c^*_{1,cc}}{c^*_{2,cc}} = \frac{1+r}{1+\rho_1}, \tag{25}$$

$$m^*_{0,cc} = {c^*_{1,cc}}^{\epsilon}\,(\rho_0 + \pi_1)^{-\epsilon}, \tag{26}$$

$$m^*_{1,cc} = {c^*_{2,cc}}^{\epsilon}\,(\rho_1 + \pi_2)^{-\epsilon}. \tag{27}$$

Condition (25) indicates that consumption might not be the same in both periods. Specifically, the ratio $(c^*_{1,cc}/c^*_{2,cc})$ equals one if $\rho_1 = r$, and is a decreasing function of ρ_1; consumption is higher when it is cheaper.

Substituting equation (25) into (20) and considering (24), we have that

$$c^*_{1,cc} = \bar{c}\left[\frac{(2+r)(1+r)}{(2+r)(1+r) + (\rho_1 - r)}\right], \tag{28}$$

$$c^*_{2,cc} = \bar{c}\left[\frac{(2+r)(1+\rho_1)}{(2+r)(1+r) + (\rho_1 - r)}\right]. \tag{29}$$

To understand further the intertemporal distortion of consumption under capital controls we define

$$Distortion(c_1) = \left| \; c^*_{1,cc} - \bar{c} \; \right|, \tag{30}$$

$$Distortion(c_2) = \left| \; c^*_{2,cc} - \bar{c} \; \right|. \tag{31}$$

Combining (28), (29), (30) and (31) we find that $Distortion(c_1)(1+r) = Distortion(c_2)$, so that $Distortion(c_1) < Distortion(c_2)$ whenever $\rho_1 \neq r$. That is to say, the impact of any difference between ρ_1 and r on consumption is more pronounced for $c^*_{2,cc}$ than for $c^*_{1,cc}$. For example, if $\rho_1 < r$, then $c^*_{1,cc}$ is higher than the permanent income $\bar{c}$ while $c^*_{2,cc}$ is lower than $\bar{c}$ by an even greater margin. In other words, when $\rho_1 < r$, the PA experiences a *consumption party* in period 1 and a severe *hangover* in period 2.

1.2.3 Endogenous Determination of Fiscal Policy

Now we focus on the FA's optimization problem under alternative exchange rate regimes by solving the Ramsey planner's problem. The FA chooses quantities, as a planner would, but subject to the constraint that the chosen allocation be implementable as a competitive equilibrium. As remarked earlier, the solutions for fixed and flexible regimes correspond to Tornell and Velasco and are only developed for comparison purposes.

1.2.3.1 Endogenous Determination of Fiscal Policy: Fixed Regime Case

The benefit of increasing fiscal transfers derives from the direct increase in the FA's utility, while the cost originates from the lower real balances held by the PA in period 2. The FA effectively chooses τ_1, τ_2, and m_1 to maximize (19) subject to (17), (9), (21), (24), $\pi_1 = 0$ and $\pi_2 = \bar{c}m_1^{-1/\epsilon} - r$ from (23). Combining the optimal conditions we obtain

$$\upsilon'(\tau^*_{1,fixed}) = (1+r)\beta\upsilon'(\tau^*_{2,fixed}), \tag{32}$$

$$\upsilon'(\tau^*_{1,fixed}) = (1+r)\beta\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{1,pcm}}, \tag{33}$$

$$\upsilon'(\tau^*_{2,fixed}) = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{2,pcm}}. \tag{34}$$

Equation (32) states that the intertemporal pattern of transfers depends only on the discount and interest rates. Equations (33) and (34) also indicate that there is a positive relationship between consumption and fiscal transfers. This occurs because of the positive association between the marginal utility of FA's transfers and the marginal utility of PA's consumption. In other words, aside from the terms involving r, β, α and ϵ, the FA increases (decreases) fiscal transfers as consumption increases (decreases). However, because there is consumption smoothing under perfect capital mobility, this factor does not play an active role in the intertemporal pattern of fiscal transfers. Since $\upsilon''(\tau) < 0$, the Ramsey planner's problem uniquely determines $(\tau^*_{1,fixed}, \tau^*_{2,fixed}, m^*_{1,fixed}, \pi^*_{2,fixed})$.

1.2.3.2 Endogenous Determination of Fiscal Policy: Flexible Regime Case

The benefit of increasing fiscal transfers derives from the direct increment in the FA's utility, while the costs originate from the lower real balances held by the PA in periods 1 and 2. Hence, unlike the fixed regime case, inflation is endogenously determined in period 1 and responds to events that are anticipated to take place in period 2. This forces the FA to consider the effect that fiscal transfers have, not only on money demand in period 2, but also in period 1. The FA selects τ_1, τ_2, m_0 and m_1 to maximize (19) subject to (17), (9), (21), (24), $\pi_1 = \bar{c}m_0^{-1/\epsilon} - r$ from (22), $\pi_2 = \bar{c}m_1^{-1/\epsilon} - r$ from (23) and $m_1 \equiv m_0(1-\pi_1)$. Combining the optimal conditions we have

$$\upsilon'(\tau^*_{1,flex}) = (1+r)\beta\upsilon'(\tau^*_{2,flex}), \tag{35}$$

$$\upsilon'(\tau^*_{1,flex}) = (1+r)\beta\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{1,pcm}}\left[\frac{1+x}{1+x\beta(1+r)}\right], \tag{36}$$

$$\upsilon'(\tau^*_{2,flex}) = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{2,pcm}}\left[\frac{1+x}{1+x\beta(1+r)}\right], \tag{37}$$

where $x \equiv \left(\frac{1}{\beta}\right)\left(\frac{r+\pi^*_1}{r+\pi^*_2}\right)\left[\frac{1}{(1+r)+[(1-\epsilon)/\epsilon](r+\pi^*_1)}\right]$. Equation (35) indicates, identically to fixed regimes, that the intertemporal profile of transfers depends only on the rates of discount and interest. Once again, (36) and (37) also imply a positive relation between consumption and fiscal transfers. Nevertheless, since $c^*_{1,pcm} = c^*_{2,pcm} = \bar{c}$ under perfect capital mobility, this effect plays no role in the intertemporal pattern of transfers for flexible

regimes. Since $\upsilon''(\tau) < 0$, the Ramsey planner's problem uniquely determines $(\tau^*_{1,flex}, \tau^*_{2,flex}, m^*_{0,flex}, m^*_{1,flex}, \pi^*_{1,flex}, \pi^*_{2,flex})$.

1.2.3.3 Endogenous Determination of Fiscal Policy: Capital Controls Case

As under fixed regimes, the benefit of increasing fiscal transfers derives from the direct increase in the FA's utility, while the cost originates from the lower real balances held by the PA in period 2. However, as long as the FA is not more patient than the PA, there is an extra benefit to the FA from higher fiscal transfers, coming from the increase in PA consumption in period 1 that occurs because of the decrease in the real domestic interest rate ρ_1. The real domestic interest rate, ρ_1, falls below r because of the increase in the financial exchange rate Q_1, which occurs as the PA attempts to rearrange her portfolio because of the expected inflation tax in period 2. This extra incentive for higher transfers is absent under fixed and flexible regimes because of the consumption smoothing that occurs under perfect capital mobility.

We solve the Ramsey planner's problem in which the FA effectively chooses τ_1, τ_2, c_1, c_2 and m_1 to maximize (19) subject to $\rho_0 = c_1 m_0^{-1/\epsilon} - \pi_1$ from (26), $\rho_1 = (1+r)(c_2/c_1) - 1$ from (25), $\pi_1 = 0$, $\pi_2 = c_2 m_1^{-1/\epsilon} - \rho_1$ from (27) and $m_0 = m_{0-}$.[17] Combining the optimal conditions with (28) and (29) we obtain

[17] This is the result of the condition $f_0 = f_{0-}$ under capital controls.

$$\upsilon'(\tau^*_{1,cc}) = (1+r)\ \beta\ \frac{1+\rho^*_1}{1+r}\ \upsilon'(\tau^*_{2,cc}), \tag{38}$$

$$\begin{aligned}\upsilon'(\tau^*_{1,cc}) &= (1+r)\beta\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{1,cc}}, \\ &= (1+r)\beta\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{\bar{c}}\left[\frac{(2+r)(1+r)+(\rho^*_1-r)}{(2+r)(1+r)}\right],\end{aligned} \tag{39}$$

$$\begin{aligned}\upsilon'(\tau^*_{2,cc}) &= \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{c^*_{2,cc}}, \\ &= \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\frac{1}{\bar{c}}\left[\frac{(2+r)(1+r)+(\rho^*_1-r)}{(2+r)(1+\rho^*_1)}\right].\end{aligned} \tag{40}$$

Equation (38) shows that the intertemporal pattern of fiscal transfers depends on the discount rate and the domestic real interest rate ρ^*_1. As in fixed and flexible regimes, the intertemporal profile of transfers depends in part upon the relative degree of impatience of the FA (i.e. $(1+r)\beta$). In addition, there is another effect that is represented by the term $(1+\rho^*_1)/(1+r)$. This new factor captures the fact that the intertemporal ratio of the marginal utilities of private consumption is not necessarily one due to the potential discrepancy between domestic and world real interest rates. In consequence, if $\rho^*_1 < r$ then $c^*_{1,cc} > c^*_{2,cc}$, inducing the FA to make bigger transfers in period 1 relative to period 2. On the other hand, if $\rho^*_1 > r$ then $c^*_{1,cc} < c^*_{2,cc}$ inducing the FA to make smaller transfers in period 1 relative to period 2. These particular intertemporal pattern of fiscal transfers occurs because the FA increases (decreases) fiscal transfers as consumption increases (decreases).

Hence, this new effect exacerbates the intertemporal pattern of transfers induced by an impatient FA if $\rho_1^* < r$, while it moderates this profile if $\rho_1^* > r$. Since $\upsilon''(\tau) < 0$, the Ramsey planner's problem uniquely determines ($\tau_{1,cc}^*$, $\tau_{2,cc}^*$, $c_{1,cc}^*$, $c_{2,cc}^*$, $m_{1,cc}^*$, $\pi_{2,cc}^*$, Q_0^*, ρ_0^*, Q_1^*, ρ_1^*).

1.2.4 Comparing Fiscal Performance Under Alternative Monetary and Capital Flows Policies

In this section we compare fiscal performance under alternative monetary and capital flows policies. We define fiscal discipline in terms of the present value of net fiscal transfers ($pdv\tau$), where $pdv\tau \equiv \tau_1 + \tau_2 \, (1+r)^{-1}$. An exchange rate regime induces more fiscal discipline if it has a lower value for $pdv\tau$. However, it is important to recall that since all regimes *explode* in period 2, we effectively observe the performance of each regime only under the relatively "tranquil" conditions of period 1. Because of this, we also examine the intertemporal profile of fiscal transfers, in particular the fiscal performance in period 1.

Combining (33), (34), (36), (37), (39) and (40) we obtain

$$\upsilon'(\tau_{1,fixed}^*) = \upsilon'(\tau_{1,flex}^*)\left[\frac{1+x\beta(1+r)}{1+x}\right] = \upsilon'(\tau_{1,cc}^*)\left[\frac{(2+r)(1+r)}{(2+r)(1+r)+(\rho_1^*-r)}\right], \tag{41}$$

$$\upsilon'(\tau_{2,fixed}^*) = \upsilon'(\tau_{2,flex}^*)\left[\frac{1+x\beta(1+r)}{1+x}\right] = \upsilon'(\tau_{2,cc}^*)\left[\frac{(2+r)(1+\rho_1^*)}{(2+r)(1+r)+(\rho_1^*-r)}\right]. \tag{42}$$

Considering (41), (42), (33) and (34), it is clear that the ranking of transfers across regimes depends on the degree of patience of the FA and on the relation between ρ_1^* and r. We can summarize the main results as follows:

1. Fixed vs. Flexible: As in Tornell and Velasco, fixed regimes induce larger transfers in each period than flexible arrangements if the FA is impatient in the sense that $\beta < 1/(1+r)$. If $\beta > 1/(1+r)$, fixed regimes induce smaller transfers in each period than flexible arrangements. If $\beta = 1/(1+r)$ both regimes induce the same fiscal behavior.

2. Fixed vs. Capital Controls: The comparison of the levels and the intertemporal distortion of transfers across these regimes depends on the relation between ρ_1^* and r. As we show later, $\rho_1^* < r$ in equilibrium.

- If $\rho_1^* = r$ capital controls and fixed regimes behave identically, since the capital control does not bind, and the commercial exchange rate coincides with the financial rate.

- If $\rho_1^* < r$ then $\tau_{1,cc}^* > \tau_{1,fixed}^*$ and $\tau_{2,cc}^* < \tau_{2,fixed}^*$. The capital control binds and the financial rate Q_1^* is bigger than E_1, so that, there is a positive exchange premium.

- If $\rho_1^* > r$ then $\tau_{1,cc}^* < \tau_{1,fixed}^*$ and $\tau_{2,cc}^* > \tau_{2,fixed}^*$. The capital control binds and the financial rate Q_1^* is smaller than E_1, so that, there is a negative exchange premium.

Thus, capital controls *exacerbate* the distortion of fiscal transfers present

under fixed arrangements when (i) $\rho_1^* < r$ and the FA is impatient or (ii) when $\rho_1^* > r$ and the FA is patient. However, capital controls counterbalance the intertemporal distortion of transfers when (i) $\rho_1^* < r$ if the FA is patient or (ii) when $\rho_1^* > r$ and the FA is impatient.

3. Flexible vs. Capital Controls: The comparison of the intertemporal distortion of transfers across these regimes depends on the relation between ρ_1^* and r; however, the ranking between the levels of transfers also depends upon the degree of impatience of the FA. As we show later $\rho_1^* < r$ in equilibrium.

Capital controls *exacerbate* the intertemporal profile of fiscal transfers present under flexible arrangements when (i) $\rho_1^* < r$ and the FA is impatient or (ii) when $\rho_1^* > r$ and the FA is patient. However, capital controls counterbalance the intertemporal distortion of transfers when (i) $\rho_1^* < r$ if the FA is patient or (ii) when $\rho_1^* > r$ and the FA is impatient.

Regarding the level of transfers, we can state that $\tau_{1,cc}^* > \tau_{1,flex}^*$ if: i) the FA is impatient and $\rho_1^* \leqslant r$, or ii) $\beta = 1/(1+r)$ and $\rho_1^* < r$. However $\tau_{2,cc}^* \lesseqgtr \tau_{2,flex}^*$.

4. Notice that even when $\beta = 1/(1+r)$, so that $\tau_{1,fixed}^* = \tau_{2,fix}^* = \tau_{1,flex}^* = \tau_{2,flex}^*$, the optimal pattern of fiscal transfers differs under capital controls if $\rho_1^* \neq r$ because of the effect of the intertemporal consumption distortion on fiscal transfers.

5. Aside from the particular case when $\rho_1^* = r$, we cannot make an unambiguous analytical statement regarding the $pdv\tau$ of capital controls relative

to fixed or flexible regimes. This is not surprising, since the main new feature generated by capital controls is the intertemporal distortion of consumption and fiscal transfers created by deviations of the domestic interest rate from the world one.

6. Nevertheless, we can state that capital controls induce looser fiscal policy initially than fixed and flexible regimes whenever $\rho_1^* < r$ as long as the FA is not patient. That is to say, if $\beta \leqslant 1/(1+r)$ and $\rho_1^* < r$, then $\tau_{1,cc}^* > \tau_{1,fixed}^* \geqslant \tau_{1,flex}^*$.

Although we cannot solve analytically the Ramsey planner's problem for the capital controls case, below we present some intuition and some numerical examples suggesting that $\rho_1^* < r$ *in equilibrium* under capital controls. In other words, under reasonable conditions regarding the impatience of the FA, capital controls induce looser discipline than fixed and flexible regimes during the periods *before the bomb explodes*.

1.2.4.1 Interest Rates, Inflation and Transfers in Equilibrium: Intuition

The previous sections described optimal behavior for a given path of domestic inflation and interest rates. In this section we provide intuition for how these prices are determined in equilibrium. We begin by describing how the PA adjusts real balances under each regime, since this adjustment is the critical driving force behind equilibrium prices. We then describe the FA's choice of transfers in equilibrium.

How the PA adjusts real balances

The main difference between perfect capital mobility and capital controls is the mechanism by which the PA adjusts real balances. This difference is crucial for understanding equilibrium behavior in our model, since the PA would like to reduce her real balances carried to period 2 because of the expected inflation tax. Under perfect capital mobility the PA can rearrange her portfolio composition by buying or selling foreign bonds; in particular, if she wants to reduce real balances the PA can exchange money for bonds. Under *fixed* regimes the PA just changes money for bonds at the end of period 1. Under *flexible* regimes the desire to reduce money holdings carried to period 2 creates pressures on the exchange rate in period 1. Due to this pressure, and since the CB does not intervene in the exchange rate market, there is an increase in the exchange rate and positive inflation in period 1. This in turn reduces the amount of real balances the PA wishes to carry into period 1. In other words, an anticipated increase in the exchange rate in period 2 also boosts the exchange rate in period 1.

Something similar happens under *capital controls*, in the sense that the exchange rate market reacts in anticipation of future events. However, this anticipated behavior occurs via the *financial* exchange rate and not through the *commercial* one, which is assumed to be fixed. Because of the capital controls, any excess demand for bonds tends to increase the value of the financial exchange rate Q_1. The latter change reduces ρ_1, inducing an increase in

consumption in period 1 and worsening the current account deficit. In summary, the desire to reduce real balances because of the expected inflation tax in period 2 creates an increase in c_1^* and a decrease in c_2^*. This effect is always present under capital controls as long as there is an excess demand for bonds in period 1.

FA's Incentives

If the FA's *discount factor is* $\beta = 1/(1+r)$, the FA prefers not to induce any fiscal or consumption intertemporal distortion. However, since the FA has the proclivity to spend more than socially desirable, the expected inflation tax in period 2 is always positive in equilibrium. Therefore, flexible regimes induce the same fiscal behavior than fixed regimes. However, capital controls induce higher transfers in period 1 than in period 2 because of the consumption distortion that occurs as the PA attempts to get rid of real money balances because of the expected inflation tax in period 2.

Assuming an *impatient* FA, two effects can be identified:

- *Fiscal party incentive*: Since the FA's discount factor enters into its direct utility from receiving transfers (see first term in equation (19)), while the intertemporal relative cost is given by the interest rate, an impatient FA would be delighted to have a *fiscal party*. This incentive is present under fixed and flexible regimes, as well as under capital controls.

- *Consumption party incentive*: As described when we analyzed equation (19), an impatient FA would also like the PA to have a *consumption party*. Under perfect capital mobility we showed that consumption is smooth over time. However, under capital controls, an impatient FA could add fuel to the consumption party that is already likely to happen. This encourages the FA to increase the overall $pdv\tau$ in order to increase period 2 inflation and increase the exchange rate premium in period 1, so that there can be a lower ρ_1 and a bigger intertemporal consumption distortion.

Flexible regimes induce more fiscal discipline than fixed regimes because of the different timing of exchange rates adjustment. Under fixed regimes any loose fiscal behavior is reflected only in lower real money demand in period 2, while under flexible regimes money demand also falls in period 1. Thus if the FA is *impatient*, the higher up-front costs of inflation under flexible regimes induce the FA to exercise more fiscal self-control. This is the main result of Tornell and Velasco.

What happens to the FA's incentives under capital controls? Capital controls enable the FA to enjoy the same temporarily low inflation as fixed regimes, since the commercial exchange rate is assumed to be fixed. However, given the way the PA adjusts real balances, an *impatient* FA has a new incentive for looser fiscal behavior, because the bigger the expected inflation tax in period 2, the bigger the consumption party experienced by the PA in period 1. This last effect tilts transfers towards period 1; therefore, capital controls induce

looser discipline than fixed and flexible regimes before the bomb explodes in period 2.

We can anticipate from the previous discussions that:

- Case 1: When the *FA's discount factor is* $\beta = 1/(1+r)$, there will be no fiscal distortions from the FA's impatience per se. Therefore, fixed and flexible regimes will induce the same fiscal behavior. However, under capital controls $\rho_1^* < r$, the PA will have a consumption party in period 1 and a severe hangover in period 2. Therefore, fiscal transfers will tend to be bigger in period 1 and smaller by a greater margin for period 2 than under fixed and flexible regimes. As a consequence, the $pdv\tau$ under capital controls might be smaller or bigger than under fixed or flexible regimes, depending on the value of r. That is to say, $\tau^*_{1,cc} > \tau^*_{1,fixed} = \tau^*_{1,flex}$, $\tau^*_{2,cc} < \tau^*_{2,fixed} = \tau^*_{2,flex}$, $pdv\tau^*_{cc} \gtreqless pdv\tau^*_{fixed} = pdv\tau^*_{flex}$, $c^*_{1,cc} > c^*_{1,fixed} = c^*_{1,flex} = \bar{c}$, $c^*_{2,cc} < c^*_{2,fixed} = c^*_{2,flex} = \bar{c}$.

- Case 2: When the *FA is impatient* there will be intertemporal fiscal distortions due to the *fiscal party incentive* under all regimes, and because of the *consumption party incentive* only under capital controls. Fixed regimes will induce fiscal transfers in each period bigger than under flexible regimes because given the same incentive towards loose fiscal policies, the inflation cost under fixed regimes is paid in period 2, while under flexible regimes it is also paid in period 1. Under capital controls the inflation cost is, like fixed regimes, postponed into the future. However, there is a new reason why transfers in

period 1 under capital controls are bigger than under fixed regimes by an even greater margin that in Case 1. This occurs because the FA adds fuel to the consumption party by increasing the $pdv\tau$ in relation to the one in Case 1. This increase the consumption distortion, which induce the FA to have an even bigger party in period 1 than in Case 1 and, consequently, a more striking fiscal bust in period 2. That is to say, $\tau^*_{1,cc} > \tau^*_{1,fixed} > \tau^*_{1,flex}$, $\tau^*_{2,cc} < \tau^*_{2,fixed}$, $\tau^*_{2,cc} \gtreqless \tau^*_{2,flex}$, $\tau^*_{2,fixed} > \tau^*_{2,flex}$, $pdv\tau^*_{cc} \gtreqless pdv\tau^*_{fixed}$, $pdv\tau^*_{cc} \gtreqless pdv\tau^*_{flex}$, $pdv\tau^*_{fixed} > pdv\tau^*_{flex}$, $c^*_{1,cc} > c^*_{1,fixed} = c^*_{1,flex} = \bar{c}$, $c^*_{2,cc} < c^*_{2,fixed} = c^*_{2,flex} = \bar{c}$.

1.2.4.2 Numerical Examples

Although we cannot solve the Ramsey planner's problem for the capital controls case analytically, we provide in this subsection some numerical examples confirming the intuition that capital controls induce less discipline than fixed and flexible regimes during the periods before the bomb explodes.[18] We assume $\upsilon(\tau) = 1 - e^{-k\tau}$ is the FA utility function associated with the net transfers.[19] We set the following initial conditions, parameters and endowments: $y = 50$, $b_{0-} = m_{0-} = \bar{c}^{\,\epsilon}\, r^{-\epsilon}$, $f_{0-} = 0$, $r = 0.05$, $\epsilon = 0.3$, $\alpha = 0.5$, $k = 5$. Tables 1.2 and 1.3 present results from two examples with different assumptions about the patience of the FA.

[18] We rule out any scenario in which the initial asset position creates an initial excess of demand for money. This would create pressure towards a negative exchange rate premium (i.e. $Q^*_1 < E_1$) which is not observed in reality when capital controls are imposed. This peculiar scenario tends to occur if there is an initial positive net asset position in the private sector (i.e. $f_{0-} > 0$) and/or an initial positive net asset position in the government (i.e. $b_{0-} > 0$). These conditions do not generally apply for EM and developing countries, since most of them have indebted private and public sectors.

[19] We use this utility function because it implies $\upsilon'(\tau) > 0$, $\upsilon''(\tau) < 0$ and $\tau \gtreqless 0$. When transfers are positive in equilibrium, we obtain similar results using other preferences.

Table 1.2 presents results for the case in which $\beta = 1/(1+r)$. As in Tornell and Velasco, $\tau^*_{1,fixed} = \tau^*_{1,flex} = \tau^*_{2,fixed} = \tau^*_{2,flex}$, so that fixed and flexible regimes induce the same fiscal behavior. Under capital controls, consumption and transfers are distorted towards period 1 because of the low domestic interest rate ρ_1. However the transfers in each period, and their present discounted value, are virtually identical to those under fixed and flexible regimes. For the same reason, the three regimes attain almost identical PA's welfare. However, for this particular example, capital controls generate marginally higher PA's welfare than fixed and flexible regimes because they imply a lower $pdv\tau$, despite the intertemporal distortion.

Table 1.3 presents results for an *impatient* FA which is, arguably, the most realistic scenario. As in Tornell and Velasco the presence of an impatient FA induces a looser fiscal policy in both periods for fixed regimes than flexible arrangements (i.e. $\tau^*_{1,fixed} > \tau^*_{1,flex}$ and $\tau^*_{2,fixed} > \tau^*_{2,flex}$). For this particular example, the $pdv\tau$ under capital controls is lower than for fixed arrangements and higher than for flexible regimes. However, the fiscal and consumption party observed in period 1 is bigger under capital controls than under fixed and flexible arrangements. Moreover, the consumption and fiscal distortions under capital controls are larger in this case than when the FA has the same discount factor as the PA. This occurs because an impatient FA benefits directly from front-loaded transfers (i.e. *fiscal party incentive*), and because an impatient FA wants to encourage a larger consumption party in period 1 (i.e. *consumption party*

incentive). FA's impatience thus boosts the fiscal and consumption party while the stabilization plan lasts, and increases the severity of the hangover when the bomb explodes. Capital controls have negative welfare effects in relation to fixed and flexible regimes because the detrimental intertemporal distortion effect more than compensates for the reduction in the $pdv\tau$.

In summary, we argue that capital controls induce even looser fiscal policies than fixed and flexible regimes while the stabilization plan lasts. This occurs because capital controls enable free-spending politicians to enjoy the same temporarily low inflation as fixed regimes, as well as a temporary consumption boom which is regarded as desirable by impatient politicians. This temporary consumption party induce politicians to engage in a fiscal party before the stabilization plan collapses.

1.3 Empirical Analysis

In this section we empirically test the implication of our theoretical model that capital controls induce looser fiscal behavior than fixed and flexible regimes during the initial periods *before the bomb explodes* or, in other words, in relatively "tranquil" times. We also test Tornell and Velasco's core prediction that fixed regimes induce less discipline than flexible regimes. The rest of this section is organized as follows. First, we discuss earlier empirical studies of the link between fiscal discipline and exchange rate regime. Second, we present the data used in our study. Third, we show some preliminary evidence.

Fourth, we present the econometric methodology. Fifth, we show our benchmark empirical results, accounting for diverse sources of potential exchange rate regime endogeneity. Finally, we do some sensitivity analysis by considering alternative exchange rate regime classifications.

1.3.1 Previous Empirical Studies

To begin, we discuss existing empirical studies that test whether fixed regimes induce more fiscal discipline than flexible regimes. Although this comparison is not the main focus of our paper, it is useful to identify the main limitations and difficulties of previous work. Table 1.4 summarizes the principal existing studies. As mentioned in the introduction, the literature is not conclusive as to whether fixed regimes induce more discipline than flexible arrangements. Tornell and Velasco (2000) find that fixed regimes tend to induce less discipline than flexible arrangements; Alberola and Molina (2004) find similar performance; and Alberola et al. (2005) and Fatás and Rose (2001) find that fixed regimes generate more sound fiscal policies than flexible arrangements. Vuletin (2004) finds that fixed regimes induce looser (tighter) fiscal policies than flexible arrangements in relatively "stable" ("volatile") international finance contexts. These studies share four common problems:

- *Exchange rate regime classification.* Most previous studies use the *de jure* IMF exchange rate regime classification, which until recently asked member states to self-declare their arrangements. Since such an official classification

often fails to describe actual countries' practices, *de facto* classifications should be used instead. Only Vuletin (2004) and Alberola et al. (2005) consider this element.

- *Lag of dependent variable as regressor.* It is difficult to model the underlying "primitive" determinants of the level of fiscal variables like expenditures and deficits. To get around this problem, previous studies include lagged fiscal indicators as explanatory variables. Therefore, the econometric specification should be dynamic, not only because of a direct interest in the coefficient of the lagged fiscal variable itself, but also because the correct dynamic specification may be critical to recover consistent estimates of the impact of other variables of interest, such as the exchange rate regime. Only Vuletin (2004) and Alberola et al. (2003, 2005) consider this factor.

- *Country-specific effects.* Heterogeneity in fiscal institutions is considered to be important in understanding diverse fiscal outcomes.[20] Although some of this heterogeneity is manifested in formal organizations that can plausibly be measured, many institutions involve informal arrangements and behaviors impossible to quantify. Country-specific effects account for those unobserved determinants of the fiscal outcome that are peculiar to each country, and that do not vary over time. Plausible factors captured by such effects include political preferences, attitudes towards fiscal discipline, degree of discretion over expenditures, and transparency of procedures in the budget process. Only

[20] See for example Alesina and Perotti (1996) and Poterba and von Hagen (1999).

Vuletin (2004) and Alberola et al. (2005) consider this element in a panel data context.

-*Exchange rate regime endogeneity.* All studies recognize the crucial importance of this factor. Tornell and Velasco (2000) argue that the Sub-Saharan Africa sample they use provides a sort of "natural experiment", since the choice of exchange rate regime in these countries was based on colonial history and not on political or economic considerations. This statement might be correct for the CFA countries[21], which maintained a fixed exchange rate with the French franc from 1948 until 1994, as long as their connection to France did not also allow them to have a better position in credit markets, or if CFA countries were not different from non-CFA economies in other respects that could be relevant for fiscal discipline. Further, Tornell and Velasco's instrument is only available for a limited number of countries. Fatás and Rose (2001) remark that endogeneity could be relevant for currency boards, but not so much for currency unions. However, they stress that their "results are best viewed as correlations rather than causal statements". Alberola and Molina (2004) argue that endogeneity is not an issue since the choice of the sample "is done taking into account the more or less explicit attempt of using the exchange rate peg as stabilizing device". This fact not only does not guarantee the absence of endogeneity issues but, on the contrary, might suggest the opposite since it could imply that the choice of the regime is a response to fiscal performance.

[21] CFA refers to Communauté Financière d'Afrique.

Alberola et al. (2005) remark that the expected influence of the endogeneity bias is not clear-cut. While chronic deficits might induce the choice of a fixed regime, fiscal discipline makes fixed regimes more sustainable.

In summary, while the three first elements are seldom considered in previous empirical studies, a more appropriate treatment of the exchange rate regime endogeneity is an open subject in the literature. In this paper we tackle each of the factors described before, including the regime endogeneity.

1.3.2 Data

Our empirical study uses a panel data set which consists of 23 emerging market countries in the period 1970-2001.[22] We focus on this set of countries because they have at least 15 years of continuous fiscal data and; more importantly, because they experienced diverse macroeconomic problems related to fiscal, inflation and debt difficulties and have "weak" central banks that recurrently finance governments via seigniorage and inflation tax. For example, the average inflation rate for the whole sample is 23 percent, almost 20 percent of the observations involve foreign currency default and 35 percent have either a Stand-by Arrangement or an Extended Fund Facility IMF program.

The main sources of data for the macroeconomic and fiscal variables are Kaminsky et al. (2004), and the publications Global Development Finance and

[22] The countries in the sample are Argentina, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Ghana, Guatemala, India, Indonesia, Malaysia, Mauritius, Mexico, Morocco, Pakistan, Paraguay, Peru, Philippines, Tunisia, Turkey, Uruguay and Venezuela.

World Development Indicators. The *de jure* IMF and the *de facto* Reinhart-Rogoff exchange rate classifications are from Reinhart and Rogoff (2002). We also use data on natural disasters from the Center of Research on the Epidemiology of Disasters, Université Catholique de Louvain.[23]

1.3.2.1 Macroeconomic and Fiscal Variables

Taking into account the theoretical model, the most natural variable to capture net fiscal transfers is the central government primary fiscal surplus as a percentage of trend GDP. We divide by trend GDP and not GDP itself because, as Kaminsky et al. (2004) argue, normalizing by GDP understates (overstates) fiscal behavior when governments pursue procyclical (countercyclical) fiscal policies. One of the most notable characteristics of fiscal variables is their strong time inertia. Table 1.5 shows this strong positive serial correlation with a value close to 0.75 at a one year horizon.

Our control variables include: i) the country's position in the business cycle, ii) terms of trade shocks, iii) initial government debt, iv) whether the country has a debt default or bank crisis, v) whether the country has an IMF program, vi) the real LIBOR interest rate and vii) average real GDP growth in OECD countries. As instruments for the exchange rate regime we use the percentage of total long-term debt contracted in US$, short-term external debt as a percentage of total external debt, terms of trade volatility and trade openness. Later, we also use natural disasters to evaluate the response of fiscal policies to exogenous shocks

[23] See Appendix 1.5 for a complete description of all variables used in the study and their source.

under diverse exchange rate regimes. We justify these controls and instruments afterwards.

1.3.2.2 Exchange Rate Regime Classification

The selection of an exchange rate regime classification is crucial for any study that aims to measure the influence of exchange regimes on other variables. As remarked by Reinhart and Rogoff (2002), the *de jure* IMF classification can be misleading, since "the gap between *de facto* and *de jure* can be vast". Reinhart and Rogoff (2002) develop a classification that is based upon the actual evolution of the market-determined exchange rate. This classification has several advantages compared to the *de jure* IMF classification: First, it measures actual behavior as opposed to what countries claim to do. Second, it identifies capital controls, which are crucial to test our hypothesis. In this regard, a very attractive feature of this classification is that it identifies all types of capital controls. This occur because it identifies not only official dual exchange rate regimes in which the government authorizes the existence of a parallel exchange rate market, but it also detects other restrictions on the capital account that trigger off endogenously black parallel markets. Lastly, Reinhart and Rogoff create a separate category called "free falling", which includes extreme macroeconomic distress situations associated with inflation of over 40 percent per year. As suggested by Reinhart and Rogoff, this category allows the researcher to avoid mixing the effects of floating regimes under modest inflation situations with those related to severe stressful circumstances.

In line with our theoretical model, we do not include observations classified as "free falling", since we want to measure the influence of regimes in relatively "tranquil" times and not when the bomb actually explodes. As described in Table 1.6, around 20 percent of potential sample observations correspond to this category. Once "free falling" observations are excluded, we distinguish between unified markets and dual regimes, with the latter group representing almost 40 percent of the effective sample. Among unified markets we differentiate fixed from flexible regimes, which constitute around 50 percent and 10 percent of the sample respectively. Note that the division of observations under unified rates would differ notably if the IMF classification was used, since around 65 percent of the sample self-declare as having flexible regimes. As Table 1.7 shows, this occurs because most countries that claimed to follow flexible arrangements during our sample period actually fixed their exchange rates. This phenomenon is known as "fear of floating" (see Calvo and Reinhart (2000)).

1.3.3 Preliminary Evidence

Before proceeding with more elaborate tests, we provide a descriptive analysis by examining the mean differences in the government primary balance across exchange regimes. In Table 1.8 we examine both the raw data and the deviation of each observation from its country-specific mean. We find that dual regimes are associated with worse primary balances than fixed and flexible regimes under both approaches. Fixed regimes have on average higher deficits than flexible

arrangements; however, this result vanishes when we consider the within country experience.

Columns (1) and (2) of Table 1.9 confirm the mean test results using a simple regression specification without any controls beyond country fixed effects.[24] Since fixed effects might exacerbate the downward bias in standard errors due to the presence of positive error autocorrelation, column (3) allows for country clustered heteroscedasticity and autocorrelation in the errors. Given the strong time persistence of the primary balance described above, it is no surprise that this inclusion increases the standard errors and severely reduces the statistical significance of capital controls.

1.3.4 Econometric Methodology and Specification

In this section we outline the elements that an ideal econometric methodology should take into account, and conclude that the dynamic panel system GMM approach developed by Blundell and Bond (1998) constitutes the most appropriate technique. The desired econometric methodology should consider the following aspects:

- *Lag of dependent variable as regressor.* As discussed in Section 1.3.1 the specification should be dynamic, not only because of a direct interest in the coefficient of the lagged fiscal balance itself, but also because a correct dynamic specification is necessary to recover consistent estimates of other coefficients of

[24] In connection to the second chapter of this thesis, the informal economy could be interpreted as a fixed effect that influence the tax collection.

interest.

- *Country-specific effects.* As argued in Section 1.3.1 the specification should consider country-specific effects.

- *Other fiscal determinants.* Our primary goal is to test the influence of exchange regimes on the primary budget balance; however, other potential determinants should be included, especially if their behavior is suspected to be correlated with the exchange rate regime. We consider several regressors:

i) The country's position in the business cycle captures the procyclicality or countercyclicality of fiscal policies. Existing literature tends to find that deficits in emerging markets and developing countries behave procyclically, while developed countries adopt countercyclical fiscal policies.[25] Approximately 47 percent, 59 percent and 62 percent of fixed, flexible and dual regime observations are classified as recessions respectively.[26]

ii) Initial government debt measures the debt burden and the ability to borrow. It is expected that the higher the degree of initial indebtness, the more difficult will be to obtain a new loan to finance the deficit. The mean level of indebtness is similar across observations under different exchange rate regimes.

iii) Debt defaults, bank crises and IMF programs represent symptoms of diverse macroeconomic and financial difficulties. If such circumstances are mainly the result of continuous fiscal misbehavior, their occurrence might trigger a fiscal reform towards more discipline, following the arguments developed by

[25] See for example Kaminsky et al. (2004).
[26] We identify recessions as episodes where trend real GDP is above its actual value.

Alesina and Drazen (1991) and Velasco (1997). Approximately 50 percent of debt default and bank crisis episodes are concentrated in the excluded category "free falling". The remaining episodes are roughly evenly distributed between fixed and dual regimes.

iv) As in Calvo and Végh (1999), the real LIBOR interest rate and average real GDP growth in OECD countries are intended to capture the world business cycle.

v) Terms of trade shocks represent another external shock that could affect fiscal performance.[27]

-Endogeneity of the exchange rate regime and other regressors. Aside from the initial level of debt, all fiscal determinants -including the exchange rate regime- are subject to endogeneity. For example, a positive relationship between fiscal primary surplus and the business cycle could reflect countercyclical fiscal policies; however, such a positive relationship could also occur if promoting fiscal discipline drives the economy towards a boom. Therefore, the econometric technique should instrument for all potentially endogenous regressors.

Taking into account all the previous considerations, the dynamic panel system GMM approach developed by Blundell and Bond (1998) is appropriate, since it allows us to estimate a model such as the following:

$$y_{it} = \gamma + \alpha\, y_{it-1} + r_{it}^{'}\lambda + x_{it}^{'}\,\beta + \eta_i + \mu_{it} \qquad i = 1, ..., N \qquad t = 1, ..., T \qquad (43)$$

[27] See for example Lane and Tornell (1999).

where y_{it} is the central government primary balance, α is a scalar, $r_{it}^{'}$ of dimension $1 \times g$ refers to exchange rate regimes, $x_{it}^{'}$ of dimension $1 \times k$ consists of control variables that also affect the central government primary balance, β and λ are $k \times 1$ and $g \times 1$ vectors, and $\eta_i \sim IID\big(0, \sigma_\eta^2\big)$ and $\mu_{it} \sim IID\big(0, \sigma_\mu^2\big)$ are jointly independent. This GMM estimator addresses the bias and inconsistency problems that arise under fixed and random effect estimators due to the joint presence of country-specific effects and a lagged dependent variable.

The intuition for the Blundell and Bond (1998) approach is as follows. According to equation (43), y_{it} is a function of η_i and, because of this, so is y_{it-1}. Since y_{it-1} is also a regressor in equation (43) both within and random effect transformations are correlated with the transformed errors even if μ_{it} is not serially correlated, yielding a biased and inconsistent estimator of α. An alternative that eliminates the individual effect without creating the mentioned problems is the first-difference transformation. Anderson and Hsiao (1981) suggest using $\triangle y_{it-2}$ or y_{it-2} as an instrument for $\triangle y_{it-1}$. As long as μ_{it} is not serially correlated the proposed instruments would not be correlated with $\triangle \mu_{it}$. However, Ahn and Schmidt (1995) show that while consistent, the resulting estimates are not necessarily efficient because they do not use all available moments. The dynamic panel *first-difference* GMM approach developed by Arellano and Bond (1991) uses lagged levels dated $t-2$ and earlier as instruments for the equations in first-differences by assuming that μ_{it} are serially uncorrelated and that the initial conditions y_{i1} are predetermined. While

producing a consistent estimator of α, Blundell and Bond (1998) show that as α approaches unity or as σ_η^2 increases relative to σ_μ^2, this estimator has poor finite sample properties in terms of bias and imprecision because the lagged series of the levels are weak instruments for the first-difference equations.[28] Blundell and Bond (1998) developed an estimator with superior finite sample properties for dynamic panel models with persistent data, called dynamic panel *system* GMM. Assuming additionally that $E\big(\eta_i \triangle y_{i2}\big) = 0$ for each i –which holds if the means of the y_{it} series, while differing across individuals, are constant through time for periods 1, 2, ..., T for each individual– they construct an estimator that makes use of an extra set of moment conditions. The proposed estimator not only uses the lagged levels as instruments for first-difference equations but also lagged first-differences as instruments for equations in levels.

In our empirical model r_{it} and x_{it} could also be endogenous. Two possible econometric strategies are available to control for such endogeneity: i) the use of external instruments in a standard instrumental variables approach or, ii) the use of internal instruments in a similar way as suggested by Blundell and Bond (1998). The latter approach would require $E\big(\eta_i \triangle x_{it}\big) = 0$ as additional moment conditions. Following Blundell and Bond (2000), constant means of x_{it} series through time for each country would be sufficient for the validity of the preceding moment conditions. Although stationary means of business cycle

[28] Using Monte Carlo simulations Blundell and Bond (1998) show that this bias is particularly important when the number of available periods is small. For example, with a T=4 and N=100 and a true value of α=0.9, the distribution of the first-difference GMM estimator has a mean of 0.23 with a standard deviation of 0.83.

might be reasonable, constant means of the exchange rate regime series are not. For this reason we employ the first approach -using external instruments in a standard instrumental variables approach- to control for exchange rate regime endogeneity.

To test the validity of the main assumptions used by this methodology, we report three tests in each regression outcome. First, we report the Hansen's J statistic, which is an over-identifying restriction test which examines whether the moment conditions assumptions are valid. Second, since the method assumes that μ_{it} is serially uncorrelated, we also report the first and second order serial correlation test for the residuals of the first-difference equations. While the first order serial correlation test is expected to reject the null of no correlation, the second serial order correlation test should not reject the null hypothesis of no correlation. It is worth mentioning that the Hansen's J test does not reject and the second order serial correlation test rejects the null hypothesis for all regressions at 5 percent significance.

1.3.5 Benchmark Results

In this section we examine the estimation results for the conditional effects of exchange rate regimes on the primary government balance. In the first subsection we treat all regressors, including exchange rate regimes, as exogenous. Afterwards, we control for endogeneity by modifying the sample used, including additional regressors, using a standard instrumental variables approach, and using natural disaster events to evaluate the response of fiscal policies under

diverse exchange rate regimes.

1.3.5.1 Conditional Effects of Exchange Rate Regimes

Columns (1) in Table 1.10 shows the most basic dynamic panel data model, which only includes the autoregressive component. We confirm that the primary fiscal balance is highly persistent over time and that exchange rate regimes influence fiscal behavior in the predicted by the theoretical model.

Columns (2) to (6) in Table 1.10 show the results of the dynamic panel strategy controlling one-at-a-time for domestic and external variables that could affect the fiscal performance. The business cycle is negatively related to the fiscal balance, which suggests procyclicality of fiscal policies. The initial debt has a positive sign; the higher the initial debt, the lower the possibility or willingness to undergo fiscal deficits. Neither terms of trade shocks nor international interest rates seem to significatively affect the primary fiscal balance. The positive and significant coefficient associated with the average real GDP growth in OECD countries indicates that good times in the developed world economies are related to better fiscal performance in emerging markets. When all these regressors are considered altogether, in Table 1.10 column (7), the results are maintained but the business cycle loses its significance.

Abstracting from endogeneity issues, the results support the main implication of the model, that capital controls induce looser fiscal performance than fixed and flexible regimes operating under unified rates. Our findings also favor Tornell and Velasco's prediction that fixed regimes generate less fiscal discipline

than flexible arrangements. In quantitative terms, dual regimes produce deficits 1.1 percent and 0.5 percent of GDP higher than flexible and fixed arrangements, respectively, and fixed regimes cause deficits 0.6 percent higher than flexible arrangements. These are economically significant magnitudes considering that the average primary fiscal deficit in the sample is 1.25 percent of GDP.

Exchange rate regime changes over time is a source of identifying variation in our panel study. However, since the fiscal process is continuous and inertial by nature, some concern might exist to the extent that "excessive" exchange rate regime variability allow us to identify the precise influence of regimes on fiscal performance. For this reason, column (8) in Table 1.10 considers observations for which the exchange rate regime remains constant for at least four years. The results stand against this consideration, even when the size of the sample is reduced by almost 9 percent.

1.3.5.2 Exchange Rate Regime Endogeneity

In this section we address endogeneity of the exchange rate regime and the business cycle. The latter is addressed by using internal instruments following the system GMM approach, that is to say, considering lagged levels as instruments for first-difference equations and lagged first-differences as instruments for equations in levels.[29] To properly analyze exchange rate regime endogeneity, we distinguish three main potential sources:

- *Regime classification endogeneity.* The Reinhart-Rogoff classification is

[29] Similar results are obtained if the first lag of GDP Cycle is used instead.

outcome based, in that it categorizes regimes based upon the evolution of the market-determined exchange rate. For this reason, it is likely that countries experiencing poor fiscal performance would tend to have more flexible regimes ex post, while countries experiencing sound fiscal policies would increase their chance of sustaining fixed regimes or capital controls. Therefore, this source of endogeneity would tend to generate the appearance of higher surpluses for fixed and dual regimes than for flexible arrangements. Since the empirical results do not show this pattern, accounting for this source of endogeneity would strengthen our results.

- *Endogeneity due to regime choice under stress.* Countries experiencing persistent fiscal deficits or other financial and debt difficulties could adopt fixed regimes as a stabilizing device, or impose capital controls to avoid the effects of a depreciation on domestic prices while maintaining some degree of control over capital outflows and international reserves. Therefore, this source of endogeneity would tend to generate the appearance of lower fiscal surpluses under fixed and dual regimes than under flexible arrangements. Since the empirical findings do show this profile, we reduce the likelihood of this type of endogeneity by using only observations that are at least two years distant from "free falling" events and controlling for other regressors that are symptoms of macroeconomic and financial distress, such as episodes of debt default, bank crisis and the presence of IMF programs.[30]

[30] It is worth remembering that around 50 percent of debt defaults and bank crisis events were already excluded, since they occur during "free falling" episodes.

Column (1) in Table 1.11 abstracts from observations within two years of "free falling" episodes, reducing the size of the sample by 20 percent. This "tranquil" regression supports the results obtained before. Columns (2),(3) and (4) include the IMF Program, Bank Crisis and Default variables respectively. Only the last variable is statistically significant, indicating that countries experiencing debt defaults tend to improve their fiscal performance. Specifically, default increases the primary balance by 0.7 points of GDP.[31] Interestingly, when this variable is included, the Initial Debt loses its significance, which supports the idea that "things must be really bad before they start to get better again" as formalized in Alesina and Drazen (1991) and Velasco (1997).

The three distress variables are included together in columns (5) and (6) in Table 1.11, where column (6) only considers observations for which the exchange rate regime remains constant for at least four years. In both cases the previous results are sustained in both qualitative and quantitative terms.

- *Endogeneity due to government type.* As in Tornell and Velasco, we assume in our model that the central bank's monetary and capital flows policies are exogenous and are not the result of any optimization problem. However, it seems reasonable to think that, to the extent that the regime choice affects fiscal discipline, the fiscal authority will try to influence the central bank to

[31] Although endogeneity of the IMF Program, Bank Crisis and Default variables might be a concern, two things are worth noting. First, such endogeneity would tend to generate negative coefficients on the three mentioned variables, which is not what we observe. Secondly, it is relatively unlikely that the current fiscal performance per se generates such episodes; on the contrary, distress episodes are usually associated with chronic fiscal and macroeconomic mismanagement. For empirical purposes we also include the first lag of the three distress indicators, obtaining similar results.

choose the type of exchange rate regime that suits the policymaker better.

The model presented above suggests that free-spending politicians would be more likely than fiscal conservatives to persuade the central bank to choose fixed regimes or impose capital controls. For this reason, this source of endogeneity tends to generate the appearance of looser fiscal performance in fixed and dual regimes than in flexible arrangements. We control for this source of endogeneity by using instrumental variables and by exploiting the randomness of natural disaster events to evaluate the response of fiscal policies under diverse exchange rate regimes.

Four variables are used as instruments for the exchange rate regime: i) the percentage of total long-term debt contracted in US$, ii) short-term external debt as a percentage of total external debt, iii) terms of trade volatility and, iv) trade openness. The first two variables are suggested by Avellán (2005) to identify the impact of dual regimes, while the last two are typically used by empirical papers that analyze the determinants of exchange rate regimes using factors affecting optimal currency areas.[32] Following Avellán (2005): i) The percentage of total long-term debt contracted in US$ captures the currency mismatch in a country's debt structure and proxies its degree of liability dollarization. If there is a negative shock that puts pressure on the exchange rate and the currency mismatch is perceived to be critical, policymakers would rather implement a partial devaluation through a dual regime than a unified devaluation. ii) Short-term external debt as a percentage of total external

[32] See for example Rizzo (1998), Poirson (2001) and Juhn and Mauro (2002).

debt controls for the maturity imbalance that might be present in external debt, pushing a country into a liquidity crisis. If a negative shock occurs, a policymaker whose interest payments are concentrated in the near future would prefer a dual regime as opposed to a unified devaluation because the debt service remains unchanged.

The literature on optimal currency areas suggests that fixed regimes are preferable for more open countries, because of the trade gains derived from stable bilateral exchange rates, while flexible arrangements are preferable for economies subject to volatile real shocks such as terms of trade. Because of potential contemporaneous feedback from the exchange rate regime to these instruments, we use one lagged values. Columns (1) and (2) in Table 1.12 show the results employing this standard instrumental variables approach. [33]. Columns (1) and (2) use the "tranquil" sample described above and column (2) only considers observations where regime remains constant for at least 4 years. The previous results are confirmed; capital controls induce looser fiscal policies than fixed and flexible regimes operating under unified rates, and fixed regimes generate less discipline than flexible arrangements.

We also show additional evidence exploiting the randomness of natural disasters, in line with Ramcharan (2005).[34] Severe natural disasters like

[33]C tests confirm the validity of the exchange rate regimes instruments at a 25% level

[34] Ramcharan analyzes the relationship between exchange rate regimes and economic adjustment to adverse real shocks. He argues that, since the choice of the exchange rate regime may influence the type of shock that the country experiences, variables commonly used to capture real shocks -such as terms of trade volatility- can cause selection bias and hamper identification. For this reason, he takes advantage of the randomness of natural disasters to measure whether the influence of natural shocks on investment and economic growth depends on the exchange rate regime.

droughts, earthquakes, floods and wind storms have two key features which make them appealing for our purposes:

- *Unpredictability and exogeneity.* Natural disasters are typically sudden events, and they are usually unrelated to human activity.

- *Government involvement.* Since they cause great damage, destruction, and human suffering, governments generally respond to natural disasters with diverse policies intending to alleviate the damage inflicted. In particular, active fiscal policies are used to rebuild infrastructure, homes and productive systems, as well as to provide assistance and economic help to the families affected.

For these reasons we can assess the impact of exchange rate regimes on fiscal discipline by evaluating whether the fiscal response differs across exchange arrangements in the presence of such natural catastrophes. In order to evaluate this hypothesis we consider the following specification:

$$y_{it} = \gamma + \alpha\ y_{it-1} + \varphi\ ND_{it} + \sum_{j=1}^{g-1} \phi_j\ ND_{it}\ r_{it}^{j} + r_{it}^{'}\lambda + x_{it}^{'}\ \beta + \eta_i + \mu_{it}$$

$$i = 1, ..., N \quad t = 1, ..., T \tag{44}$$

where (44) is similar to (43), but also includes a natural disasters dummy ND and its interaction with the exchange rate regimes.

Using the database from the Center for the Research on the Epidemiology of Disasters, a disaster is recorded in his analysis when some of the following conditions hold: i) 10 or more reported killed, ii) 100 people reported affected, iii) a call for international assistance and/or iv) a declaration of a state of emergency. He argue that these "low thresholds ensure that most disasters are recorded in the database". A natural disaster is registered in the same year it occurs.

We identify natural disasters using data from the Center for the Research on the Epidemiology of Disasters. We classify a particular observation as a natural disaster when:

i) A drought, earthquake, flood or wind storm affects at least 5 percent of the country's total population.[35] This relatively high threshold guarantees that the natural disaster is sufficiently important to affect fiscal behavior. For example, Argentina had natural disasters in around 75 percent of the years in the period 1970-2001. However, 80 percent of those events affected less than 0.7 percent of the total population, and on average only 0.15 percent of the country was affected. Although these events have the unpredictability characteristic, it is doubtful that government fiscal policy significantly responded to such "minor" events. Using a 5 percent threshold, only 2 flood events occurred in Argentina, in 1983 and 1988, affecting around 20 percent and 15 percent of the total population.[36]

ii) The event is recorded in the year it occurs if it happens during the first 10 months of the year, while it is counted in the following year if it happens during the last 2 months of the year. Obviously, the destruction effects happen at the moment of the catastrophe; however, it is likely that the fiscal response to such severe events is reflected in the following year if the disaster occurs at the very end of the year.[37]

[35] Similar results are obtained if the percentage of country's total population used as threshold varies moderately.

[36] Although the data base also contains some information regarding total damages in monetary terms, it is quite scarce.

[37] Similar results are obtained if the month used as threshold moderately varies.

Considering this definition, 53 natural disasters are recorded, representing around 7 percent of the total sample. The average share of population affected by those events is 15 percent, which shows the severity of the recorded episodes. Excluding observations with "free falling" events, the shares of disasters occurring under each type of regime are 46 percent, 16 percent and 38 percent for fixed, flexible and dual regimes respectively. These proportions are similar to the distribution of regimes in the overall sample.

Columns (3) to (5) in Table 1.12 show the estimation outcomes when using specification (44). Columns (3) and (4) are analogous to (1) and (2) from a sample and econometric perspective, aside from the new terms included related to natural disasters. Column (5) eliminates observations for which the exchange rate regime corresponding to the disaster differs from the previous year's regime. This reduces the likelihood that the natural disaster affects the choice of exchange rate regime. The interaction terms show that fixed regimes induce lower discipline than flexible regimes in the face of a natural disaster, and dual regimes generate an even looser fiscal performance than fixed regimes, giving support to our previous results. In quantitative terms, capital controls produce deficits that are 2.6 percent and 1.2 percent of GDP higher than flexible and fixed arrangements, and fixed regimes cause deficits that are 1.4 percent higher than flexible arrangements.

1.3.6 Further Evidence and Sensitivity Analysis

In this section we provide further evidence and sensitivity analysis. First, we consider the price and reserve insulation properties of capital controls. Second, we use the *de jure* IMF exchange rate regime classification.

1.3.6.1 Insulation Properties Under Dual Exchange Rate Regimes

Our theoretical model and empirical analysis assumes, in line with most of the literature, that the financial and commercial exchange markets can be separated at zero cost.[38] However, as Guidoti (1988) notices, when the assumption of complete separation is relaxed, different types of "leakages" arise. Moreover, Kiguel et al. (1997) remark that the higher the exchange rate premium the more important are those "leakages" and, consequently, the less effective are dual regimes in insulating prices and reserves.[39] In fact, this is the main reason why these regimes are usually abandoned, not because they are no longer needed, but because they are no longer useful in protecting reserves and maintaining low inflation.

[38] Some exceptions are Guidoti (1988), Braga de Macedo (1982), Bhandari and Decaluwé (1990) and Bhandari and Végh (1990).

[39] Different "leakages" arise when exchange rate premiums increase. Following Kiguel et al. (1997) some of them are: i) Through illegal trade, as exports are diverted from official to unofficial channels (Fleming 1971, Lanyi 1975 and Bhagwati 1978). ii) Outflows of reserves may also occur through legal channels, for example Kamin (1993) reports that exporters in Argentina aggressively used special export financing facilities during the early 1980s. iii) Imports are overinvoiced (May 1995, O'Connel 1991). iv) For individuals with access to foreign exchange at the commercial exchange rate, a rise in the exchange rate premium increases the profit from diverting funds from the official market to the parallel one and, therefore, the supply of official reserves for private capital flows also increases.

Our previous results are not likely to be driven by the more severe cases in which these type of "leakages" may happen, since the sample does not include "free falling" episodes.[40] However, there could still be "leakages" of a lower magnitude. For this reason we separate dual regimes according to the evolution of the market-determined exchange rate following the Reinhart-Rogoff classification. The median exchange premium for dual regimes with flexible market-determined exchange rates, Dual(Flex.), is 20.2 percent, while for dual regimes with fixed market-determined exchange rates, Dual(Fixed), the median is 6.2 percent. This difference is statistically significant with a p-value of 0.0001.

Table 1.13 shows that capital controls induce looser fiscal policy than regimes operating under unified rates, but that effect is smaller as the market-determined exchange rate becomes more flexible and the exchange rate premium increases. This result is consistent with the idea that increments in the exchange rate premium intensify the "leakages", weakening the price and reserve insulation properties of capital controls, and consequently reducing the fiscal incentives to unsound fiscal policies. In other words, as the "leakages" become more important, price formation and capital flows tend to be closer to those under flexible regimes. For this reason, governments with low fiscal discipline face immediate inflation costs and do not enjoy the same degree of control over the consumption distortion.

[40] The median exchange premium and inflation for "free falling" events which operate under dual regimes are 28 percent and 47.5 percent respectively, while for not "free falling" dual regimes they are 12.5 percent and 11.6 percent. These differences are statistically significant with a p-value of 0.001

Two issues are worth noting. First, there might be some concern about our results if Dual(Fixed) regimes are associated with low premiums because of large official exchange rate devaluations. If this is the case, such regimes might be associated with poor fiscal performance because they are associated with the collapse of an unsustainable official exchange rate and not because of the relatively strong price and reserve insulations that low premiums may assure. This concern does not seem to be warranted, since only 1.5 percent of Dual(Fixed) regimes have official exchange devaluations higher than 25 percent, while 20 percent of Dual(Flex.) observations are associated with large devaluations. Second, endogeneity issues might also arise, since poor fiscal performance tends to increase the exchange premium. However if this element drives our results, Dual(Flex.) regimes should have worse fiscal discipline than Dual(Fixed) arrangements, which is the opposite of what we found. In other words, these two concerns affect our estimation results, correcting for them would strength our findings and not weaken them.

1.3.6.2 De jure Exchange Rate Regime Classification

So far we have used the *de facto* Reinhart-Rogoff classification. In this section we consider instead the *de jure* IMF classification for those arrangements operating under unified rates. The results are presented in Table 1.14. Considering this classification, fixed regimes generate the same discipline as flexible arrangements; however, dual regimes still induce less discipline than either regime operating under unified rates. Therefore, the difference between

what countries claim to do and what they actually do clearly matters when analyzing the influence of exchange arrangements on diverse macroeconomic variables, including the primary fiscal balance.

1.4 Conclusions

In this paper we offer both theoretical arguments and empirical evidence showing that capital controls induce looser fiscal policies than fixed and flexible regimes operating under perfect capital mobility.

On the theoretical front we argue that while capital controls allow politicians to enjoy the same temporarily low inflation as fixed regimes, lax fiscal policies also generate a temporary consumption boom which is regarded as desirable by impatient politicians. The consumption boom occurs because as the households attempt to get rid of unwanted real money balances, the real domestic interest rate falls. Therefore, the more shortsighted the politicians are, the looser the fiscal policies will be.

We performed an econometric analysis confirming that capital controls lead to larger primary deficits than fixed and flexible regimes under unified rates. Our findings also support Tornell and Velasco's core prediction that fixed regimes induce less discipline than flexible regimes. We confirm the relevance of "leakages" under capital controls. In particular we find that when the market-determined exchange rate is more flexible and the exchange rate premium increases, fiscal performance tends to improve.

The general consensus among economists is that capital controls are clearly harmful to economic efficiency because they prevent resources from being used where they are most productive. These controls have been associated with systems of financial repression, persistent overvaluation of official exchange rates, protection of inefficient import-substituting industries and low economic growth.[41] However, several arguments claim that capital controls might be a useful policy. One of the most frequent justifications is that capital controls provide at least temporary insulation of reserves and domestic prices from transitory shocks to the capital account. In this line of thought Tobin (1978) advocated throwing "some sand in the wheels of our excessively efficient international money markets". Similarly Dornbusch (1986) claims that "running the world to the tune of assets markets may be undesirable. Hence the interest in institutional arrangements that delink asset markets and free policies to be directed to a government's true priorities", and in a similar vein Krugman (1998) argues that "currency controls are a risky, stopgap measure, but some gaps desperately need to be stopped". In line with the first group of papers, we provide theoretical arguments confirming the distortions that capital controls induce in terms of consumption and current account deficits. Our findings also counter the arguments that advocate the use of capital controls as temporary relief for temporary capital account shocks, because the loose fiscal policy they induce might exacerbate the initial condition they were intended to alleviate.

[41] See for example Fry (1988), McKinnon (1973), Shaw (1973), Eichengreen et al. (1999), Barro and Lee (1993), Bhagwati (1978) and Avellán (2005).

1.5 Appendix

Table 1.1 Sources and Definitions of Variables

Variable Name	*Definition and Source*
Fixed	1 if Reinhart and Rogoff coarse exchange rate regime classification equals 1 or 2 under unified market, i.e. fixed or limited flexibility not dual. 0 for any other category. Source: Reinhart and Rogoff (2002).
Flexible	1 if Reinhart and Rogoff coarse exchange rate regime classification equals 3 or 4 under unified market, i.e. managed or freely floating not dual. 0 for any other category. Source: Reinhart and Rogoff (2002).
Dual	1 if there exists a dual exchange rate regime, i.e. a market determined and an official exchange rate. 0 for any other category. Source: Reinhart and Rogoff (2002).
Dual (Fixed)	1 if there exists a dual exchange rate regime and Reinhart and Rogoff coarse exchange rate regime classification equals 1 or 2 , i.e. there are a market-determined and an official exchange rates and the former one behaves fixed or with limited flexibility. 0 for any other category. Source: Reinhart and Rogoff (2002).
Dual (Flex.)	1 if there exists a dual regime and Reinhart and Rogoff coarse exchange rate regime classification equals 3 or 4 , i.e. there are a market determined and an official exchange rates and the former one behaves as a flexible exchange rate. 0 for any other category. Source: Reinhart and Rogoff (2002).
Freely Falling	1 if Reinhart and Rogoff's coarse exchange rate regime classification equals 5, i.e. if inflation is above 40%. 0 for any other category. Source: Reinhart and Rogoff (2002).

Variable Name	*Definition and Source*
Fixed (IMF)	1 if the IMF exchange rate regime classification is "single currency peg", "SDR peg", "other official basket peg", "secret basket peg" under unified market, i.e. de jure fixed or limited flexibility not dual. 0 for any other category. Source: Reinhart and Rogoff (2002).
Flexible (IMF)	1 if the IMF exchange rate regime classification is "more flexible" under unified market, i.e. de jure floating not dual. 0 for any other category. Source: Reinhart and Rogoff (2002).
Cgpb	Central government primary fiscal balance (as percentage of GDP trend). GDP trend was calculated using the Hodrick-Prescott filter with a smoothing parameter of 100. Source: Kaminsky, Reinhart and Végh (2004).
GDP Cycle	Calculated as $\big($(RGDP - RGDP Trend)/RGDP Trend $\big)$*100. RGDP is real GDP and its trend was calculated using the Hodrick-Prescott filter with a smoothing parameter of 100. Source: Kaminsky, Reinhart and Végh (2004).
Initial Debt	Total public and private guarantee debt as percentage of GDP at the end of last year. Source: Global Development Finance 2005.
TOT Shock	Calculated as $\big($(TOT - TOT Trend)/TOT Trend $\big)$*100. TOT is terms of trade, calculated as the ratio of the export price index to the corresponding import price index measured relative to the base year 1995. Its trend was calculated using the Hodrick-Prescott filter with a smoothing parameter of 100. Source: Kaminsky, Reinhart and Végh (2004).
Real LIBOR	Eurodollar deposits rate (London) minus US consumer price index inflation rate. The deposit's maturity is 6 months and it was annualized using a 360-day year or bank interest. Sources: The Federal Reserve Board for the Eurodollar deposit rates and World Development Indicators 2006 for inflation rates.
OECD growth	Average annual Real GDP growth for OECD countries. Source: World Development Indicators 2006.
Default	1 if foreign currency bank or bond debt default. 0 otherwise. Source: Standard & Poor's.
Bank Crisis	1 if there is a systematic banking crises. 0 otherwise. Source: Caprio and Klingebiel (1999 and 2003).

Variable Name	*Definition and Source*
IMF Program	1 if there is either a Stand-by Arrangement or an Extended Fund Facility IMF program for at least 7 months in the year under consideration. 0 otherwise. Source: Policy Development and Review Department, IMF.
ND	1 if there is a natural disaster that affects at least 5% of the country's total population in the first ten month of the current year or in the last two month of the previous year. The events include droughts, earthquakes, floods and wind storms. 0 otherwise. Source: Center for Research on the Epidemiology of Disasters, Université Catholique de Louvain, Belgium.
Fordebt	Percentage of total long-term debt contracted in US$. Source: Global Development Finance 2005.
Stdebt	Short-term external debt as percentage of total external debt. Source: Global Development Finance 2005.
Totvol	Terms of trade volatility calculated as standard deviation of terms of trade in the last five years. Source: Kaminsky, Reinhart and Végh (2004).
Openness	Imports and Exports as percentage of GDP. Source: World Development Indicators 2006.

Table 1.2 Example 1. $\beta = 1/1.05 = 1/(1+r)$.

Variable	*CC*	*Fixed*	*Flexible*	*(CC-Fixed)* $\triangle$ %	*(CC-Flex.)* $\triangle$ %	*(Fixed-Flex.)* $\triangle$ %
τ_1	1.294	1.291	1.291	0.257	0.257	0
τ_2	1.287	1.291	1.291	-0.275	-0.275	0
$pdv\tau$	2.520	2.520	2.520	-0.002	-0.002	0
c_1	55.291	54.381	54.381	1.674	1.674	0
c_2	53.425	54.381	54.381	-1.758	-1.758	0
m_0	8.146	8.146	5.406	0	50.677	50.677
m_1	4.027	3.940	4.616	2.205	-12.771	-14.653
π_1	0	0	0.146			
π_2	0.500	0.513	0.282	-2.579	77.222	81.914
ρ_1	0.015					
Q_1	1.035					
PA's Welfare	7.782	7.782	7.782	0.007	0.007	0.000

Note: *CC* denote capital controls.

Table 1.3 Example 2. $\beta = 1/1.5 < 1/(1+r)$.

Variable	*CC*	*Fixed*	*Flexible*	*(CC-Fixed)* $\triangle$ %	*(CC-Flex.)* $\triangle$ %	*(Fixed-Flex.)* $\triangle$ %
τ_1	1.384	1.362	1.339	1.595	3.369	1.746
τ_2	1.265	1.291	1.267	-1.989	-0.181	1.845
$pdv\tau$	2.588	2.591	2.545	-0.105	1.686	1.793
c_1	60.618	54.381	54.381	11.470	11.470	0
c_2	47.832	54.381	54.381	-12.043	-12.043	0
m_0	8.146	8.146	5.390	0	51.131	51.131
m_1	3.524	3.884	4.592	-9.278	-23.258	-15.410
π_1	0	0	0.148			
π_2	0.890	0.540	0.288	64.681	209.040	87.660
ρ_1	-0.171					
Q_1	1.267					
PA's Welfare	7.763	7.781	7.782	-0.232	-0.236	-0.005

Note: *CC* denote capital controls.

Table 1.4 Brief Description of Previous Empirical Studies.

Study	*Countries and Period Coverage*	*ERR Classif.*	*Main Econometric Specification*	*ERR Endogeneity Considerations*	*Main Findings*
Tornell and Velasco (2000)	28 african countries. Early 80s.	Fixed: CFA countries. Flexibles: Non-CFA countries.	Cross-section: $y_{i,t_1} - y_{i,t_0} = \gamma_0 + \lambda_1\ ERR_i +$ $+ \sum_h \gamma_h\ x_i^h + \mu_i$ t_0=1980, 1981 and t_1=1983-1987. y=several fiscal measures including fiscal deficit and expenditures as share of GDP. x=initial debt, RGDPpc, TOT.	Argue that the sample provides a "natural experiment"since ERR selection is due to colonial history and not to econ. or pol. causes.	Fixed ERRs induce looser fiscal policies than flexible ERRs.
Fatás and Rose (2001)	206 countries. 1960-1998.	Ghosh et al. (2003) and IMF.	Panel Data-Time FE: $y_{it} = \gamma_0 + \sum_j \lambda_j ERR_{it}^j +$ $+ \sum_h \gamma_h\ x_{it}^h + \nu_t + \mu_{it}$ y=several fiscal measures including fiscal deficit and expenditures as share of GDP. x=RGDPpc, Openness, Population, Land Area, Urbanization.	Could be important for currency boards, not so much for currency unions.	Currency unions do not induce more fiscal discipline, but currency boards seem to.

Notes: ERR denote exchange rate regime, FE indicate fixed effects, CFA refers to Communauté Financière d'Afrique.

Study	*Countries and Period Coverage*	*ERR Classif.*	*Main Econometric Specification*	*ERR Endogeneity Considerations*	*Main Findings*
Vuletin (2004)	83 countries. 1974-1998.	LYS and IMF.	Panel Data-Country FE-Dynamic: $y_{it} = \gamma_0 + \alpha_1\ y_{it-1} + \sum_j \lambda_j ERR_{it}^j + + \sum_h \gamma_h\ x_{it}^h + \eta_i + \mu_{it}$ y=several fiscal measures including fiscal deficit and expenditures as share of GDP. x=RGDPpc, Openness, TOT, inflation, hyper-inflation.	Addressed using internal instruments of GMM approach.	Fixed ERRs induce looser (tighter) fiscal policies than flexible ERRs in "stable" ("volatile") international finance contexts.
Alberola and Molina (2004)	32 emerging markets. 1972-2001.	Modified IMF.	Panel Data-No FE-Dynamic: $y_{it} = \gamma_0 + \alpha_1\ y_{it-1} + \sum_j \lambda_j ERR_{it}^j + + \mu_{it}$ y=several fiscal measures including fiscal deficit and expenditures as share of GDP.	Argue that it is not an issue since the choice of the sample considers explicit attempts to use the fixed ERR as a stabilization device.	Fixed ERRs induce similar fiscal discipline than flexible ERRs.

Notes: ERR denote exchange rate regime, FE indicate fixed effects. RR adduce to Reinhart and Rogoff (2002) ERR classification, LYS adduce to Levy-Yeyati and Sturzenegger (2000) ERR classification and TOT means terms of trade.

Study	*Countries and Period Coverage*	*ERR Classif.*	*Main Econometric Specification*	*ERR Endogeneity Considerations*	*Main Findings*
Alberola, Molina and Nadia (2005)	110 countries. 1991-2001.	RR and IMF.	Panel Data-Country FE: $y_{it} = \gamma_0 + \sum_j \lambda_j ERR_{it}^j + + \eta_i + \mu_{it}$ y=primary fiscal balance as share of GDP.	Endogeneity bias sign is not clear: i) chronic deficits might induce the election of fixed ERR. ii) a better fiscal performance makes more likely the sustainability of the fixed ERR.	Using the RR (IMF) classif., fixed ERRs do (do not) provide more fiscal discipline than flexible ERRs.

Notes: ERR denote exchange rate regime, FE indicate fixed effects and RR adduce to Reinhart and Rogoff (2002) ERR classification.

Table 1.5 Serial Correlation of Central Government Primary Fiscal Balance (as percentage of Trend GDP)

	$Cgpb_t$
$Cgpb_{t-1}$	0.741
$Cgpb_{t-2}$	0.516
$Cgpb_{t-3}$	0.420
$Cgpb_{t-4}$	0.389

Note: 551 Obs.

Table 1.6 Exchange Rate Regime Categories using Reinhart and Rogoff Classification

Category	Observations	Share of total sample	Share of total sample excluding "free falling"
Fixed unified rates	298	40.5	51.6
Flexible unified rates	56	7.6	9.7
Dual	224	30.4	38.8
"Free falling"	158	21.5	
Total	736	100	100

Table 1.7 Deeds vs. Words: Reinhart and Rogoff vs. IMF Classification.

		Reinhart and Rogoff Classification		
		Fixed	*Flexible*	*Total*
IMF	*Fixed*	119	11	130
Classification	*Flexible*	179	45	224
	Total	298	56	354

Note: Neither "free falling" nor dual regime observations are considered.

Table 1.8 Mean Test for Central Government Primary Fiscal Balance (as percentage of Trend GDP) across Exchange Rate Regimes.

	Cgpb mean value			H_0 : *Means are equal* H_1*: Means are different (p-value)*		
	Fixed	*Flexible*	*Dual*	*Fixed vs. Flexible*	*Fixed vs. Dual*	*Dual vs. Flexible*
Overall	-0.760	-0.027	-2.294	0.047	0	0
Within	0.592	0.507	-1.004	0.833	0	0.001

Note: Within measures are obtained by subtracting from each observation the country's mean value. We allow unequal variances in the the two-sample t-test. There are 489 Obs. The value 0 is reported when the first four decimal digits equal zero.

Table 1.9 Unconditional Effects of Exchange Rate Regimes. Dependent Variable:Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	Pooled Cross-Section	*Country Fixed Effects*	*Country Fixed Effects Clustered*
	All	All	All
	(1)	(2)	(3)
Fixed	-0.734	0.367	0.367
	$(2.041)^{**}$	(0.722)	(0.297)
Dual	-2.267	-2.19	-2.19
	$(5.611)^{***}$	$(4.266)^{***}$	(1.496)
Observations	489	489	489
Countries	23	23	23
R^2	0.076	0.133	0.133
p-value: Fixed=Flex.	0.042	0.471	0.769
Dual=Flex.	0	0	0.149
Fixed=Dual	0	0	0.01

Notes: Flexible regime is the omitted category. Intercept estimatior not reported. Estimations are performed with OLS -column 1- and country fixed effects -columns 2 and 3. Standard errors of columns 1 and 2 are adjusted by heteroscedasticity while those reported in column 3 are also clustered by country, that is, the observations are assumed to be independent across countries, but not necessarily within countries.
The value 0 is reported when the first four decimal digits equal zero.
Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% l levels, respectively.

Table 1.10 Conditional Effects of Exchange Rate Regimes.
Dependent Variable: Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	GMM All (1)	*GMM* All (2)	*GMM* All (3)	*GMM* All (4)	*GMM* All (5)	*GMM* All (6)	*GMM* All (7)	*GMM* "Const." (8)
Cgpb (-1)	0.721	0.727	0.717	0.72	0.718	0.725	0.716	0.721
	(15.348)***	(15.813)***	(15.835)***	(14.999)***	(14.649)***	(15.297)***	(14.461)***	(14.854)***
Fixed	-0.621	-0.514	-0.649	-0.634	-0.626	-0.608	-0.592	-0.609
	(2.093)**	(1.798)*	(2.428)**	(2.130)***	(2.094)**	(2.178)***	(2.445)**	(2.164)**
Dual	-1.097	-1.034	-1.102	-1.115	-1.104	-1.127	-1.128	-1.139
	(3.252)***	(3.251)***	(3.404)***	(3.270)***	(3.260)***	(3.471)***	(3.608)***	(3.041)***
GDP Cycle		-0.046					-0.032	-0.011
		(2.196)**					(1.426)	(0.448)
Initial Debt			0.013				0.013	0.014
			(2.770)***				(2.645)***	(2.912)***
TOT Shock				0.003			0.008	0.008
				(0.285)			(0.988)	(0.856)
Real LIBOR					-0.03		-0.065	-0.082
					(0.600)		(1.386)	(1.641)
OECD growth						0.209	0.211	0.21
						(2.886)***	(2.856)***	(2.951)***
Observations	471	471	471	471	471	471	471	433
Countries	23	23	23	23	23	23	23	23
p-value: OIR test	1	1	1	1	1	1	1	1
m_1	0.004	0.003	0.004	0.004	0.004	0.002	0.002	0.004
m_2	0.101	0.1	0.1	0.103	0.102	0.102	0.109	0.088
p-value: Fixed=Flex.	0.036	0.072	0.015	0.033	0.036	0.029	0.014	0.03
Dual=Flex.	0.001	0.001	0.001	0.001	0.001	0.001	0.0003	0.002
Fixed=Dual	0.047	0.03	0.046	0.047	0.05	0.025	0.024	0.039

Notes: Flexible regimes is the omitted category. Intercept estimatior not reported. All estimations are performed with country fixed effects using Blundell and Bond (1998) system GMM approach. All regressors, including exchange rate regimes, are treated as exogenous.
Column 9 only considers observations for which the exchange rate regime remains "constant" for at least 4 years.
OIR test refers to the Hansen over-identifying restrictions test. m_1 and m_2 refers to first and second order serial correlation test, respectively.
Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 1.11 Conditional Effects of Exchange Rate Regimes Considering Endogeneity Due to *Regime Choice Under Stress*.
Dependent Variable: Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	GMM "Tranquil"	*GMM* "Tranquil"	*GMM* "Tranquil"	*GMM* "Tranquil"	*GMM* "Tranquil"	*GMM* "Tranquil" "Const."
	(1)	(2)	(3)	(4)	(5)	(6)
Cgpb (-1)	0.737	0.738	0.738	0.73	0.729	0.728
	(15.530)***	(15.577)***	(15.612)***	(15.537)***	(15.743)***	(15.449)***
Fixed	-0.552	-0.551	-0.545	-0.554	-0.567	-0.563
	(2.231)**	(2.267)**	(2.204)**	(2.193)**	(2.284)**	(2.037)**
Dual	-1.086	-1.083	-1.094	-1.18	-1.221	-1.212
	(2.823)***	(2.798)***	(2.848)***	(2.873)***	(2.907)***	(2.659)***
GDP Cycle	-0.033	-0.032	-0.031	-0.03	-0.03	-0.026
	(1.509)	(1.515)	(1.456)	(1.495)	(1.466)	(1.302)
Initial Debt	0.011	0.011	0.01	0.005	0.005	0.005
	(2.346)**	(2.512)**	(2.163)**	(0.921)	(0.992)	(0.910)
TOT Shock	0.003	0.003	0.003	0.002	0.002	0.002
	(0.306)	(0.301)	(0.309)	(0.245)	(0.206)	(0.217)
Real LIBOR	-0.02	-0.02	-0.024	-0.021	-0.023	-0.018
	(0.417)	(0.418)	(0.490)	(0.445)	(0.461)	(0.361)
OECD Growth	0.161	0.162	0.162	0.159	0.156	0.165
	(2.185)**	(2.201)**	(2.189)**	(2.150)**	(2.121)**	(2.283)**
IMF Program		0.013			-0.126	-0.149
		(0.080)			(0.837)	(0.962)
Bank Crisis			0.233		0.14	0.16
			(0.913)		(0.607)	(0.663)
Default				0.702	0.737	0.773
				(2.441)**	(2.644)***	(2.836)***
Observations	395	395	395	395	395	381
Countries	22	22	22	22	22	22
p-value: OIR test	1	1	1	1	1	1
m_1	0.007	0.006	0.007	0.006	0.006	0.006
m_2	0.101	0.101	0.1	0.098	0.1	0.1
p-value: Fixed=Flex.	0.026	0.023	0.028	0.028	0.022	0.042
Dual=Flex.	0.005	0.005	0.004	0.004	0.004	0.008
Fixed=Dual	0.05	0.053	0.045	0.027	0.027	0.029

Notes: Flexible regimes is the omitted category. Intercept estimatior not reported. All estimations are performed with country fixed effects using Blundell and Bond (1998) system GMM approach. In all columns the exchange rate regimes are treated as exogenous. *GDP Cycle* is instrumented using internal instruments following the system GMM approach. Similar results are obtained if the first lag of *GDP Cycle* is used instead. All columns use observations that are at least two years distant from free falling regimes, which proxy for "tranquil" times. Column 6 only considers observations for which the exchange rate regime remains "constant" for at least 4 years.
OIR test refers to the Hansen over-identifying restrictions test. m_1 and m_2 refers to first and second order serial correlation test, respectively.
Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 1.12 Conditional Effects of Exchange Rate Regimes Considering Endog. Due to *Regime Choice Under Stress* and *Government Type* Endog. Dependent Variable:Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	GMM "Tranquil" (1)	*GMM* "Tranquil" "Const." (2)	*GMM* "Tranquil" (3)	*GMM* "Tranquil" "Const." (4)	*GMM* "Tranquil" "Const." "Const. ND" (5)
Cgpb (-1)	0.729	0.727	0.717	0.717	0.714
	(15.708)***	(15.613)***	(15.332)***	(15.324)***	(15.217)***
Fixed	-0.565	-0.557	-0.504	-0.481	-0.482
	(2.251)**	(1.984)**	(1.567)	(1.319)	(1.325)
Dual	-1.213	-1.206	-1.058	-1.022	-1.031
	(2.907)***	(2.633)***	(2.360)**	(2.065)**	(2.088)**
Fixed*ND			-0.964	-1.105	-1.467
			(2.030)**	(2.063)**	(3.154)***
Dual*ND			-2.207	-2.263	-2.626
			(3.052)***	(3.109)***	(4.806)***
ND			0.223	0.275	0.636
			(0.397)	(0.462)	(1.855)*
GDP Cycle	-0.03	-0.025	-0.021	-0.019	-0.019
	(1.494)	(1.247)	(1.116)	(0.996)	(1.030)
Initial Debt	0.005	0.005	0.005	0.005	0.005
	(1.000)	(0.916)	(1.063)	(0.937)	(0.912)
TOT Shock	0.002	0.002	-0.002	-0.002	-0.002
	(0.212)	(0.262)	(0.218)	(0.218)	(0.243)
Real LIBOR	-0.023	-0.019	-0.028	-0.022	-0.021
	(0.462)	(0.368)	(0.543)	(0.429)	(0.409)
OECD Growth	0.156	0.165	0.17	0.18	0.181
	(2.126)**	(2.285)**	(2.407)**	(2.552)**	(2.577)***
IMF Program	-0.127	-0.153	-0.179	-0.209	-0.228
	(0.848)	(0.991)	(1.159)	(1.378)	(1.503)
Bank Crisis	0.139	0.161	0.097	0.113	0.114
	(0.605)	(0.672)	(0.446)	(0.508)	(0.513)
Default	0.735	0.775	0.857	0.901	0.909
	(2.640)***	(2.827)***	(2.995)***	(3.230)***	(3.261)***
Observations	395	381	395	381	379
Countries	22	22	22	22	22
p-value: OIR test	1	1	1	1	1
m_1	0.006	0.005	0.006	0.006	0.006
m_2	0.1	0.1	0.091	0.092	0.091
p-value: Fixed=Flex.	0.024	0.047	0.117	0.186	0.185
Dual=Flex.	0.004	0.008	0.039	0.039	0.037
Fixed=Dual	0.028	0.032	0.066	0.076	0.072
Fixed*ND=Flex.*ND			0.042	0.039	0.002
Dual*ND=Flex.*ND			0.002	0.002	0
Fixed*ND=Dual*ND			0.036	0.061	0.061

Notes: Flexible regimes is the omitted category. Intercept estimation not reported. All estimations are performed with country fixed effects using Blundell and Bond (1998) system GMM approach. Exchange rate regimes are instrumented using the first lag of i) Fordebt, ii) Stdebt, iii) Openness and iv) Totvol. *GDP Cycle* is instrumented using internal instruments following the system GMM approach. Similar results are obtained if the first lag of *GDP Cycle* is used instead. All columns use obs. that are at least two years distant from "free falling" regimes. Columns 2, 4 and 5 only consider obs. for which the exchange rate regime remains "constant" for at least 4 years. Column 5 does not include obs. for which the exchange rate regime corresponding to the year in which the natural disaster (ND) is registered does not coincide with the one of the previous year.
OIR test refers to the Hansen over-identifying restrictions test. m_1 and m_2 refer to first and second order serial correlation test, respectively. The value 0 is reported when the first four decimal digits equal zero. Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 1.13 Conditional Effects of Exchange Rate Regimes Considering Endogeneity Due to *Regime Choice Under Stress*.
Dependent Variable: Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	GMM "Tranquil" (1)	*GMM* "Tranquil" "Const." (2)
Cgpb (-1)	0.71	0.709
	(15.812)***	(15.527)***
Fixed	-0.578	-0.577
	(2.228)**	(2.000)**
Dual (Fixed)	-1.61	-1.608
	(3.129)***	(2.943)***
Dual (Flex.)	-0.683	-0.666
	(1.890)*	(1.666)*
GDP Cycle	-0.018	-0.015
	(0.940)	(0.784)
Initial Debt	0.006	0.006
	(1.110)	(0.996)
TOT Shock	0.003	0.004
	(0.398)	(0.406)
Real LIBOR	-0.044	-0.04
	(0.964)	(0.866)
OECD Growth	0.142	0.151
	(1.954)*	(2.125)**
IMF Program	-0.059	-0.075
	(0.402)	(0.493)
Bank Crisis	0.125	0.144
	(0.587)	(0.647)
Default	0.657	0.688
	(2.253)**	(2.441)**
Observations	395	376
Countries	22	22
p-value: OIR test	1	1
m_1	0.007	0.007
m_2	0.091	0.092
p-value: Fixed=Flex.	0.026	0.046
Dual (Fix)=Flex.	0.002	0.003
Dual (Flex)=Flex.	0.059	0.096
Fixed=Dual (Fix)	0.013	0.015
Fixed=Dual (Flex.)	0.639	0.684
Dual (Fix)=Dual (Flex.)	0.024	0.024

Notes: Flexible regimes is the omitted category. Intercept estimatior not reported. All estimations are performed with country fixed effects using Blundell and Bond (1998) system GMM approach. In all columns the exchange rate regimes are treated as exogenous. *GDP Cycle* is instrumented using internal instruments following the system GMM approach. Similar results are obtained if the first lag of *GDP Cycle* was used instead. All columns use observations that are at least two years distant from free falling regimes, which proxy for "tranquil" times. Column 2 only considers observations for which the exchange rate regime remains "constant" for at least 4 years.
OIR test refers to the Hansen over-identifying restrictions test. m_1 and m_2 refers to first and second order serial correlation test, respectively.
Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 1.14 Conditional Effects of Exchange Rate Regimes Considering Endogeneity Due to *Regime Choice Under Stress*.
Dependent Variable: Central Government Primary Fiscal Balance (as percentage of Trend GDP).

	GMM "Tranquil" (1)	*GMM* "Tranquil" "Const." (2)
Cgpb (-1)	0.731	0.731
	(15.425)***	(15.281)***
Fixed (IMF)	-0.038	-0.01
	(0.171)	(0.045)
Dual	-0.737	-0.713
	(2.558)**	(2.448)**
GDP Cycle	-0.034	-0.032
	(1.517)	(1.406)
Initial Debt	0.004	0.004
	(0.799)	(0.697)
TOT Shock	0.002	0.002
	(0.236)	(0.236)
Real LIBOR	-0.024	-0.018
	(0.457)	(0.338)
OECD Growth	0.161	0.17
	(2.189)**	(2.381)**
IMF Program	-0.096	-0.109
	(0.631)	(0.700)
Bank Crisis	0.152	0.161
	(0.630)	(0.652)
Default	0.721	0.76
	(2.712)***	(2.885)***
Observations	395	381
Countries	22	22
p-value: OIR test	1	1
m_1	0.006	0.006
m_2	0.1	0.096
p-value: Fixed (IMF)=Flex. (IMF)	0.864	0.964
Dual =Flex. (IMF)	0.011	0.014
Fixed (IMF)=Dual	0.063	0.064

Notes: Flexible regimes is the omitted category. Intercept estimatior not reported. All estimations are performed with country fixed effects using Blundell and Bond (1998) system GMM approach. In all columns the exchange rate regimes are treated as exogenous. *GDP Cycle* is instrumented using internal instruments following the system GMM approach. Similar results are obtained if the first lag of *GDP Cycle* was used instead. All columns use observations that are at least two years distant from free falling regimes, which proxy for "tranquil" times. Column 2 only considers observations for which the exchange rate regime remains "constant" for at least 4 years. OIR test refers to the Hansen over-identifying restrictions test. m_1 and m_2 refers to first and second order serial correlation test, respectively.
Absolute t-statistics in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Chapter 2

What is the Size of the Pie? Measuring the Informal Economy in Latin America and the Caribbean

2.1 Introduction

The measurement of the size of the informal economy has evoked considerable interest in both academic environments and policy circles, especially given its importance for emerging markets and developing countries. At the same time, measuring the informal economy is not an easy task. The biggest challenge arises from the lack of a clear definition of the informal economy. A wide range of similar terms are used in the literature such as hidden economy, shadow economy, clandestine economy, parallel economy, subterranean economy, unreported economy, cash economy and black economy. However, as a result of recent comprehensive publications and handbooks, there seems to exist some level of consensus regarding some terms. Following Feige (2005):

- The *illegal economy* consists of the income produced by those economic activities pursued in violation of legal statutes defining the scope of legitimate forms of commerce.

- The *unreported economy* consists of those legal and illegal economic activities that evade fiscal rules as codified in the tax laws.

- The *informal economy* comprises those economic activities that circumvent the costs and are excluded from the benefits and rights incorporated in the laws and administrative rules covering property relationships, commercial licensing, labor contracts, torts, financial credit and social systems. A summary measure of the informal economy is the income generated by economic agents who operate informally. Similarly, Portes et al. (1989) defines the informal economy as "a process of income-generation characterized by one central feature: it is unregulated by the institutions of society, in a legal and social environment in which similar activities are regulated".

Measuring the size of the informal economy is important for many reasons. First, there seems to be strong evidence that suggests a direct and clear link between the size of the informal economy and tax evasion. Table 2.2 shows, by using data for the early 90s from Schneider and Enste (2000) and Silvani and Brondolo (1993), that there is a clear positive relationship between these two concepts. As extreme cases, countries like Bolivia, which had an informal economy share of approximately 65 percent, experienced VAT tax evasion of about 45 percent; while countries like New Zealand, which had a low share of informal activity, around 12 percent, had a much lower level of tax evasion, close to 5 percent.

Second, the informal economy, as a job provider, has an impact on the viability of social security institutions, specifically in terms of the latter's ability to provide protection while receiving enough financial support. For example, in the early 90s, while 94 percent of the labor force contributed to the social security system in Netherlands, this percentage was only 19 for Honduras[1]. Third, inaccurate perceptions about the actual size of the economy could seriously decrease the effectiveness of a wide variety of policies.

This paper estimates the size of the informal economy and the relative contribution of each underlying factor in the ECCU and 26 mainly Latin American countries in the "early 2000s", being the first study to address this issue for the Eastern Caribbean Currency Union (ECCU) economies and many other Central American and Caribbean countries. For this purpose, a structural equation model approach that considers the informal economy as a latent variable with multiple causes and indicators is used. This approach surpasses typical limitations of some commonly used time series methods because, among other reasons, it does not require information regarding the absolute value of the informal economy for *each* country at some point in time to pin down the evolution of the informal economy over time. On the contrary, this cross section approach needs this information for *only one country* in the sample. This method also allows the exclusive use of *real* variables, as opposed to *monetary* ones,

[1] Based on information from Forteza and Rama (2001).

which might underestimate and misrepresent the relevance of the informal economy in countries subject to high degree of dollarization in circulating currency.

We find that a stringent tax system and regulatory environment, higher inflation, dominance of the agriculture sector, and weakness in governance are the key factors underlying the informal economy. The evidence obtained also confirms that a higher degree of informality reduces labor unionization, the number of contributors to social security schemes and enrollment rates in intermediate education.

The size of the informal economy varies considerably from around 16 percent of total GDP for Bahamas to 70 percent for Paraguay. Notwithstanding, the average size of the informal economy for the ECCU and Caribbean countries (around 33 percent of GDP) is lower than for Latin American economies (average of 43 percent of GDP).

The relative contribution of each underlying factor to the overall size of the informal economy is also estimated for each country. For some countries like Antigua and Barbuda, Barbados and Trinidad and Tobago, the key element is tax burden. For example, for the period under consideration, Antigua and Barbuda had the highest marginal corporate and personal tax rates of 55 and 35 percent

respectively. For others like St. Vincent and the Grenadines, St. Lucia and Belize, the importance of the agriculture sector appears to be decisive, with around 75 percent of exports concentrated in agriculture and food products. For other countries like Paraguay and the Dominican Republic, labor rigidities are some of the most important factors, with minimum wages representing 170 percent and 90 percent of the corresponding GDP per capita.

The paper is organized as follows. The next section reviews the different methods used by the literature to estimate the size of the informal economy. It also carefully explains the "Multiple Indicators, Multiple Causes" (MIMIC) approach, which is the econometric method used in this study. Section III presents the set of countries and variables used in the analysis. The empirical results are discussed in Section IV, and Section V contains some concluding remarks.

2.2 Methods for Measuring the Size of the Informal Economy

Many alternative methods have been used to measure the size of the informal economy[2]. Some approaches use direct methods based on surveys, but most studies use indirect methods based on (i) the discrepancy between national expenditure and income statistics, (ii) the discrepancy between the official and actual labor force, (iii) the "electricity approach" of Kauffman and Kaliberda (1996), (iv) the monetary "transaction approach" of Feige (1979), (v) the "currency demand" approach of Cagan (1958) and others, and (vi) the "Multiple Indicators, Multiple Causes" (MIMIC) approach. A brief description of each methodology, as well as a detailed explanation of the MIMIC approach, is provided below.

2.2.1 Surveys[3]

These micro approaches use surveys and samples based on voluntary replies, or tax auditing and other compliance methods to measure the informal economy. While providing great detail about the structure of the informal economy, the results are sensitive to the way the questionnaire is formulated and the

[2] A thorough review of these approaches is discussed in Schneider and Enste (2000) and the OECD handbook "Measuring the Non-Observed Economy" released in 2002.

[3] See for example Isanchen and Strom (1985), Witte (1987), Mogensen et al. (1995), Ivan-Ungureanu and Pop (1996) and Feige (1996).

respondents' willingness to cooperate. Therefore surveys are unlikely to capture all informal activities.

2.2.2 Discrepancy Between National Expenditure and Income Statistics[4]

If those working in the informal economy were be able hide their incomes for tax purposes but not their expenditure; the difference between national income and national expenditure estimates could be used to approximate the size of the informal economy. If all the components of the expenditure side were measured without error and were constructed so that they were statistically independent from income factors, then this approach would indeed yield a good estimate of the size of the informal economy. Unfortunately this gap also reflects other types of omissions and errors and several expenditure estimates are based on income calculations; thus the reliability of this method is seriously arguable.

2.2.3 Discrepancy Between Official and Actual Labor Force[5]

If the total labor force participation is assumed to be constant, a decline in official labor force participation can be interpreted as an increase in the importance of the informal economy. Since movements in the participation rate might have many other explanations, such as the position in the business cycle,

[4] See for example MacAfee (1980) and Yoo and Hyun (1998).
[5] See for example Contini (1981), Del Boca (1981) and O'Neil (1983).

difficulty in finding a job and education and retirement decisions, these estimates represent weak indicators of the size of the informal economy.

2.2.4 Electricity Approach[6]

Kaufmann and Kaliberda (1996) endorse the idea that electricity consumption is the single best physical indicator of overall (official and unofficial) economic activity. Using some findings that the electricity-overall GDP elasticity is close to one[7], these authors suggest using the difference between growth of electricity consumption and growth of official GDP as a proxy for the growth of the informal economy. This method is simple and appealing, but has many drawbacks, including: (i) not all informal economy activities require a considerable amount of electricity (e.g. personal services) or use other energy sources (like coal, gas, etc.), hence only part of the informal economy growth is captured and; (ii) the electricity-overall GDP elasticity might significantly vary across countries and over time.

2.2.5 Transaction Approach[8]

Using Fischer's quantity equation, *Money·Velocity = Prices ·Transactions*, and assuming that there is a constant relationship between the money flows related to

[6] See for example Del Boca and Forte (1982), Portes (1996) and Johson et al. (1997).
[7] See Dobozi and Pohl (1995).
[8] See for example Feige (1979), Boeschoten and Fase (1984) and Langfeldt (1984).

transactions and the total (official and unofficial) value added, i.e. *Prices · Transactions = k (official GDP + informal economy)*, it is straightforward to obtain the following equation *Money · Velocity = k (official GDP + informal economy)* . The stock of money and official GDP estimates are known and money velocity can be estimated. Thus, if the size of the informal economy as a ratio of the official economy is assumed to be known for a benchmark year, then the informal economy can be calculated for the rest of the sample. Although theoretically attractive, this method has several weaknesses; for instance: (i) the assumption of *k* constant over time seems quite arbitrary and (ii) other factors like the development of checks and credit cards could also affect the desired amount of cash holdings and thus velocity.

2.2.6 Currency Demand Approach[9]

Assuming that informal transactions take the form of cash payments, in order not to leave an observable trace for the authorities, an increase in the size of the informal economy will, consequently, increase the demand for currency. To isolate this resulting "excess" demand for currency, Tanzi (1980) suggests to use a time series approach in which currency demand is a function of conventional factors, such as the evolution of income, payment practices and interest rates, and

[9] See for example Cagan (1958), Gutmann (1977), Tanzi (1980, 1983), Scheneider (1997) Johnson et al. (1998).

factors causing people to work in the informal economy, like the direct and indirect tax burden, government regulation and the complexity of the tax system. The size and evolution of the informal economy can be calculated by following two steps. First, the difference between the evolution of currency when government regulations and the direct and indirect tax burden are held at their lowest value and the development of currency with the current (higher) burden of taxation and government regulations is calculated. Secondly, assuming the same income velocity for currency used in the informal economy as for legal money in the official economy, the size of the informal economy can then be computed and compared to the official GDP. However there are several problems associated with this method and its assumptions: (i) this procedure may underestimate the size of the informal economy, because not all transactions take place using cash as means of exchange; (ii) at least in the United States, increases in currency demand deposits seem to occur mainly because of a slowdown in demand deposits rather than an increase in currency used in informal activities; (iii) it seems extremely arbitrary to assume equal velocity of money in both types of economies and; (iv) the assumption of no informal economy in a base year is open to criticism.

2.2.7 Multiple Indicators, Multiple Causes (MIMIC) Approach[10]

All methods described above consider only one indicator or manifestation of the informal economy -e.g. electricity consumption, money or cash demand. However, there exist several manifestations or symptoms showing up simultaneously. The MIMIC approach explicitly considers several causes, as well as the multiple effects of the informal economy. The methodology makes use of the associations between the observable causes and the observable effects of an unobserved variable, in this case the informal economy, to estimate the unobserved factor itself. The model for one latent variable can be described as follows:

$$y = l\ IE + e \tag{1}$$

$$IE = g'x + u \tag{2}$$

where IE is the unobservable scalar latent variable (the size of the informal economy), $y' = (y_1, ..., y_p)$ is a vector of indicators for IE, $x' = (x_1, ..., x_q)$ is a vector of causes of IE, l and g are the (px1) and (qx1) vectors of the parameters and e and u are the (px1) and scalar errors. In other words, equation (1) links the informal economy with its indicators or symptoms, while equation (2) associates the informal economy with its causes. Assuming that these errors

[10] See for example Giles (1999) and Loayza (1997).

are normally distributed and mutually uncorrelated with $\text{var}(u) = s_u^2$ and $\text{cov}(e) = \Theta_e$, the model can be solved for the reduced form as a function of observable variables by combining equations (1) and (2):

$$y = p\ x + m \tag{3}$$

where $p = l\ g'$, $m = l\ u + e$ and $\text{cov}(m) = l\ l'\ s_u^2 + \Theta_e$.

Because *y* and *x* are observable data vectors, equation (3) can be estimated by maximum likelihood estimation using the restrictions implied in both the coefficient matrix p and the covariance matrix of the error m. Since the reduced form parameters of equation (3) remain unaltered when l is multiplied by a scalar and g and s_u^2 are divided by the same scalar, the estimation of (1) and (2) requires a normalization of the parameters in (1), and a convenient way to achieve this is to constrain one element of l to some pre-assigned value.

Since the estimation of l and g is obtained by constraining one element of l to some arbitrary value, it is useful to standardize the regression coefficients $\hat{l}$ and $\hat{g}$ as follows:

$$\hat{l}^s = \hat{l}\left(\frac{\hat{s}_{IE}}{\hat{s}_y}\right) \qquad\qquad \hat{g}^s = \hat{g}\left(\frac{\hat{s}_x}{\hat{s}_{IE}}\right)$$

The standardized coefficient measures the expected change in the standard-deviation units of the dependent variable due to a one standard-deviation change of the given explanatory variable when the other variables are held constant. Using the estimates of the g^s vector and setting the error term u to its mean value of zero, the predicted *ordinal* values for the informal economy (IE) can be estimated by using equation (2). Then, by using information regarding the specific value of informal activity for some country (if it is a cross country study) or for some point in time (if it is a time series study), obtained from some other source, the within-sample predictions for IE can be converted into *absolute* series.

The MIMIC approach is chosen as the most appropriate method to calculate the size of the informal economy for this sample of countries because of the following reasons:

- Tax auditing and other similar survey based methods are unavailable for most Caribbean countries in the sample.
- The methods based on statistical and labor force discrepancies present, as described before, serious limitations and weaknesses.
- Aside from above mentioned critiques, the electricity, transaction and currency demand approaches share a common crucial limitation. Since the three

approaches are based on time series regressions, extra information[11] for *each country* is required in order to pin down the absolute size of the informal economy. Without this extra knowledge, the most one can learn is the growth pattern of the informal economy. While for some countries like Argentina, Mexico and Chile this extra information is possible to obtain, for the ECCU countries and other Caribbean countries there is no such data. On the contrary, the proposed cross section MIMIC approach requires extra information regarding the absolute size of the informal economy for *only one country* in the sample.

This paper only focuses on *real* cause and indicator variables, as opposed to *monetary* ones, which might underestimate and misrepresent the relevance of the informal economy in countries subject to a high degree of dollarization in circulating currency[12]. This occurs because although monetary data is easily obtained for local currency, data is not available for foreign currency circulating. In this sense, the present study follows closely the study conducted by Loayza (1997) who estimates the size of the informal economy for 14 Latin American countries for the early 90s using real variables[13].

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[11] This extra information could be obtained either by knowing the absolute value of the informal economy for a certain year or by assuming a base year without informal economy.

[12] There exist the presumption and some concrete evidence based on Feige et al. (2001, 2002) and Feige (2003, 2005) that dollarization in circulating currency is a relevant issue for both low inflation and non crisis countries like the ECCU, because of tourism and currency substitution issues, and for typically high inflation countries like Argentina and Mexico, due to asset substitution issues.

[13] Loayza uses the used tax burden, labor market restrictions and governance measures as cause variables and tax evasion and the share of the labor force contributing to social security schemes as indicators of the informal economy.

2.3 Data

The cross section study considers the ECCU countries and 26 mainly Latin American countries for the early 2000s[14]. The countries included are: Antigua and Barbuda, Argentina, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Cyprus, Dominica, Dominican Republic, Ecuador, El Salvador, Fiji, Grenada, Guatemala, Guyana, Honduras, Jamaica, Malta, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, The Bahamas, Trinidad and Tobago, Uruguay and Venezuela. The cause and indicator variables considered, and their expected relationship with the size of the informal economy, are presented below[15].

2.3.1 Cause Variables

First, the *tax burden* is proxied by the average of corporate and personal marginal income tax rate. The highest rate is used when there is more than one rate. The hypothesis is that an increase of the tax burden boosts the incentive to work in the informal economy.

[14] Most of the data is based on 2002 or 2003 information.
[15] More details regarding the construction and sources of the data used can be found in the Appendix.

Second, increases in legal restrictions on the labor market are hypothesized to increase the size of the informal economy. *Labor rigidities* are captured by two alternative indices[16]:

- Labor rigidity index #1 considers minimum wage constraints and is calculated as the ratio of the annual minimum wage to GDP per capita.

- Labor rigidity index #2 equals the average of two normalized components, one of which is the minimum wage ratio as described before, and the other of which captures mandated benefits, as measured by the social security contribution rates as a percentage of wages. Following Loayza (1997) in spirit, this second rigidity index is divided by GDP per capita in order to account for differences in labor productivity across countries.

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[16] Most empirical studies use the labor rigidity index developed by Forteza and Rama (2001). This index is constructed by averaging the normalized values of four labor-related variables, including minimum wage restrictions, mandated benefits, labor unions (measured by the membership of the labor movement as percentage of the labor force) and government employment (measured as the employment in the government as percentage of the labor force). These last two factors are not included in the labor rigidity indices developed in this study for the following reasons:
L*abor unionization* seems to be, at least for emerging and developing countries, a consequence of the informal economy more than its cause since bigger informal sectors seem to weak the bargain power of the workers in the formal sector. For example, countries with well known important informal sectors, like Peru and Ecuador, have very low degree of unionization, approximately 5 to 10 percent of the labor force; while countries with traditional lower informality like Argentina and Mexico have percentages close to 35 percent. For this reason, labor unionization is included as an indicator variable and it is expected to be negatively related with the size of the informal economy.
Higher *government employment*, far from increasing labor rigidity and consequently incrementing the size of the informal economy, could reduce the informality, since most public employees contribute to social security systems and are regulated by most institutions of the society. This variable is not included separately as another cause variable because it might be also subject to the Wagner's law and consequently subject to some endogeneity problem if the degree of development is related with the size of the informal economy.

Third, the *importance of agriculture* in the economy is included, since many studies endorse the idea that informal working is highly segmented by sector, with clear prevalence in the agricultural and related sectors. One of the most important reasons for this is the minimum enforcement capacity prevalent in rural areas. The importance of agriculture is measured as agriculture and food exports as a percentage of total exports to reduce problems of endogeneity[17]. The more prominent the agriculture sector, the bigger the expected size of the informal economy.

Fourth, following Giles (1999) the *inflation* rate is included to allow for the upward "creep" of tax brackets, and the associated incentive for tax-payers to engage in informal activities. A more pervasive effect of inflation is that, as it tends to be uneven across sectors, it alters the income distribution, and this may induce disrespect for tax law. The higher the inflation, the larger the expected size of the informal economy.

Last, the *strength of enforcement system* is proxied by an average of three indicators developed by International Country Risk Guide (ICRG), specifically quality of bureaucracy, corruption in government and rule of law. The stronger the enforcement capability of government, the lower is the expected size of the informal economy.

[17] The share of agriculture as percentage of GDP was also considered with similar results.

2.3.2 Indicator Variables

First, following Loayza (1997) the percentage of the labor force *contributing to the social security system* is included. The bigger the informal economy, the lower the expected number of contributors to the social security system.

Second, the *degree of unionization*, measured as the percentage of labor force with membership in some labor union, is considered. The bigger the informal economy, the weaker the bargain power of the workers in the formal sector and, therefore, the lower the degree of unionization.

Last, the *gross enrollment ratio for secondary school* is included as an informal economy indicator. Most countries in the world have signed the International Labor Organization Convention 138, which made fourteen the minimum working age; however one of the most well-recognized consequences of the informal economy is child labor and the effect it has on rates of education enrollment[18]. Thus, the bigger the informal economy, the lower is the expected enrollment rate.

[18] The primary net enrolment rate would be maybe the best proxy to capture this phenomenon, however because of data unavailability for most ECCU countries and since for the countries with such information there is a high correlation with the secondary gross enrolment rate, the last measure is used.

2.4 Empirical Results

2.4.1 Preliminary Evidence

Table 2.3 shows the correlation between each cause and indicator variable. If both the conjectured relation between the cause variables and the informal economy and the hypothesized association between the informal economy and its indicators are present, there should be a specific pattern in the correlations between the cause and indicator variables. For example, if stronger labor rigidities are expected to increase the size of the informal economy and the latter effect is supposed to decrease the percentage of contributors to social security, then there should exist a negative relationship between labor rigidity and percentage of contributors to social security. It is clear from Table 2.3 that, aside for the relationship between tax burden and degree of unionizations (top-right cell), all the rest of the observed correlations matches their expected signs. Therefore, there seems to be strong preliminary support for our hypothesis.

2.4.2 MIMIC Estimation Results

The benchmark MIMIC specification, Model 1, is represented in Figure 2.1. The labor rigidity index #1, the tax burden, importance of agriculture and inflation are the cause variables of the informal economy, while the number of contributors to

the social security system, the degree of unionization and the gross enrollment ratio for secondary school are the indicator variables[19]. Before analyzing the estimation results it is important to remark that several goodness-of-fit statistics support the underlying model (see grey box in Figure 2.1). These set of goodness-of-fit measures are based on fitting the model to sample moments, which means to compare the observed covariance matrix to the one estimated on the assumption that the model being tested is true. The Discrepancy function (CMIN) is one of the most common fit tests and it is the minimum value of the discrepancy function between the sample covariance matrix and the estimated covariance matrix. The chi-square value should not be significant if there is a good model fit, while a significant chi-square indicates lack of satisfactory model fit. The goodness-of-fit index (GFI) and the adjusted goodness to fit index (AGFI) tests are also measures of discrepancy between the predicted and observed covariances. The GFI can be interpreted as the percent of observed covariances explained by the covariances implied by the model. The AGFI is a variant of the GFI which adjusts GFI for degrees of freedom. By convention, both GFI and AGFI should by equal to or greater than 0.90 to accept the model. The root mean square error of approximation (RMSEA) is also a fit test that some authors argue is less sensitive to sample size than the above mentioned tests

[19] Although most variables are subject to certain extent to some endogeneity problem, strength of enforcement system might be the one which could be more severely affected. For this reason it is not included in the benchmark specification.

(see for example Fan et al. (1999)). By convention, there is good model fit if the RMSEA less than or equal to 0.05.

The coefficients on the causal and indicator variables have the expected signs and are statistically significant mostly at 1 or 5 percent. Specifically, one standard deviation increases in the tax burden, labor rigidities, importance of agriculture and inflation increase the size of the informal economy by 0.274, 0.519, 0.404 and 0.465 standard deviations, respectively. Even more, the joint influence of these four cause variables explains approximately 79 percent of the variance of the informal economy.

We find that increases in the informal economy reduce the number of workers contributing to the social security system, the degree of unionization and the secondary enrollment ratio, and explains 76, 35 and 57 percent of their respective variances.

Alternative MIMIC specifications are considered for robustness purposes. Models 2 and 3, respectively displayed in Figures 2.2 and 2.3, include an alternative measure of labor rigidity and strength of enforcement system. They both confirm the results obtained in the benchmark model, and Model 3 also

presents evidence suggesting that the strength of enforcement appears to be an important determinant of the size of informal economy.

2.4.3 Estimations of the Size of the Informal Economy

Using the estimates of the benchmark model, Table 2.4 and Figure 2.4 show the standardized *ordinal* values of the size of the informal economy for the countries in the sample. Since these ordinal values only identify the relative position of the countries, we set the informal economy of Jamaica equal to 35 percent of total GDP in order to estimate the *absolute* values of the informal economy as percentage of total GDP[20]. Bahamas, Cyprus, Grenada, St. Kitts and Nevis, Trinidad and Tobago and Barbados are among the countries with the smallest informal economies, with values ranging from 16 to 25 percent of GDP. These values are among the lowest not only for the Caribbean region, but also in relation with most Latin American countries. On the other hand, St. Vincent and the Grenadines, Belize and Dominican Republic are among the countries with the largest informal economies in the Caribbean, with sizes varying between 41 and 51 percent. Notwithstanding, these estimates are smaller than those for the countries with the highest levels of informal activity in Latin America like Paraguay and Nicaragua, with values around 70 percent. The rest of the

[20] According to a study conducted by De La Roca et al. (2002), the informal economy in Jamaica accounted for about 35 percent of the total GDP in 2000-2001.

Caribbean countries have sizes of the informal economy similar to the most developed countries in Latin America like Argentina, Chile, Mexico and Uruguay.

As detailed before, the *absolute* values of the informal economy, unlike the *ordinal* measures, rely on extra information pinning down the absolute value of the informal economy for one country, in this case Jamaica. The information for Jamaica is based on a comprehensive study by De La Roca et al. (2002) that used different methodologies and data collected as part of the 2001 Jamaica Survey of Living Conditions, and is therefore a very attractive data source to pin down the absolute series of the informal economy[21]. Since the *order* of countries according to the size of the informal economy is independent of this extra information, while the *absolute* values of the informal economy do depend on this data, a word of caution should be taken regarding the use of the latter values as accurate measures of the degree of informality.

Table 2.5 shows the absolute values of the informal economy for the ECCU and other Caribbean countries by using the different specifications employed in

[21] De La Roca et al. (2002) studies the informal economy for Jamaica in the early 2000s to evaluate the impact of the 1990's structural reforms. They found similar informal economy estimates using macroeconomic approaches like monetary and electricity consumption approach and microeconomic approaches based on the addition of the total amount of wages of the informal workers, the unreported income of the formal workers in the economy and the value added generated by household's independent activities whether agricultural or non-agricultural.

Model 1, 2 and 3. It can be inferred that the estimated absolute sizes of the informal economy are similar across models. The Spearman's rank correlation coefficient is 0.89 between Model 1 and 2, 0.98 between Model 1 and 3 and 0.85 between Model 2 and 3. The null hypothesis that the estimated absolute sizes of the informal economy are independent across models is rejected at the 1 percent level of significance for all comparisons.

The estimates reported here are similar to those for "late 90s" reported in Schneider (2002). For 15 common countries, there is a positive correlation of 0.37 between the absolute sizes of the informal economy, and the spearman's rank correlation test has a rho value of 0.44, which rejects at the 10 percent level of significance the null that these rankings have zero correlation.

2.4.4 Relative Contribution of Each Cause Variable to the Size of the Informal Economy

Table 2.6 shows the relative contribution of each cause variable to the size of the informal economy for all countries studied, and Figure 2.5 displays these values for the Caribbean economies. On average tax burden, labor rigidity, importance of agriculture and inflation constitute around 35, 26, 31 and 8 percent of the overall size of the informal economy respectively. However, this profile differs importantly across countries:

- For countries like Antigua and Barbuda, Barbados and Trinidad and Tobago the main component influencing the informal economy is the tax burden. For example, for the period under consideration, Antigua and Barbuda has maximum marginal corporate and personal tax rates of 55 and 35 percent respectively.

- For others like St. Vincent and the Grenadines, St. Lucia and Belize the importance of the agriculture sector seems to be one of the most relevant factors, with approximately 75 percent of exports concentrated in agriculture and food products.

- For countries like Paraguay and Dominican Republic the significance of labor rigidities appears to be decisive, with minimum wages representing 170 percent and 90 percent of the corresponding GDP per capita.

- For most of the economies, inflation does not seem to be an important factor determining the size of the informal economy, because of the price stability observed in the second part of the 90s.

2.5 Conclusions

This paper estimates the size of the informal economy and the relative contribution of each underlying factor in the ECCU countries and 26 mainly Latin American countries in the early 2000s, being the first study to address this issue for the ECCU economies and many other Central American and Caribbean countries.

Using a structural equation model approach that considers the informal economy as a latent variable with several causes and effects, we find that a stringent tax system and regulatory environment, higher inflation and dominance of the agriculture sector are the key factors in determining the informal economy, representing altogether around 79 percent of the informal economy variance. The results also confirm that a higher degree of informality reduces labor unionization, the number of contributors to social security schemes and enrollment rates in education.

The size of the informal economy differs considerably among countries. While in countries like Paraguay and Nicaragua the informal sector reaches values around 70 percent of total GDP, in economies like Bahamas, Cyprus, Grenada, St. Kitts and Nevis, Trinidad and Tobago and Barbados the informal share has values below 25 percent. The average size of the informal economy for the ECCU and Caribbean countries is around 33 percent of GDP, while for Latin America the average share is 43 percent. Not only do many Caribbean economies have smaller levels of informality than the Latin American countries with the smallest informal economies, but also the Caribbean economies with the most informality have smaller informal economies than the Latin American countries with the biggest informal sector.

We also find that the relative contribution of each cause variable to the informal economy varies significantly across countries. For countries like Antigua and Barbuda and Trinidad and Tobago the most important factor influencing the informal economy is the tax burden. For others like St. Vincent and the Grenadines, St. Lucia and Belize the relevance of the agriculture sector appears to be one of the most important elements, while for economies like Paraguay and Dominican Republic the significance of labor rigidities seems to be crucial.

The above analysis has important policy implications for authorities striving to reduce the degree of informality. For instance, in countries where the informal economy is related to a high tax burden, policy options include lowering and homogenizing effective tax rates across all sectors in the economy. In economies where labor market rigidities generate the informal economy, steps need to be taken to increase labor market flexibility. In countries where inflation is the key factor, priority should be given to tightening monetary policy and stabilizing prices, while in economies with important an agricultural sector, measures to improve the strength and expertise of government officials should be emphasized.

2.6 Appendix

Table 2.1 Sources and Definitions of Variables

Variable Name	*Definition and Source*
Tax burden	The proxy for tax pressure is the average of corporate and personal marginal income tax rate. The highest rate is used when there is more than one rate. This proxy measure is normalized between 0 and 100. The data correspond mostly for 2003 and is obtained from World Development Indicators 2006 and Bain and dos Santos (2004).
Importance of agriculture	It is measured by the agricultural raw material and food exports (as percentage of total exports) using World Development Indicators 2006 and correspond mainly for 2000. For Dominican Republic the year 2001 and for Fiji the year 2002 information is used.
Inflation	Annual average consumer prices inflation for the period 1995-1999. Aside for Antigua and Barbuda in which IMF data is used, the rest of the information is obtained from World Development Indicators 2006.
Strength of enforcement system	Following Loayza (1997) the strength of enforcement system is proxied by an average of three subjective indicators reported in the International Country Risk Guide (ICRG) for 2002. The three variables considered are quality of bureaucracy, corruption in government and rule of law. Quality of bureaucracy scores high under "autonomy from political pressure" and "strength and expertise to govern without drastic changes in policy or interruption in government services". Low scores in corruption in government indicate "high government officials are likely to demand special payments" and "illegal payments are generally expected throughout lower levels of government". The variable rule of law "reflects the degree to which the citizens of a country are willing to accept the established institutions to make and implement laws and adjudicate disputes". Higher values are associated with "sound political institutions, a strong court system, and provisions for an orderly succession of power". ICRG is a publication of Political Risk Services of Syracuse, NY.
Workers contributing to social security	Active contributors to old-age pension schemes, in percent of the labor force. It is based on social security agencies, household surveys and IMF country desks information predominantly for 2002.
Degree of unionization	Total union membership considering both public and the private sectors, in percent of the labor force. The data is mainly from "Country Reports on Human Rights Practices" (2002), but also country authority's information is used.

Labor rigidity index #1	Is represented by the ratio of minimum wage and GDP per capita normalized between 0 and 100. The minimum wage corresponds to the most general minimum wage regime. When minimum wages vary across sectors, the one for manufacturing (or for commerce, if manufacturing is not available) is reported. When minimum wages vary across regions, the value reported is either a simple average across regions or the minimum wage applicable in the main urban centers. A zero indicates that the country has no government set minimum wage, although minimum wages negotiated at the sectoral level may exist. The data for minimum wages correspond to 2002 and it is mainly obtained from the "Country Reports on Human Rights Practices" (2002). The Country Reports on Human Rights Practices are submitted annually by the U.S. Department of State to the U.S. Congress. The reports cover internationally recognized individual, civil, political, and worker rights, as set forth in the Universal Declaration of Human Rights. For Costa Rica and Mexico information from the respective ministries of labor is used.
Labor rigidity index #2	Is the normalized average of two components divided by real GDP per capita. The first component captures minimum wages restrictions and corresponds to labor rigidity index #1, while the second element represents mandated benefits and it is measured by the contribution rates (as percentage of salaries) for all social security programs for both the employee and the employer. Only for Belize, where the contributions are flat-rate according to earning classes, the normalized legal number of days of maternity leave with full pay without complications is used. Following Loayza (1997) the normalized average of these components is divided by real GDP per capita in order to account for differences in labor productivity across countries. The data for minimum wages correspond to 2002 and it is mainly obtained from the "Country Reports on Human Rights Practices" (2002). The Country Reports on Human Rights Practices are submitted annually by the U.S. Department of State to the U.S. Congress. The reports cover internationally recognized individual, civil, political, and worker rights, as set forth in the Universal Declaration of Human Rights. For Costa Rica and Mexico information from the respective ministries of labor is used. The social security contribution data correspond mostly to year 2003 and it is obtained from "Social Security Programs Throughout the World". Maternity leave information correspond to the average of the period 1999-2002 and it is obtained from several online publications from The Clearinghouse on International Developments in Child, Youth and Family Policies, Columbia University.
Gross enrolment ratio for secondary school	Total secondary enrolment as a percentage of the corresponding official school-age population, mostly for 2001. The sources of information are Human Development Report 2005 and "Organization of the Eastern Caribbean States. Towards a New Agenda for Growth" (2005).

Table 2.2 Size of the Informal Economy and VAT Tax Evasion

	Informal economy (early 90s)	VAT tax evasion (early 90s)
New Zealand	12%	5%
Sweden	16%	6%
Argentina	21%	30%
Honduras	47%	35%
Bolivia	66%	44%

Source: Schneider and Enste (2000) and Silvani and Brondolo (1993).

Table 2.3 Correlations Between Cause and Indicator Variables

	Workers contributing to social security	Gross enrolment ratio for secondary school	Degree of unionization
Tax burden	-0.14	-0.12	0.07
Labor rigidity index #1	-0.59	-0.60	-0.39
Labor rigidity index #2	-0.59	-0.53	-0.36
Importance of agriculture	-0.39	-0.32	-0.31
Inflation	-0.40	-0.29	-0.30
Strength of enforcement system	0.82	0.58	0.49

Source: Author's calculation.

Table 2.4 Size of the Informal Economy: Standardized and Absolute Values

Country	Standardized value	Absolute value (% of GDP)
The Bahamas	-1.766	15.9
Cyprus	-1.496	19.3
Grenada	-1.244	22.5
St. Kitts and Nevis	-1.108	24.2
Trinidad and Tobago	-1.092	24.4
Barbados	-1.087	24.5
Mexico	-0.797	28.2
Brazil	-0.779	28.4
Malta	-0.752	28.7
Antigua and Barbuda	-0.562	31.2
Chile	-0.486	32.1
Argentina	-0.428	32.9
Dominica	-0.322	34.2
Jamaica	-0.259	35.0
Uruguay	-0.161	36.2
El Salvador	-0.150	36.4
Guyana	-0.122	36.7
Peru	-0.017	38.1
St. Lucia	0.251	41.5
Costa Rica	0.274	41.8
Guatemala	0.318	42.3
Venezuela	0.369	43.0
Colombia	0.410	43.5
Panama	0.480	44.4
Dominican Republic	0.515	44.8
Belize	0.673	46.8
St. Vincent and the Grenadines	0.974	50.6
Ecuador	0.980	50.7
Honduras	1.247	54.1
Fiji	1.719	60.1
Nicaragua	2.061	64.4
Paraguay	2.357	68.2
Mean	0.000	38.3
Standard deviation	1.000	12.7

Source: Author's calculation based on Model 1 MIMIC results.

Table 2.5 Absolute Size of the Informal Economy
Under Different MIMIC Specifications

Country	MIMIC Model 1	MIMIC Model 2	MIMIC Model 3
The Bahamas	15.9	11.5	15.1
Grenada	22.5	31.8	22.9
St. Kitts and Nevis	24.2	24.6	24.4
Trinidad and Tobago	24.4	25.2	24.8
Barbados	24.5	36.6	24.3
Antigua and Barbuda	31.2	29.7	31.7
Dominica	34.2	38.8	35.0
Jamaica	35.0	35.0	35.0
Guyana	36.7	57.3	37.3
St. Lucia	41.5	52.0	41.8
Dominican Republic	44.8	46.1	45.3
Belize	46.8	56.5	47.4
St. Vincent and the Grenadines	50.6	58.4	51.4

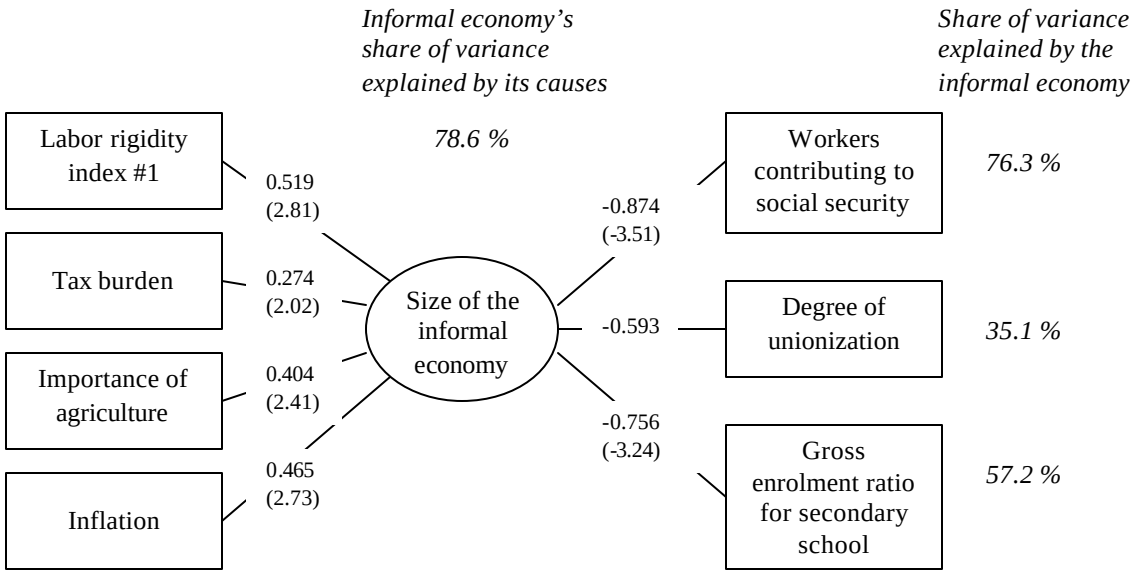
Source: Author's calculation.

Table 2.6 Relative Contribution of Each Causal Variable to the Size of Informal Economy

Country	Tax burden	Labor rigidity index #1	Importance of agriculture	Inflation
The Bahamas	0.0	54.6	42.3	3.1
Cyprus	32.2	0.0	63.5	4.3
Grenada	57.1	0.0	40.9	2.0
St. Kitts and Nevis	34.0	32.4	28.1	5.5
Trinidad and Tobago	61.4	26.5	6.5	5.6
Barbados	65.6	0.0	31.2	3.2
Mexico	52.4	14.4	5.4	27.8
Brazil	31.1	19.6	27.5	21.8
Malta	52.2	42.1	2.6	3.1
Antigua and Barbuda	60.5	31.3	6.1	2.1
Chile	36.1	27.6	30.2	6.0
Argentina	45.6	15.3	38.3	0.7
Dominica	43.2	24.7	30.7	1.4
Jamaica	36.2	33.3	17.6	12.9
Uruguay	22.8	15.4	43.0	18.9
El Salvador	32.1	30.3	32.8	4.8
Guyana	46.3	0.0	47.6	6.1
Peru	31.9	36.7	24.4	7.0
St. Lucia	32.9	16.4	48.7	2.0
Costa Rica	30.8	35.6	22.0	11.6
Guatemala	31.4	23.0	39.5	6.1
Venezuela	33.9	24.9	1.1	40.1
Colombia	36.4	35.3	15.2	13.1
Panama	29.0	23.1	47.1	0.8
Dominican Republic	23.9	44.4	26.3	5.4
Belize	22.9	26.7	49.3	1.1
St. Vincent and the Grenadines	33.8	23.9	41.0	1.2
Ecuador	21.1	35.7	22.2	21.0
Honduras	19.8	31.2	37.4	11.7
Fiji	22.8	29.6	45.8	1.7
Nicaragua	18.5	37.1	38.9	5.6
Paraguay	10.4	52.4	32.7	4.5
Mean	34.6	26.4	30.8	8.2

Source: Author's calculation based on Model 1 MIMIC results.

Figure 2.1 MIMIC Estimation Results. Model 1



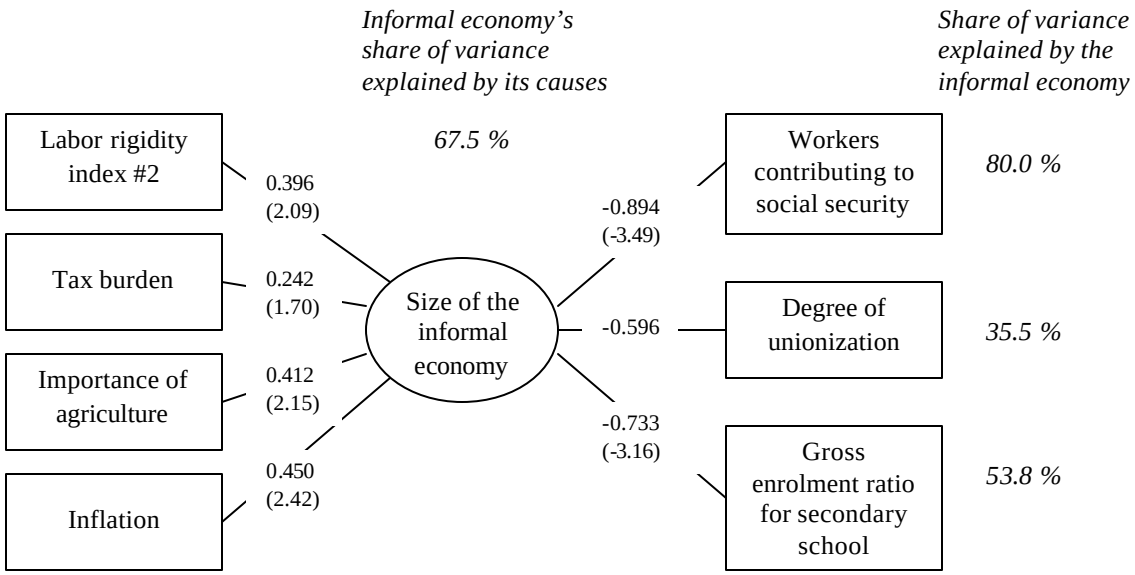
Overall model fit:
Discrepancy function (CMIN) (p-value) : 0.932
Goodness of fit index (GFI) : 0.973
Adjusted goodness of fit index (AGFI) : 0.907
Root mean square error of approximation (RMSEA) : 0

Note: The standardized regression coefficients and their respective t-values, indicated in parenthesis, are displayed by the arrow pointing in the direction of influence.

In order to remove the structural indeterminacy of the coefficients, the non-standardized coefficient associated with *Degree of unionization* was set to -1. For this reason a t-test cannot be performed on this coefficient. The same standardized coefficients are obtained by setting the coefficient of another indicator equal to -1.

Source: Author's calculation.

Figure 2.2 MIMIC Estimation Results. Model 2



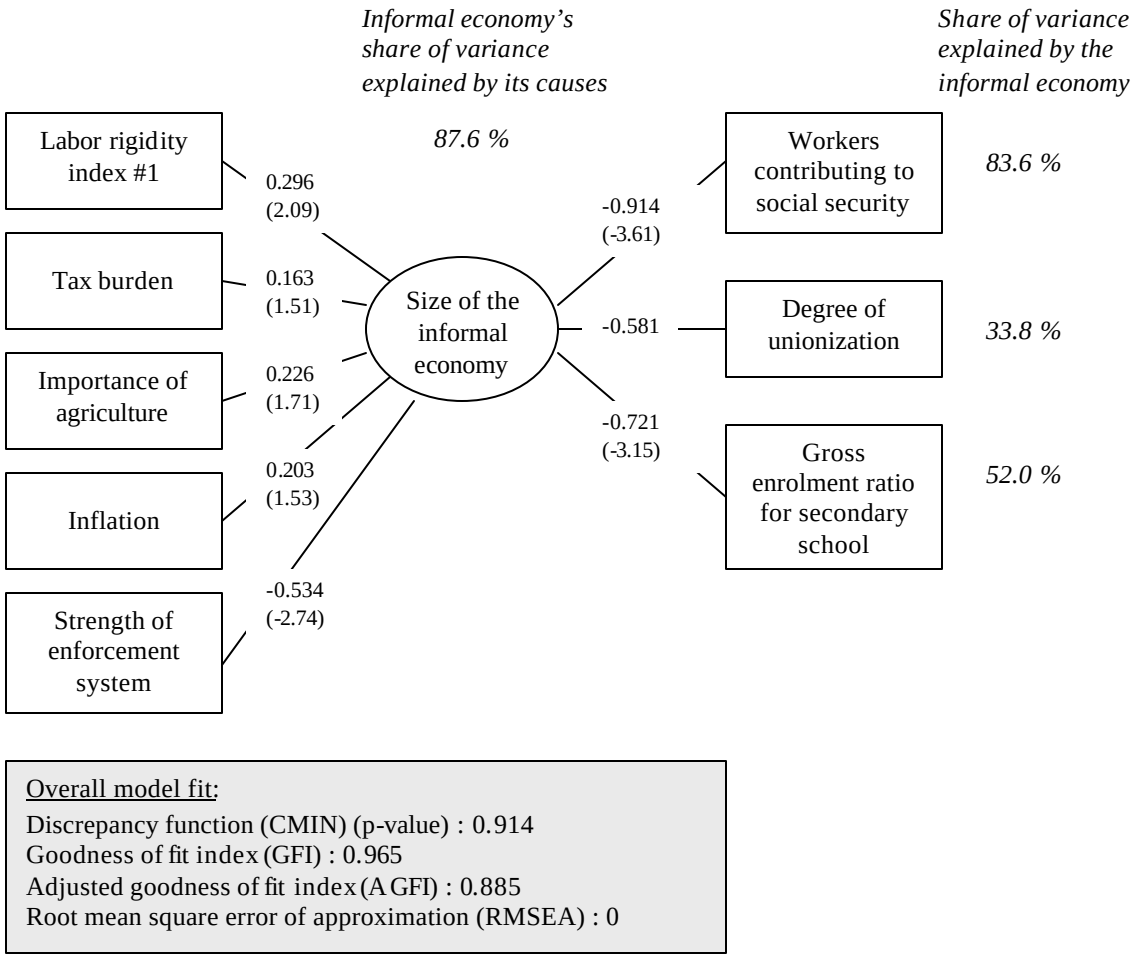
Overall model fit:
Discrepancy function (CMIN) (p-value) : 0.951
Goodness of fit index (GFI) : 0.977
Adjusted goodness of fit index (AGFI) : 0.918
Root mean square error of approximation (RMSEA) : 0

Note: The standardized regression coefficients and their respective t-values, indicated in parenthesis, are displayed by the arrow pointing in the direction of influence.

In order to remove the structural indeterminacy of the coefficients, the non-standardized coefficient associated with *Degree of unionization* was set to -1. For this reason a t-test cannot be performed on this coefficient. The same standardized coefficients are obtained by setting the coefficient of another indicator equal to -1.

Source: Author's calculation.

Figure 2.3 MIMIC Estimation Results. Model 3

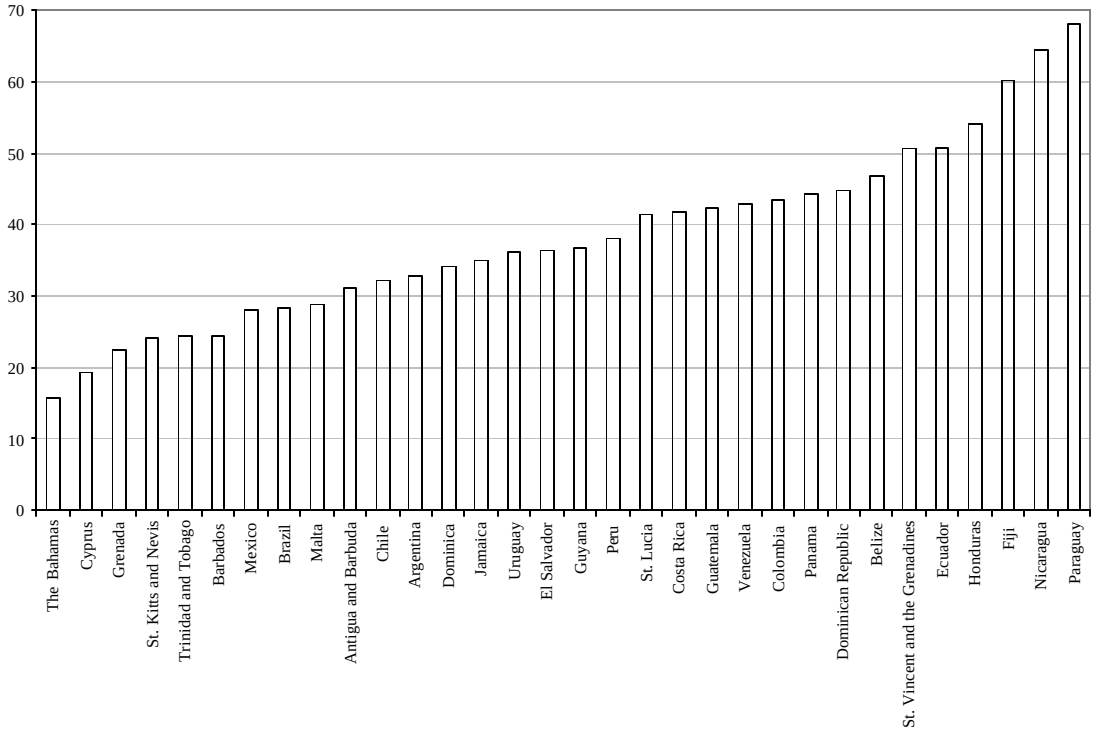


Note: The standardized regression coefficients and their respective t-values, indicated in parenthesis, are displayed by the arrow pointing in the direction of influence.

In order to remove the structural indeterminacy of the coefficients, the non-standardized coefficient associated with *Degree of unionization* was set to -1. For this reason a t-test cannot be performed on this coefficient. The same standardized coefficients are obtained by setting the coefficient of another indicator equal to -1.

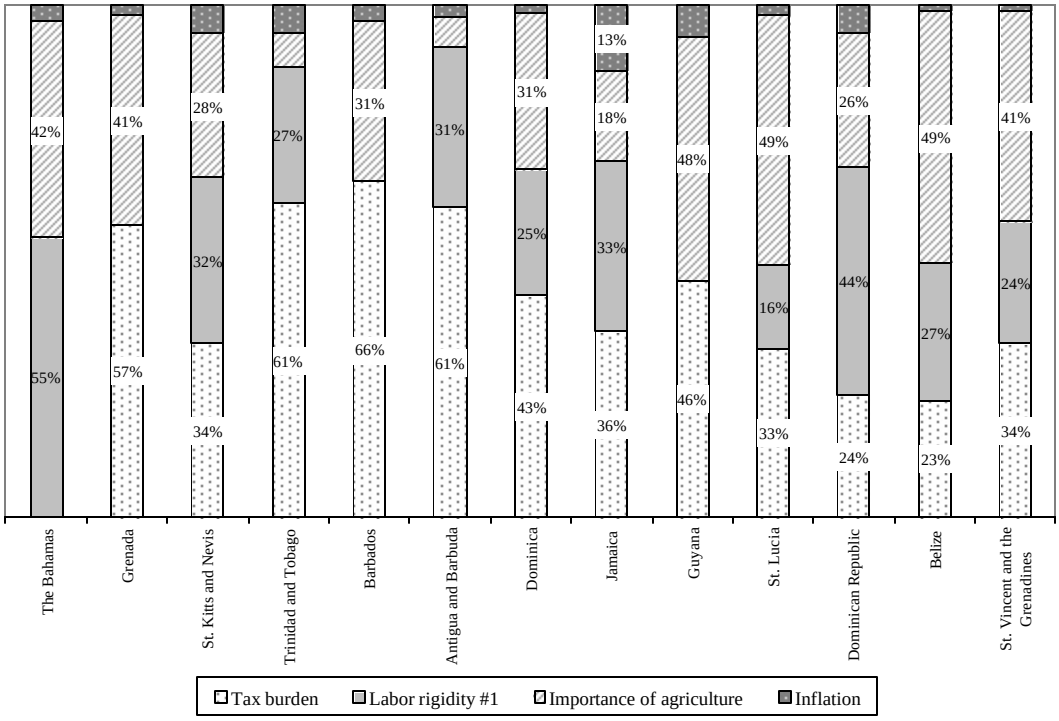
Source: Author's calculation.

Figure 2.4 Size of the Informal Economy



Source: Author's calculation based on Model 1 MIMIC results.

Figure 2.5 Relative Contribution of Each Cause Variable to the Informal Economy



Note: Because of graphical reasons only variables with contributions higher than 7% display the associated number.

Source: Author's calculation based on Model 1 MIMIC results.

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