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Abstract[1]

Our paper addresses the issue on the interaction between monetary and macroprudential policies in small open economies for different exchange rate regimes. The need for macroprudential policy arises from exacerbated macroeconomic fluctuations due to frictions in the financial system as in Bernanke, Gertler and Gilchrist (1999). Understanding these dynamics in developing nations has been even more important after the most recent events of the Great Recession. Policy makers within the scrutinized economies will see the exact magnitude of shocks caused by changes in financial frictions, monetary and macroprudential policy. Exchange rate considerations are also brought to the fore, by assessing the effects of these policies on two emerging economies from the Caribbean with differing monetary policy frameworks. Despite differences between flexible and fear of floating exchange rate regimes, macroprudential policies implementation help mitigate the effects of credit supply shocks affecting regional economies.

JEL codes: E42, E43, E52
Keywords: Monetary Policy, Macroprudential Policy, Interest Rates, Capital Controls and Flows, DSGE

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1. Introduction

The economic recession has led to a shift in the prevailing thought on financial and macroeconomic stability, with more research pointing towards the efficacy of macroprudential regulations, especially in developing nations. In hindsight, the view that a flexible exchange regime and monetary policy changes would be sufficient to mitigate the destabilizing effects of massive volatile capital flows proved erroneous, as neither was able to detect or prevent building financial fragilities. Financial frictions based on asset prices that abate during economic upswings and rise during downturns, exacerbate the procyclicality in the financial system and real economy. Macroprudential policies geared towards proper risk management and its interactions with monetary policy have been shown to provide a buffer during periods of changing financial friction (e.g. Blanchard et al 2010, Cavallari 2013, Jeanne and Korinek 2010, Unsall 2013, Quint and Rabanal 2014).

This study is to carefully outline the impact that shifting financial frictions and the interaction of monetary and macroprudential policy changes have on two developing economies in the Caribbean. The model utilized is of a small open economy specified by Unsal (2013), in which entrepreneurs fund investments in capital goods through external debt accumulation. It integrates elements recommended by Bernanke, Gertler and Gilchrist (1999) where financial frictions are incorporated through a risk premium impacting the cost of credit contracts. These are central to the model and through their dynamics during times of large financial flows, the effect that the changes in monetary and macroprudential policies have on key economic variables are displayed. The analysis is then extended to encompass the effects of these policies under alternative exchange rate regimes by evaluating counterfactual exercises of the two individual nations, namely Jamaica and the Dominican Republic (DR). The interaction of these two policies is important because they help to minimize the negative effects of risky behavior in financial systems during economic upswings.

The paper contributes to the existing literature by extending the discourse on the macroeconomic impact of adverse changes in financial frictions to Caribbean economies which have had limited insight on the matter[2]. Various studies have noted that prudential capital controls may be utilized to counter the pecuniary externalities (usually exchange rate or asset price fluctuations) in developing nations emanating from modern financial crisis that involve inter alia financial acceleration (Korinek 2011; Ostry et al 2010; Bianchi 2011). Others have examined how

[2] Studies have traditionally been focused on European, Asian and American market dynamics and experiences for their analyses, See inter alia Bernanke, Gertler and Gilchrist (1999), Getler Gilchrist and Natalucci (2007), Mendoza and Smith (2006), Lorenzoni (2008) among other analytical works

optimal monetary policies, on their own “can play a potential stabilization role by responding to misalignments in asset price” (Merola 2010). Our study departs from these types of research in looking at the interaction of monetary and macroprudential policies in combatting macroeconomic vulnerabilities in times of high capital inflows. Additionally, the counterfactual exercises capture how the combination of these policies impact the dynamics of an economy given different exchange rate regimes as in Aoki et al (2016). Works in line with that of Gertler, Gilchrist and Natalucci (2007) only examine how monetary policies are constrained (or enabled) by the existing regime and exclude the potential impact of macroprudential policies.

Our analysis, like Unsal (2013), examines the economic phenomena in a small open economy context, unlike studies from Kannan, Rabanal and Scott (2012) and Angeloni and Faia (2013) among many researchers that look at the interaction of the two policies in a closed economy framework. Jeanne and Korinek (2010) in a general equilibrium framework of a small open economy with three time periods, models capital controls as a Pigouvian tax which is shown to curtail inflows during booms and reduces outflows during busts, however these results were qualitative. Our study is theoretically similar in the application of macroprudential measures; however, it has modeled credit constraints as being dependent on the current value of a firm's assets, used as collateral (See Mendoza and Smith (2006), Mendoza (2010), Mendoza and Bianchi (2011)). Jeanne and Korinek (2013) among others[3] focus on the use of macroprudential controls ex-post. However in contrast to the aforementioned, our paper looks at the use of macroprudential measures ex-ante, a method that has been noted to improve an economy's performance during financial acceleration episodes (Benigno et al, 2012).

The results show that macroprudential measures ex-ante along with monetary policies improve the response of key macroeconomic variables for the economies assessed, much like the outcomes of Unsal (2013). Our model follows the expected direction of the transmission mechanism, in that a positive credit supply shock increases GDP, consumption, stock of capital and investment; meanwhile, as monetary policy tightens and interest rates rise, the real exchange rate appreciates, controlling inflation pressures in the short-run. In the presence of macroprudential measures in both countries, the growth in GDP, consumption and investment is smaller during times of financial acceleration, which ensures that the corresponding downturns are not as pronounced. We address the importance of the role of exchange rate regimes along with broad macroprudential tools in mitigating the responses of macroeconomic variables to a credit supply shock. The most favorable impulse responses in the macroeconomic variables were

[3] See Rodrik and Kaplan 2001, Edwards and Rigobon, 2009

in flexible regimes with macroprudential policies in place. However, these regulations were noted to have a stabilizing impact no matter what regime was in place. In an examination of the literature, most studies were focused on the effectiveness of macroprudential measures and their effects during increasing capital inflows and gave little attention to monetary policy rules of the Central Bank. The literature on the interaction of these policies is growing, and the main contribution of the study will be towards the examination of this theory for the Caribbean countries.

The paper is organized as follows. Section 2 presents a review of the literature, exploring the theoretical benefits of macroprudential and monetary policies and consequently examines the related empirical literature on the topic. The theoretical framework of the model is described in section 3 while section 4 provides the discussion on the model's parameter calibration. Section 5 presents the results of variable responses during episodes of financial acceleration and counterfactual exercises. Section 6 offers concluding remarks.

2. Review of Selected Literature

The increase in volatile capital flows to developing nations since the great recession has brought a greater emphasis on the use of macroprudential regulations, in addition to monetary policy in an attempt to maintain financial and macroeconomic stability. Macroprudential policies are a general framework ensuring the stability of financial markets with a particular focus on risk management and protecting it from shocks while also ensuring the market's effectivity. These policy measures have become necessary in a globalized economy where financial innovations resulting in spillover effects could easily cause detrimental outcomes worldwide, as seen during the recent global economic recession.

The sub-prime crisis prompted irregular economic activities globally which, among others included extended periods of historically low interest rates in developed economies. This was a source of concern to the developing nations' policy makers as investors started funneling large volumes of low cost funds to their economies circa 2009 (Lambert et al 2012). Ostry et al (2010) assert that "*many of the flows are perceived to be temporary, reflecting interest rate differentials, which may be at least partially reversed when policy interest rates in advanced economies return to more normal levels*". The effects of "hot money" and "sudden stops" in the presence of financial friction have been well documented with both being associated with boom and busts cycles in many small developing economies (See Calvo et al 2006; Korinek 2011).

The influx of capital deepens financial sectors, while underpinning investment and economic activity. During upswings, asset prices and the borrowing capacity of firms are high as collateral valuation determines credit availability. In addition to the rapid expansion in private

sector indebtedness; these capital inflows have also been associated with an appreciation in the real exchange rate and deterioration in the current account balance. During busts, usually occasioned by capital flight, financial frictions surface with declining asset prices impairing firms' borrowing capacity. A credit crunch ensues and the indebted firms embark on deleveraging campaigns with assets being sold below their market value. Financial uncertainty keeps domestic economic activity subdued and with investment and consumption waning, there is a reversal in the capital account and a sharp deterioration of the real exchange rate. Large capital inflows have been shown to lead to credit booms and economic growth; however these conditions when reversed tend to leave economies in crisis situations.

The notion that volatile capital flows in the presence of financial frictions cause financial fragility in developing nations is generally accepted among economists (See Fisher 1933; Greenwald and Stiglitz 1993; Krugman 1999; Rodrik 2000; Reinhart and Rogoff 2009; Obstfeld 2012). There is also a vast amount of literature from the Post-Keynesian and Structuralist[4] view hypothesizing that free capital flows drastically reduce the room for macroeconomic management and policy autonomy since sustaining private foreign capital inflows require a strong exchange rate and high interest rates (Gallagher 2011). Reinhart and Reinhart (2008) postulate that large capital flows into emerging markets are associated with a higher likelihood of banking, inflation and currency crises, and contribute to economic and financial instability. Mussa (2000) also speaks to the negative effects of short term capital inflows on developing markets, though he attributes the instability to inadequate policy and regulations encouraging market frictions. An economy's "inability" to manage the heightened financial flows is credited to varying factors including the incomplete adjustment of market institutions, the degree of financial openness and exchange rate regime (See Rossi 1999; Glick, Guo and Hutchison 2006).

Cespedes, Chang and Velasco (2004) state that when debts are dollarized, real exchange rate devaluations as in the ones characteristic of sudden stops, negatively impacts the balance sheet of domestic firms. This reduction in net worth leads to reductions in investment, consumption and GDP growth and increases economic uncertainty. Bleany and Vargas (2007) in examining different studies explain that "*If the stickiness is in nominal wages, as in Céspedes et al. (2004), or in import prices, as in Devereux et al. (2006), the main effect of the financial accelerator mechanism is to amplify cycles… If however, the stickiness is in domestic prices, as in Cook's (2004) menu cost model, a real depreciation has a pronounced net worth effect, leading to higher capital costs and contractions in capital spending".* The conclusion of the studies have

[4] See Eatwell and Taylor 2002, Ocampo 2002, Helleiner, 1998, Saad-Filho, 2007; Palma 2002 and Grabel 2006

all indicated that if the foreign currency debt exposure is sufficiently high in emerging markets (as it is during financial acceleration periods), currency depreciations are strongly contractionary. These effects are further amplified because the inflation rate prior to the sudden stop calls for an adjustment in the monetary policy stance (Aoki et al. 2016).

Up until recently financial acceleration was assumed to be controllable ex-post solely through monetary policies and Balance of Payment (BOP) adjustments. Sharp increases in policy rates prior to financial crises, if they could even be predicted, may not have been able to stop the acceleration process and could potentially cause harmful effects on output growth and volatility (Canuto and Cavallari, 2013), hence their usefulness after the fact. Blanchard et al (2010) portray monetary policies as blunt tools that are inadequate to address imbalances in the financial sector or overheating in a specific sector of the economy, thus advocating for other policies and regulations in that process. Canuto and Cavallari (2013) describe an "inflation-targeting-cum-flexible-exchange-rate" regime as being viewed as sufficient to mitigate the effects of financial acceleration ex-post, however this did not fully encompass how financial sector interconnectivity was relevant for macroeconomic stability. Their conclusions propose a need for macroprudential regulation playing a larger role in the broad-based macroeconomic stability and advocated for their use in unison with monetary policy tools as their “imperfect substitutability” could improve their effectiveness.

The failure of monetary policies in detecting and containing the effects of financial crises and the failure of the external adjustments in limiting this has given more credence to macroprudential regulations and their potentially beneficial effects. They should aid in one or more of the following purposes: (1) limiting exchange rate appreciation, (2) reducing portfolio inflows (3) reducing inflation, (4) reducing volatility, (5) and reducing specific measures of financial fragility (such as bank leverage, credit growth, asset bubbles, foreign- currency exposure, or short-term liabilities). Essentially, these regulations would make it more difficult for agents to borrow during upswings, thus reducing the magnitude of the negative effects during downturns.

The IMF recently approved the use of macroprudential measures, capital controls in particular, deeming the latter as a useful part of the “policy toolkit” for developing nations under specific circumstances, in contrast to earlier sentiments that any tool opposing free market operations were too costly and in some cases ineffective (Foley et al 2004; Frenkel et al 2001). However, these regulations have not been viewed as a replacement for the use of monetary policy measures as studies indicate that they can be used collectively to maintain financial and macroeconomic stability in instances of large, volatile capital flows. Both do have shortfalls in their uses, however they can aid each other in providing stabilizing effects as Unsal (2013) describes:

1. Macroprudential regulations can be focused on high risk financial sectors, whereby the magnitude and application of monetary policy tools may have broad-based effects.
2. Monetary policies are useful in cases where macroprudential regulations can be avoided.
3. Macroprudential regulations can have stabilizing effects in abnormal times whereby monetary policies may be inadequate alone.
4. Macroprudential regulations can be more suitable for stability, as the use of monetary policy tools may have effects that are inconsistent with broader macroeconomic targets.

Jeanne (2014) modeled macroprudential regulation as a Pigouvian tax on inflows in a DSGE model in an attempt to compare the welfare effects of domestic and capital account prudential policies and explores the case for the coordination of macroprudential and monetary policies on a worldwide stage. The study concludes that (i) domestic prudential policies were preferred to capital controls but the implementation of the former may be troublesome, (ii) the case for international coordination of the policies can be made but on an ad hoc basis and (iii) emerging market economies could use price-based and moderately sized prudential capital controls.

Given the general acceptance of the effectiveness of macroprudential measures, the focus of the analysis has been mainly on analyzing them in crises situations, with monetary policy considerations secondary. However, general recommendations point to the importance of the latter's effect in stability (Forbes 2005; Frenkel et al 2001; Tamirisa 2004; Baba and Kokenye 2011[5]). Recently, there has been an expansion in the literature analyzing the interaction between optimal monetary and macroprudential polices (Angelini et al 2011; Unsal 2013; Canuto and Cavallari 2013a; Yellen, 2010). Correa (2012) in examining the Brazilian experience with macroprudential measures conclude that they can reduce risks and instability and that they can help as complementary tools to monetary policy.

Quint and Rabanal (2014) examine the optimal mix of monetary and macroprudential policies in a DSGE model of the euro area and find that the effects of the latter are much smaller in the absence of The Central Bank's monetary policy rules that are close to the optimal one. They also posit that when the macroprudential regulations are aimed at stabilizing the domestic credit market, that it is more effective. The authors use a model of two countries, which share the same financier and include a financial accelerator mechanism on the household side as they allow financial shocks in the credit market and the broader macroeconomy. Unsal (2013), examined

[5] These studies don't advocate for the usefulness of macroprudential capital controls, however they advocate broader macroprudential measures and monetary policy rules

the interaction between these policies in a small open economy during financial acceleration. The results also point to the efficacy of macroprudential tools and their use along with the monetary policy rules in promoting financial and macroeconomic stability in instances of financial acceleration. The study found that broad macroprudential measures were more beneficial than those that discriminated against foreign liabilities (capital controls).

Exchange rate considerations have also been a key subject, as it has been shown that flexible regimes have been more resilient to financial acceleration than less flexible arrangements due to adequate BOP adjustments. The economic rationale lies in the fact that the upsurge in banking credit during periods of capital inflows are much more pronounced in countries with fixed exchange rates as they forego independent monetary policy decisions. They effectively lose their ability to implement policy adjustments to partially nullify the growth in credit, by increasing the harmful effects during a sudden stop. In an analysis of Mundell's trilemma which states that perfect capital mobility, a fixed exchange rate regime, and independent monetary policy cannot all coexist, researchers have concluded that in the case of fixed regimes, impeding capital mobility is a means of regaining monetary policy autonomy. The use of macroprudential regulations is once again justified; however, evidence has shown its usefulness in flexible regimes as well.

The evaluation of exchange rate regimes during abnormal economic times have been prominent in the literature as Yagci (2001) noted that the major currency crises in the 1990's all involved a fixed exchange rate and a reversal of capital flows. Furthermore, it has been noted that economies with less rigid exchange regimes are less likely to face financial and economic crises (Magud et al 2011; Ghosh et al 2014; Furceri et al 2012) though flexibility does not fully protect economic systems from reversals in credit (Magud and Vesperoni 2014). Utilizing a DSGE model of a small open economy with risk premium shocks to investigate Mundell's Trilemma, Farhi and Werning (2013) find that the capital controls can play a significant role in fixed as well as floating regimes by mitigating the exchange rate depreciation, fall in consumption and the outflow of capital during sudden stops.

3. The model

This section describes the main features of the theoretical framework used to study the role of financial frictions and the interaction of monetary and macroprudential policy in the propagation of shocks affecting a small open economy.

The model is based on the specification proposed by Unsal (2013) where entrepreneurs producing final capital goods finance their operations externally through foreign debt. As in Bernanke, Gertler and Gilchrist (1999) the equilibrium conditions for the entrepreneur block considers the existence of a financial risk premium influencing the cost of the credit contract. This

risk premium arises as a result of the informational asymmetry pertaining to the ex-post return of the investment project. A contracting problem is formulated by the parts involved and the costs associated are internalized, giving as a result a premium rate which is a function of the net worth of the entrepreneur. The formal representation and description of this contract problem can be found in detail in Bernanke, Gertler and Gilchrist (1999).

3.1 Households

3.1.1 The intertemporal problem

This model considers a representative household which extracts utility from the maximization of

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

Where:

C_t: composite consumption index

H_t: hours of work

Setting the utility function depends of β which is the discount factor, σ the inverse of the intertemporal elasticity of substitution, χ the utility weight of labor, and φ the inverse elasticity of labor supply.

One of the characteristics of the business cycle of economies like those in the Caribbean is the pro-cyclical behavior of the current account. To the model replicates this behavior, the utility function chosen is the GHH[6] which eliminates the wealth effects in labor supply.

The household budget constraint is given by:

$$P_t C_t + (1 + i_{t-1}^*)\Psi_{t-1} S_t D_t^H + (1 + i_{t-1}) D_t^D = W_t H_t + \Pi_t + S_t D_{t+1}^H + D_{t+1}^D \quad (2)$$

Where

P_t: Consumption price level

Ψ_t: Household debt risk premium

S_t: Nominal exchange rate

D_t^H: External debt (bonds)

D_t^D: Domestic debt (bonds)

[6] Greenwood, Jeremy and Hercowitz (1988) preferences

W_t: Nominal wage
i_t^*: Foreign nominal interest rate
Π_t: Profits

The left side gives household expenditures, consisting of buying consumption goods, (represented by the composite) interest and capital payments on domestic and external borrowing. The right side is the household's sources of income, comprising of labor income, profits from producer and importer firms and the proceeds from contracting new debt. As is common in the literature on small open economies, households pay a premium when borrowing from the rest of the world (Schmitt – Grohe and Uribe, 2003). This premium is a function of the debt to GDP ratio:

$$\Psi_t = 0.5\Psi\left(\exp\left(\frac{S_t D_t^H}{P_t GDP_t} - \frac{SD^H}{PGDP}\right) - 1\right)^2 \quad (3)$$

From the first order condition of this problem, we can obtain the labor supply relation, the dynamic equation for aggregate consumption (Euler equation) and the uncovered interest rate parity:

$$\chi H_t^{\varphi} = W_t \quad (4)$$

$$\left(C_t - \frac{\chi}{1+\varphi} H_t^{1+\varphi}\right)^{\sigma} = \beta(1+i_t)E_t\left[\left(C_{t+1} - \frac{\chi}{1+\varphi} H_{t+1}^{1+\varphi}\right)^{\sigma}\right] \quad (5)$$

$$(1+i_t) = (1+i_t^*)\Psi_t E_t\left(\frac{S_t}{S_{t+1}}\right) \quad (6)$$

3.1.2 The intratemporal problem

The aggregate consumption, C_t , is a compound basket of two tradable consumption goods: domestic (H) produced and imported (M) goods,

$$C_t = \left[(1-\alpha)^{\frac{1}{\gamma}} C_{H,t}^{\frac{\gamma-1}{\gamma}} + \alpha^{\frac{1}{\gamma}} C_{M,t}^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}} \quad (7)$$

Where $\alpha \in [0,1]$ is the openness of the economy, measured as the ratio of imported goods to aggregate consumption, and $\gamma > 0$ is the elasticity of substitution between domestic and imported goods. $C_{H,t}$ and $C_{M,t}$ are compound indexes of different varieties of each kind of good, given by the following CES aggregators:

$$C_{H,t} = \left[\int_0^1 C_{H,t}(j)^{\frac{\gamma-1}{\gamma}} dj\right]^{\frac{\gamma}{\gamma-1}} \quad (8)$$

$$C_{M,t} = \left[\int_0^1 C_{M,t}(j)^{\frac{\gamma-1}{\gamma}} dj\right]^{\frac{\gamma}{\gamma-1}} \quad (9)$$

The solution of the intratemporal problem gives the following demand functions:

$$C_t^H = (1-\alpha)\left(\frac{P_t^H}{P_t}\right)^{-\gamma} C_t \quad (10)$$

$$C_t^M = \alpha\left(\frac{P_t^M}{P_t}\right)^{-\gamma} C_t \quad (11)$$

And a definition of CPI

$$P_t = \left[(1-\alpha){P_t^H}^{1-\gamma} + \alpha {P_t^M}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} \quad (12)$$

3.2 Firms

There are two types of firms: production and importing firms

3.2.1 Production firms

There is a continuum of production firms each producing a differentiated good and indexed by $j \in [0,1]$ using the production function

$$Y_t(j) = A_t N_t(j)^{1-\eta} K_t(j)^{\eta} \quad (13)$$

Where

Y_t: is the level of production of the firm j

$N_t(j)$: is the labor input

$K_t\ (j)$: is the capital input

As in Unsal (2013), the labor input is a composite of household labor (H) and entrepreneurial labor (H_t^E) defined as $N_t(j) = H_t(j)^{1-\Omega} H_t^E(j)^{\Omega}$. H_t^E is normalized to 1.

The election of the optimal level of labor and capital, firms minimize

$$W_t N_t\ (j) + R_t K_t(j) \tag{14}$$

Subject to the production function. The first order condition gives the firm demand for labor and capital,

$$W_t = \frac{(1-\eta)(1-\Omega)Y_t MC_t}{N_t} \tag{15}$$

$$W_t^E = (1-\eta)\Omega Y_t MC_t \tag{16}$$

$$R_t = \frac{\eta Y_t MC_t}{K_t} \tag{17}$$

$$MC_t = \frac{R_t^{\eta} W_t^{1-\eta}}{A_t \eta^{\eta}(1-\eta)^{(1-\eta)}} \tag{18}$$

Where

W_t^e: Entrepreneurial wage rate

R_t: Rental rate of capital

MC_t: Nominal marginal cost

3.3 Price setting

Nominal rigidity is added to the model considering sticky prices, which are introduced to the analysis as suggested by Calvo (1983). Accordingly, in each period a subset of firms receives a signal to change prices which is randomly assigned, orthogonal to past signals and independent across firms. Those firms that have not received this signal change prices through indexation to past inflation.

Formally, $\mu_H \in [0,1]$ represents the fraction of firms that did not receive the signal of price actualization. Thus, the price index of domestic goods, $P_{H,t} = \left(\int_0^1 P_{H,t}^{1-\varepsilon}(i)\right)^{\frac{1}{1-\varepsilon}}$ can be decomposed into two components, the prices of firms who get the signal and the subset who index to past inflation:

$$P_{H,t} = \left[\mu_H \int_{s(t)} \hat{P}(i)_{H,t}^{1-\varepsilon} + (1-\mu_H)\left(P_{H,t}^{opt}\right)^{1-\varepsilon}\right]^{1-\varepsilon} \tag{19}$$

Where $s(t)$ is the subset of firms that do not actualize prices at period t, $\hat{P}_{H,t}$ represents prices for the firms that index to past inflation and $P_{H,t}^{opt}$ are the prices for the firms that change optimally; for those firms indexing to past inflation the rule is:

$$\hat{P}_{H,t} = P_{H,t-1}\left(\Pi_{H,t-1}\right)^{\chi^H} \tag{20}$$

Substituting in 19:

$$P_{H,t} = \left\{\mu_H \left[P_{H,t-1}\left(\Pi_{H,t-1}\right)^{\chi^H}\right]^{1-\varepsilon} + (1-\mu_H)\left(P_{H,t}^{opt}\right)^{1-\varepsilon}\right\}^{\frac{1}{1-\varepsilon}} \tag{21}$$

In the case of firms who receive the signal to change prices, they choose the price $\bar{P}_{H,t}$, that maximizes the discounted profit flow, given by the equation

$$\underset{\{P_{H,t}^{opt}\}}{max} = E_t \sum_{k=0}^{\infty} \theta_H^k Q_{(t|t+1)}\{Y_{t+k}[P_{H,t}^{opt} - \mathrm{F}_{t+k}(Y_{(t+k|t)}]\} \tag{22}$$

Subject to

$$Y_{(t+k|t)} = \left(\frac{P_{H,t}^{opt}}{P_{H,t+k}^{opt}}\right)^{-\varepsilon} (C_H + Y_X) \tag{23}$$

Where $\mathrm{F}_{t+k}\left(Y_{(t+k|t)}\right)$ is the cost function and Y_x are the exports of domestically produced goods.

The first order condition is:

$$E_t \sum_{k=0}^{\infty} \theta_H^k \, Q_{(t|t+1)} Y_{t+k} \left\{P_{H,t}^{opt} - \frac{\varepsilon}{1-\varepsilon} F'_{(t+k|k)}\right\} = 0 \tag{24}$$

With $F'_{(t+k|k)} = \frac{\partial F}{\partial P_H^{opt}}$

This equilibrium condition, establishes that firms changing prices optimally choose the price that earns mean profits of zero (on average), given a markup.

3.3.1 Importing firms

Importers are price-takers in the rest of the world, but product differentiation in the domestic market allow them set prices in local currency. They confront price adjustment costs as domestic producers. The optimal rule of price setting for firms indexing to past inflation is:

$$\hat{P}_{M,t} = P_{M,t-1}\left(\Pi_{M,t-1}\right)^{\chi^M} \tag{25}$$

For firms who receive the signal to change prices optimally.

$$E_t \sum_{k=0}^{\infty} \theta_M^k \, Q_{(t|t+1)} Y_{t+k} \left\{ P_{M,t}^{opt} - \frac{\varepsilon}{1-\varepsilon} \psi_{(t+k|k)} \right\} = 0 \tag{26}$$

Where ψ_t is the deviation from the law of one price, defined as:

$$\psi_t = S_t P_t^* / P_{M,t}$$

Where P_t^* is the price of imported goods in foreign currency.

This mechanism, ensures incomplete pass-through of nominal exchange rates movements as in Gali and Monacelli (2005).

The price index for imported goods is:

$$P_{M,t} = \left\{ \mu_M \left[P_{M,t-1}\left(\Pi_{M,t-1}\right)^{\chi^M} \right]^{1-\varepsilon} + (1-\mu_M)\left(P_{M,t}^{opt}\right)^{1-\varepsilon} \right\}^{\frac{1}{1-\varepsilon}} \tag{27}$$

3.3.2 Unfinished-Capital Producers

This type of producer uses domestic and imported investment goods to produce capital, which is sold to the entrepreneur as unfinished capital. Aggregate investment is given by the CES aggregator:

$$I_t = \left[\alpha^{\frac{1}{\gamma}} I_{H,t}^{(\gamma-1)/\gamma} + (1-\alpha)^{\frac{1}{\gamma}} I_{M,t}^{(\gamma-1)/\gamma} \right]^{\frac{\gamma}{\gamma-1}} \tag{28}$$

The prices of investment goods, either domestic or imported are the same as consumption goods. These competitive firms use the investment goods which are combined with rented capital to produce unfinished-capital goods. In addition, the marginal return to investment is subject to an adjustment cost which is decreasing in the level of investment taken relative to the current capital stock. As a result, the evolution of capital is:

$$K_{t+1} = \left[\frac{I_t}{K_t} - \frac{\Psi_I}{2}\left(\frac{I_t}{K_t} - \delta\right)^2\right] K_{t-1} + (1-\delta)K_t \quad (29)$$

The optimal condition delivers the following equation for the nominal price of a unit of capital, Q:

$$\frac{Q_t}{P_t} = \left[1 - \Psi_I\left(\frac{I_t}{K_t} - \delta\right)\right]^{-1} \quad (30)$$

The intratemporal problem gives a solution to the optimal demand for each type of investment good:

$$I_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\gamma} I_t \quad (31)$$

$$I_{M,t} = \alpha\left(\frac{P_{M,t}}{P_t}\right)^{-\gamma} I_t \quad (32)$$

3.3.3 Entrepreneurs

The block of entrepreneurs is central to the analysis. They enter in the model using the same logic as in most papers that introduce the financial accelerator mechanism described in Bernanke, Gertler and Gilchrist (1999). The main difference is that entrepreneurs accumulate external debt to finance their activities. This section also draws on certain elements from Unsal (2013); as we offer a brief description to clearly explain the mechanism.

The objective of entrepreneurs is to buy unfinished capital, transform them into finished capital goods and sell them to the producer firms. There is a continuum of entrepreneurs, indexed by k in the interval [0,1] that use the same technology in the production of these capital goods:

$$K_{t+1}(k) = K'_{t+1} \quad (33)$$

Where $K'_{t+1} = \omega_{t+1}(k)K_{t+1}(k)$, is the finished capital good. $\omega_{t+1}(k)$ is the idiosyncratic productivity and it is assumed to be i.i.d. The underlying distribution of the idiosyncratic shock is a log-normal, as is customary in the literature.

There are two sides involved in the negotiation: lenders and borrowers. Entrepreneurs (borrowers) finance purchases of the unfinished capital using its net worth and foreign currency denominated debt:

$$Q_t K_{t+1}(k) = P_t NW_t(k) + S_t D^F_{t+1}(k) \quad (34)$$

Where

D^F_{t+1}: is the foreign currency denominated debt

NW_t: is the entrepreneur's net worth

On the other side, ex ante, lenders have an imperfect knowledge of the distribution of $\omega_{t+1}(k)$, which as Unsal (2013), we use the specification of Cúrdia (2007,2008) as:

$$\omega^*_{t+1}(k) = \omega_{t+1}(k)\varrho_t \tag{35}$$

$$\ln(\varrho_t) = \rho_\varrho \ln(\varrho_{t-1}) + \varepsilon_\varrho \tag{36}$$

Where

ϱ_t: is the misperception factor over a given interval.

Ex-post, lenders only observe $\omega_{t+1}(k)$ at monitoring cost, μ. The formulation and solution of the costly state verification problem can be found in Gale and Hellwig (1985), Bernanke, Gertler and Gilchrist (1999) and the appendix of Unsal (2013). This contracting problem gives the capital demand of entrepreneurs and a cut-off value: the minimum level of productivity that lenders require. Conditional on that, the first order conditions are represented by:

$$E_t[R^K_{t+1}] = E_t[(1 + i^*_t)(1 + \Phi_{t+1})] \tag{37}$$

Where

R^K_{t+1}: is the ex-post average across agents (aggregate) return on capital

$(1 + \Phi_{t+1})$: is the default premium on foreign borrowing.

This equation establishes that in equilibrium, to fund the project the expected return must equal the cost of borrowing plus a compensation (premium) for a possible bad state of the nature. That is, the asymmetry problem is internalized as an additional cost of the loan.

Following Bernanke, Gertler and Gilchrist (1999), the premium or gross external finance premium is an inverse function of the net worth to gross value of capital:

$$1 + \Phi_{t+1} = S\left(\frac{NW_{t+1}}{q_t K_{t+1}}\right)\varepsilon^\Phi_t,\ S'(.) < 0, S(1) = 1 \tag{38}$$

Where

Q_t is the price of capital

ε_t^{Φ} is an exogenous risk premium shock (credit supply shock, as in Christiano et al (2005)) that follows an AR(1) process.

This expression is a central feature of the financial accelerator mechanism. A greater use of the external financing relative to the net worth (higher leverage) raises the probability of default, as a result of more entrepreneurs taking more risky projects.

Each period a fraction $(1-\upsilon)$ of the entrepreneurs leave the scenario and are replaced by newcomers. The agents consume their return on capital as:

$$P_t C_t^E = (1-\upsilon)\left[R_t^K Q_{t-1} K_{1-\nu_t} - (1+i_t^*) S_t D_t^F\right] \tag{39}$$

And split their consumption as:

$$C_{Ht}^E = (1-\alpha)\left(\frac{P_{Ht}}{P_t}\right)^{-\gamma} C_t^E \tag{40}$$

$$C_{Mt}^E = \alpha\left(\frac{P_{Mt}}{P_t}\right)^{-\gamma} C_t^E \tag{41}$$

The net worth of the rest of entrepreneurs who survive to the next period evolves as:

$$P_t NW_t = \upsilon\left[R_t^K Q_{t-1} K_{1-\nu_t} - (1+i_t^*) S_t D_t^F\right] + W_t^E \tag{42}$$

Finally, the link between the rental rate of capital and the expost rate of return is given by:

$$E_t[R_{t+1}^K] = E_t\left[\frac{R_{t+1}}{Q_t} + \frac{Q_{t+1}}{Q_t}\left\{(1-\delta) + \Psi_I\left(\frac{I_{t+1}}{K_{t+1}} - \delta\right)\frac{I_{t+1}}{K_{t+1}} - \frac{\Psi_I}{2}\left(\frac{I_{t+1}}{K_{t+1}} - \delta\right)^2\right\}\right] \tag{43}$$

This equation states the difference between rates due to the existence of investment adjustment costs and incomplete capital depreciation. In addition, it shows the role of the fluctuation in capital valuation on the evolution of the ex-post rate of return.

3.4 Macroprudential policy

Macroprudential policy is introduced as in Unsal (2013) where the cost of macroprudential policy is reflected as higher interest rates through the inclusion of what she calls a “regulation premium”, so the equation is

$$E_t[R_{t+1}^K] = E_t[(1+i_t^*)(1+\Phi_{t+1})(1+RP_t)] \tag{44}$$

Where RP_t is a function of aggregate credit growth:

$$RP_t = \Psi\left(\frac{D_t}{D_{t-1}} - 1\right) \quad (45)$$

Where $D_t = D_t^H + D_t^E$.

The rationale is that policymakers are motivated to stabilize aggregate the foreign credit growth. The instrument counterbalances credit growth by increasing its opportunity cost.

3.5 Monetary policy

Monetary policy is set according a Taylor rule

$$1 + i_t = \left[(1+i)(\pi_t)^{\epsilon_\pi}\left(\frac{Y_t}{Y}\right)^{\epsilon_Y}\right]^{\varpi}[1 + i_{t-1}]^{\,1-\varpi} \quad (46)$$

Where
π_t: is the CPI inflation.

We assume that monetary policy is set independent of the level of macroprudential instrument

3.6 General Equilibrium

The market clearing for the final goods sector requires that all production is sold domestically or exported:

$$Y_t = Y_{H,t} + Y_{X,t} \quad (47)$$

Where:

$$Y_{H,t} = C_{H,t} + C_{H,t}^E + I_{H,t} + (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\gamma}\left[\frac{\Psi_H}{2}\left(\frac{P_{H,t}}{P_{H,t-1}} - 1\right)^2 + \frac{\Psi_M}{2}\left(\frac{P_{M,t}}{P_{M,t-1}} - 1\right)^2 + \nu_t \frac{R_t^k}{P_t} Q_{t-1}K_t\right] \quad (48)$$

For the import demand :

$$Y_{M,t} = C_{M,t} + C_{M,t}^E + I_{M,t} + \alpha\left(\frac{P_{M,t}}{P_t}\right)^{-\gamma}\left[\frac{\Psi_H}{2}\left(\frac{P_{H,t}}{P_{H,t-1}} - 1\right)^2 + \frac{\Psi_M}{2}\left(\frac{P_{M,t}}{P_{M,t-1}} - 1\right)^2 + \nu_t \frac{R_t^k}{P_t} Q_{t-1}K_t\right] \quad (49)$$

Finally, the balance of payment is given by

$$S_t P_{X,t} Y_{X,t} - S_t P_t^* Y_{M,t} = S_t(1 + i_{t-1}^*)(D_t^H \Psi_{t-1} + D_t^F) - S_t(D_{t+1}^H + D_{t+1}^F) \quad (50)$$

4. Parameter Calibration and Estimation

This section contains the discussion on the model's parameter calibration and estimations associated with the risk premium and shock persistence for two Caribbean economies: Jamaica and the Dominican Republic (DR). The model is then used to study the response of the main

macroeconomic variables to a financial risk shock in each economy. Finally, taking these parameterizations as a given, the response of the variables under different assumptions on monetary policy regimes will be analyzed, with and without the presence of macroprudential instruments.

Table 1. in the Appendix presents parameters common across monetary policy regimes. We use the calibration of Unsal (2013) for the Household and Firm blocks, with the exception of the discount factor which is calibrated to 0.90 for Jamaica and 0.99 for the DR, the average interest rate of the two considered countries. Parameters in the price equations and the degree of openness are calibrated to a previous estimation for the case of DR (see Ramirez and Torres (2013)).

We use information on GDP output, CPI inflation, interbank interest rate, real exchange depreciation, foreign interest rate and risk premium of Jamaica and the Dominican Republic to estimate the entrepreneur risk premium elasticity and shock persistence of the model, given the calibration of the other variables. The entrepreneur risk premium is matched by the Emerging Market Bond Index (EMBI) published by J.P. Morgan. The sample covers from 2003 until 2012 in the case of the DR and from 2006 to 2012 for Jamaica, in a quarterly frequency.

To form the prior distribution of these parameters, the mode of the elasticity of the entrepreneur risk premium is set as in Bernanke, Gertler and Gilchrist (1999) to 0.0461. Finally, as in Justiniano (2010), the elasticity premium used to close the model is set to 0.001 for the emerging economies. Table 3 summarizes the priors and the results of the posterior estimation. Where S is the risk premium elasticity, ρ_i and σ_i for $i = r, i^*, a, S$, are shocks persistence parameters and the standard deviations of the source of fluctuations in the model. Special attention is given to the estimation of the risk premium elasticity. This elasticity is higher in the case of the Dominican Republic compared with Jamaica, but less than one as observed in Bernanke, Gertler and Gilchrist (1999). Another finding is that the volatility of shocks associated with the risk premium is very important in the Jamaican economy, relative to the DR.

Table 1: Priors and Posteriors of Estimate Parameters Dominican Republic

Parameters	Prior Mean	Posterior Mean	Conf. Interval		Prior	Posterior Deviation
S	0.050	0.0335	0.0090	–	gamma	0.0200
			0.539			
$\boldsymbol{\rho_r}$	0.500	0.4542	0.2449	–	beta	0.2000
			0.4037			
$\boldsymbol{\rho_{i^*}}$	0.500	0.2429	0.0910	–	beta	0.2000
			0.4037			

ρ_a	0.500	0.7872	0.6804 0.8932	–	beta	0.2000
ρ_S	0.500	0.7276	0.6442 0.8044	–	beta	0.2000
σ_a	0.100	0.0153	0.0126 0.0178	–	Inv. gamma	2.000
σ_{i^*}	0.100	0.0129	0.0118 0.0142	–	Inv. gamma	2.000
σ_S	0.100	0.7336	0.3220 1.0519	–	Inv. gamma	2.000
σ_r	0.100	0.0167	0.0138 0.0196	–	Inv. gamma	2.000
σ_{π^*}	0.100	0.0320	0.0220 0.0417	–	Inv. gamma	2.000

Table 2 : Priors and Posteriors of Estimate Parameters for Jamaica

Parameters	Prior Mean	Posterior Mean	Conf. Interval		Prior	Posterior Deviation
S	0.050	0.0227	0.0075 0.0372	–	gamma	0.0200
ρ_r	0.500	0.3419	0.2516 0.4227	–	beta	0.2000
ρ_{i^*}	0.500	0.6322	0.4144 0.8397	–	beta	0.2000
ρ_a	0.500	0.7068	0.4917 0.8985	–	beta	0.2000
ρ_S	0.500	0.4822	0.3226 0.7168	–	beta	0.2000
σ_a	0.100	0.0267	0.0201 0.0333	–	Inv. gamma	2.000
σ_{i^*}	0.100	0.0164	0.0124 0.0197	–	Inv. gamma	2.000
σ_S	0.100	7.3872	4.1244 10.4145	–	Inv. gamma	2.000
σ_r	0.100	0.1447	0.1093 0.1810	–	Inv. gamma	2.000
σ_{π^*}	0.100	0.2216	0.1234 0.3160	–	Inv. gamma	2.000

5. Results

5.1 Response Functions to a Positive Credit Supply Shock

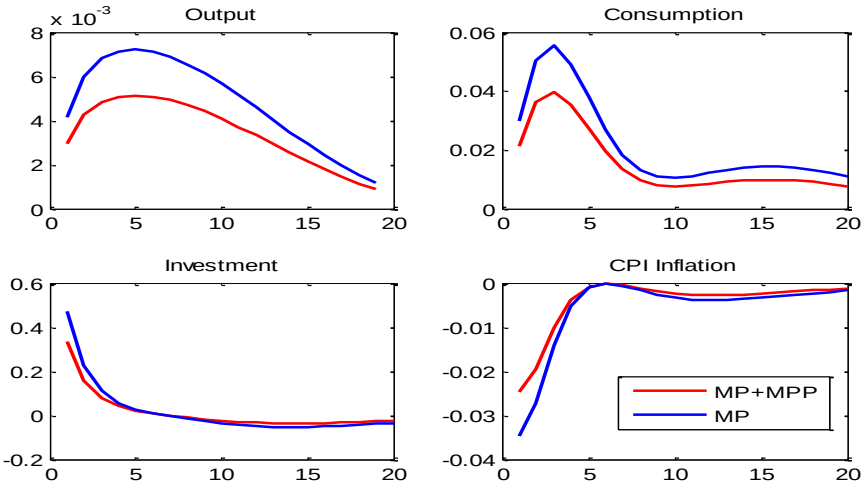
This section analyzes the responses of the pertinent macroeconomic variables to a positive shock to the economies' credit supply, which improves the entrepreneurs' risk profile and borrowing capacity. This shock reduces the required return on capital as the risk premium is reduced,

relaxing the financial restriction of these agents. Results are shown for each economy with and without macroprudential policy, as is specified in the model.

Figure 1 illustrates the dynamic response of the model estimated for Jamaica. The positive credit supply shock, in the absence of macroprudential controls, results in a sharp increase in the entrepreneurs' external debt accumulation effectively lowering their net worth. Simultaneously, output, consumption and investment rise as entrepreneurs demand more intermediate capital due to the reduction in financial frictions during the economic upswing. In addition, the external risk of the economy subsides, inducing a real exchange rate appreciation, which contributes to the decline in the inflation rate. Monetary policy plays an active role as the Central Bank reduces the interest rate in response to falling prices, fueling the further expansion of aggregate demand components. The effects of the positive supply shocks wear off approximately five periods after.

In the presence of the macroprudential instrument and monetary policy, the dynamics of these variables remain the same; however, there is a notable decrease in the magnitude of the observed reactions. The entrepreneur's net worth remains relatively higher, compared to the case with only monetary policy present as its debt accumulation moderates. The corresponding effects on the rest of the economy are also subdued as output, consumption and investment all increase at a slower rate than previously observed. All the aforementioned contributes to a marginally smaller appreciation in the exchange rate and a smaller dip in prices, warranting less reaction on the monetary policy end. There is a smaller reduction in the interest rates than when the economy operates sans macroprudential regulations.

Figure 1 : Response of macroeconomic variables to a positive credit supply shock: Jamaica



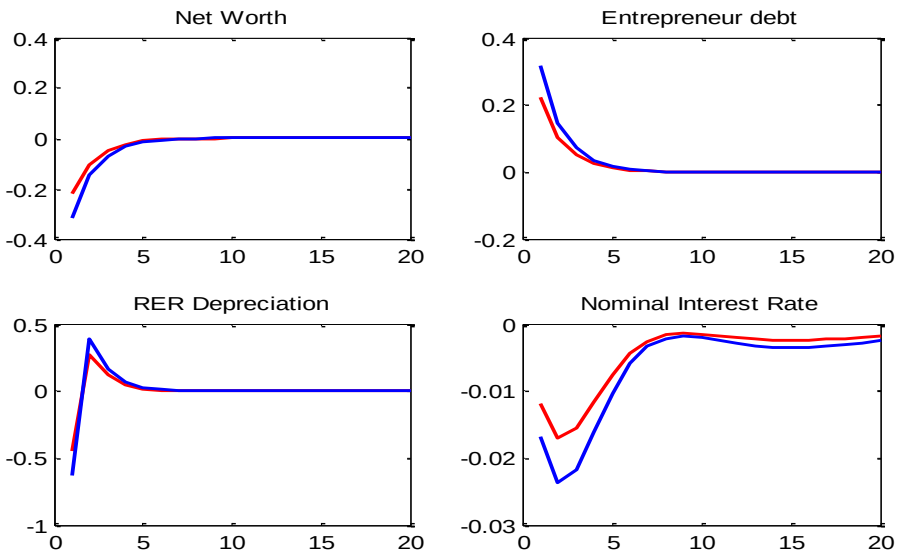
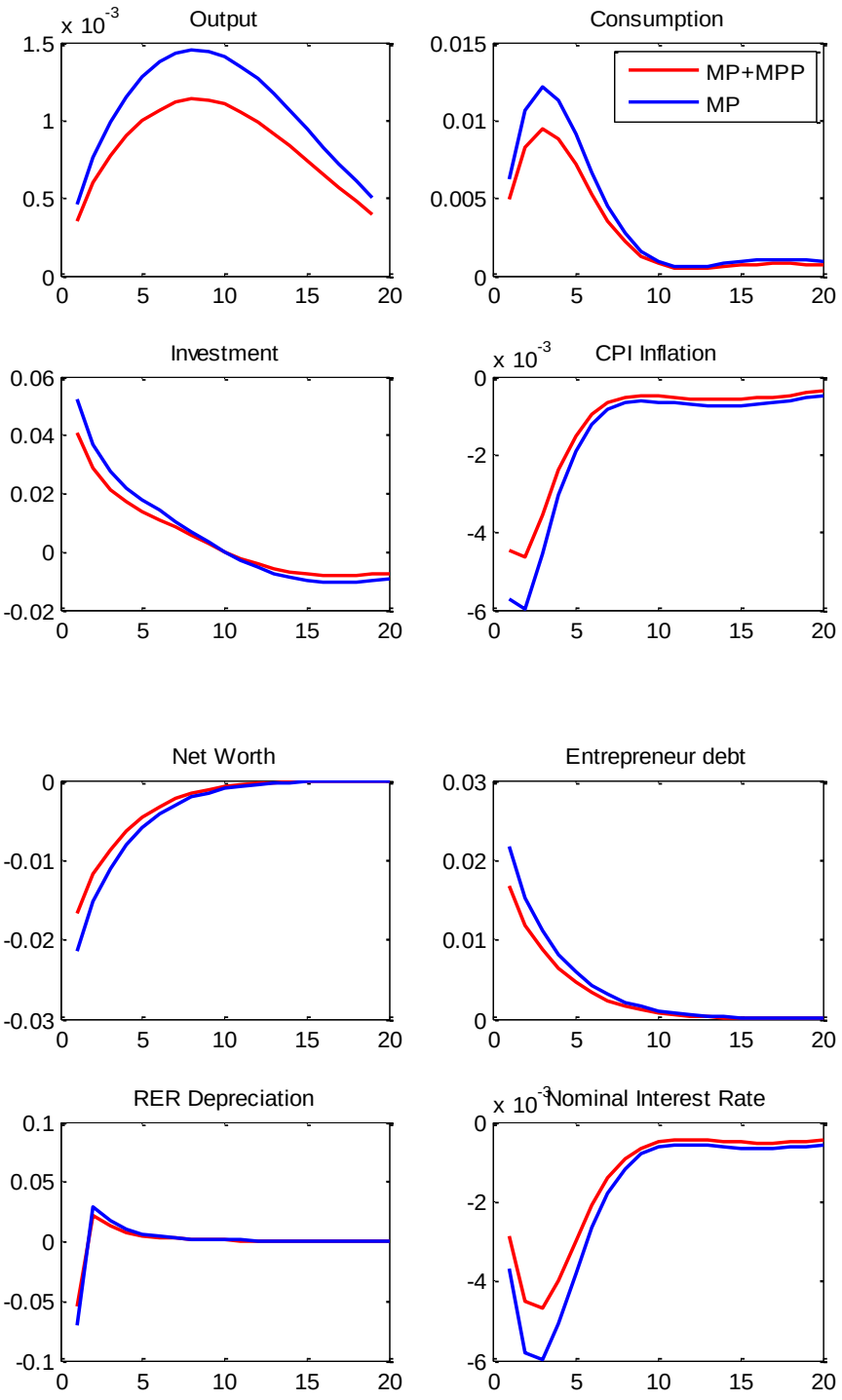


Figure 2 illustrates the dynamic response of the model estimated for the DR. The results are similar to the Jamaican case in which the absence of macroprudential controls causes a spike in the entrepreneur's debt while increasing output, consumption and investment.

Figure 2. Response of macroeconomic variables to a positive credit supply shock: Dominican Republic



The magnitude of the effects, however, is not as large. In the DR, macroprudential regulations also improves the reaction of the macroeconomic variables as output, consumption

and investment are more subdued in the short and long run than without these regulations. Despite the marginal increase in the real exchange rate of the DR, the reduction in the nominal interest rate is more pronounced than that of Jamaica, indicating the strong reaction of the authorities to changes in financial frictions (Ramirez and Torres (2013)). In the presence of macroprudential regulations, however the changes in the interest rates are not as pronounced. The model indicates that the use of both macroprudential policies and monetary policies in these two Caribbean economies provide more of a buffer in cases of a positive credit shock. Results were favorable in both Jamaica and the DR, as movements in the important macro-variables were smaller and more suited for stability than in the case where the countries would only utilize the monetary policy rules of the Central Bank. Changes in these variables will now be assessed under different exchange rate regimes.

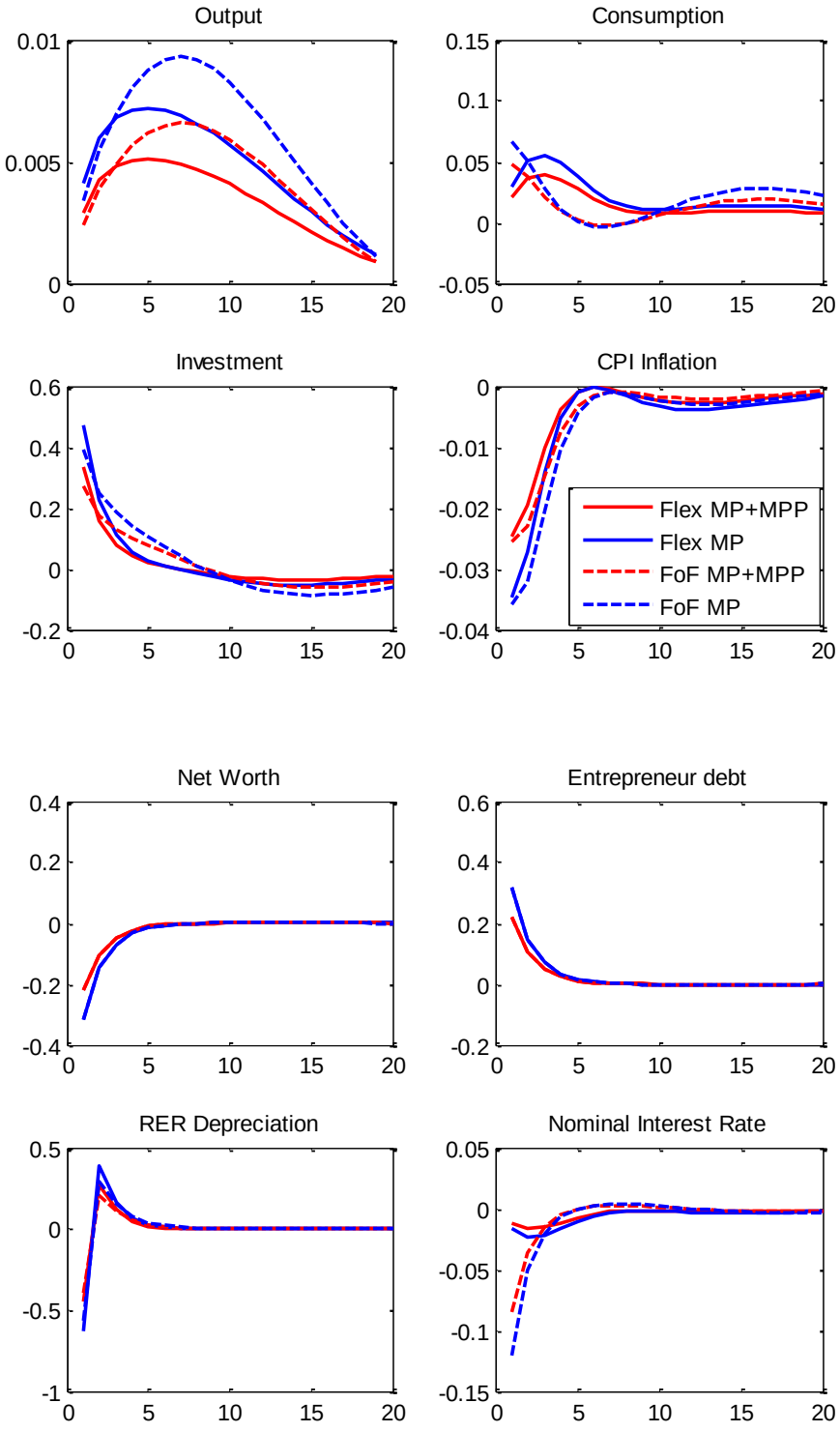
5.2 Counterfactual Exercises

To provide a full analysis of the usefulness of monetary policy complemented by macroprudential regulation in the selected countries, we considered the impact of a positive credit supply shock in different exchange rate regimes in the estimated counterfactual analysis. Jamaica and the DR both operate under a crawl-like arrangement[7], which allows continuous depreciation or appreciation of their exchange rates in response to a variety of external shocks. They differ on the monetary policy end, as Jamaica has anchored its currency to the U.S. dollar, while the DR follows an inflation targeting framework. This counterfactual exercise will help us understand the effects of these policies on two emerging economies from the Caribbean. The exchange rate regimes presented are fear of floating with or without macroprudential policy (FOF MP and FOF MP+MPP) and flexible exchange rate with or without macroprudential policy (Flex MP or Flex MP+MPP). Results of dynamic responses for DR and Jamaica are detailed below.

Figure 3. presents the counterfactual results for Jamaica. Results show that there are significant differences in the response functions of the macroeconomic variables across exchange rate regimes and in the presence of macroprudential policies. However, these responses are very similar across the board in terms of the debt accumulation and the net worth of the entrepreneurs, with the presence of macroprudential policies influencing lower borrowing regardless of the regime.

[7] See IMF: *Annual Report on Exchange Arrangements and Exchange Restrictions 2013* for classification.

Figure 3. Jamaica Counterfactual



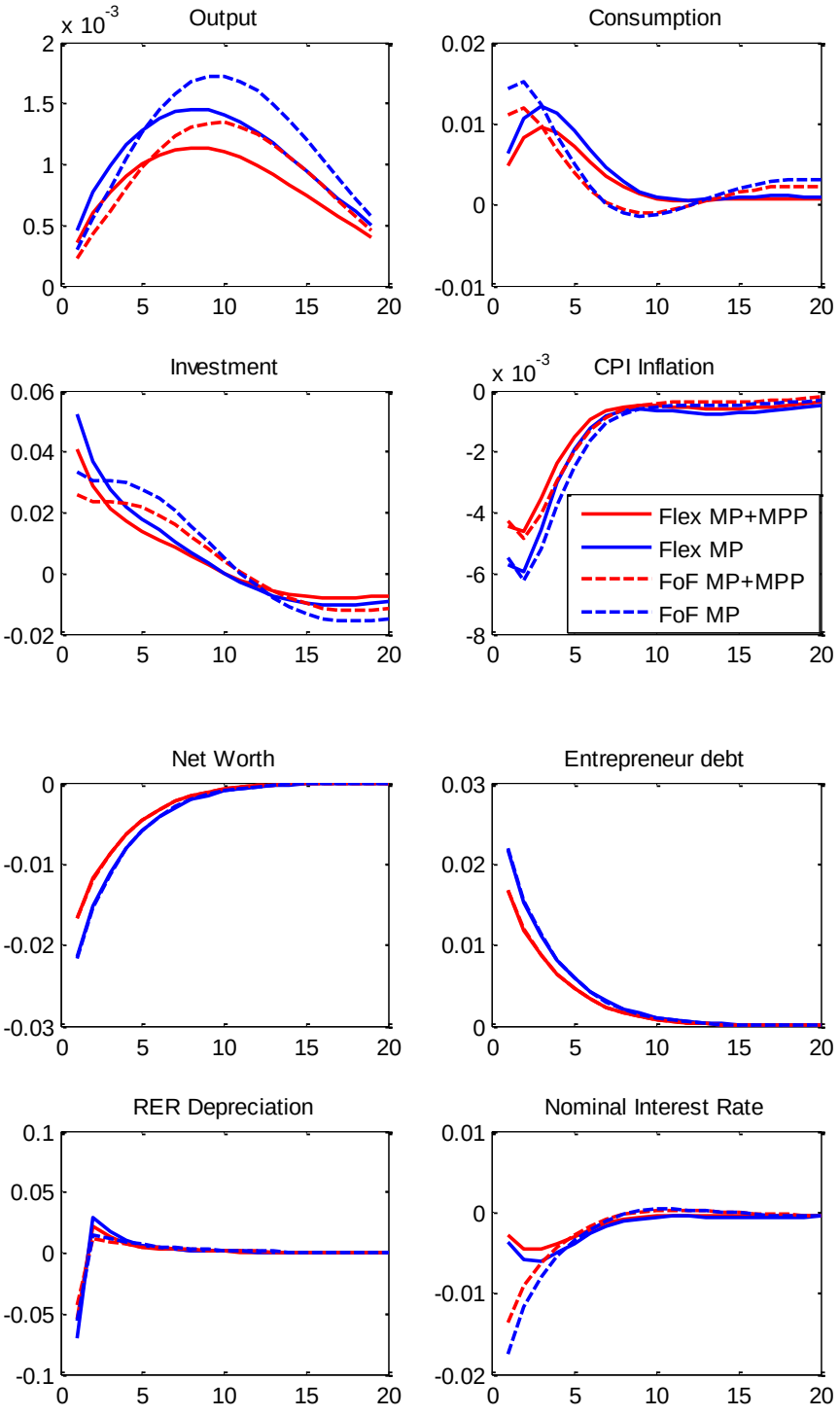
In the macroeconomic variables there is less fluctuation in the flexible regime with both monetary and macroprudential policies. The expansion in output, investment and consumption is among the lowest and the movements are most stable over the period assessed, which would moderate the negative effects in the case of a sudden stop, consistent with the findings of Magud et al (2011). The FOF economy, with macroprudential policies also performs well, diminishing the effect of the positive shock in output, consumption and investment. It is important to notice that in the short run, FOF with macroprudential policies better contain the upward effect; but in the long-run Flex with macroprudential policies has an outstanding performance. The real exchange rate appreciation is also more subdued in economies with macroprudential policies, regardless of the exchange rate, while the policy response is greater in the FOF economies. Interest rates aren't lowered much in the flexible regime, with or without macroprudential policies, which is not the case for the FOF economy that responds strongly in both cases. Our findings are consistent with Quint and Rabanal (2014); with a DSGE model of the euro area, they found that the introduction of macroprudential regulation along with monetary policy could help in reducing macroeconomic variables' volatility.

Our study indicates that macroprudential regulation and exchange rates are important tools to mitigate external shocks. Similar to the results of Farhi and Werning (2013) with their small open economy model, we found that flexible exchange rate movements allow appreciation to mitigate the positive shock effects in a more efficient way. Macroprudential policies in FOF economies play an important role by stabilizing macroeconomic responses. In a similar framework to ours, Unsal (2013) use an open economy DSGE model to study the interaction of monetary and macroprudential responses. Their findings show that macroprudential policies are beneficial in both flexible and fixed exchange rate regimes. His results are consistent with our own, supporting the use of macroprudential tools in constrained exchange rate regimes to mute financial shocks that may affect financial stability.

Figure 4. presents the counterfactual results for DR. As is the case with Jamaica, the debt accumulation is subdued in cases where macroprudential policies are present regardless of the exchange regime. The response of the output, investment and consumption variables is also most favorable under the flexible regime with macroprudential policies, though the FOF regime with macroprudential policies also regulates the volatility of the macro-variables well. The main difference lies in the magnitude of the effects with those from the DR being smaller than the Jamaican responses. It is suggested that an inflation targeting framework restricts a steeper effect. The macroprudential regulations regardless of the regime help to subdue a sharp increase in output, consumption and investment and discourage a higher appreciation of the real exchange

rate, controlling inflation levels. Prudential regulation along with monetary policy has beneficial effects in controlling upward pressures in real variables during business cycles and in stabilizing inflation.

Figure 4. Dominican Republic Counterfactual



6. Concluding Remarks

This paper utilizes a small open economy model specified by Unsal (2013) where entrepreneurs buy unfinished goods and transform them in finished capital which is sold to producer firms. Entrepreneurs, who are central to the model, finance their operations using their net worth and external borrowing. As in Bernanke, Gertler and Gilchrist (1999), the entrepreneur block considers the existence of a financial risk premium influencing the cost of credit contracts. Following Kannan, Rabanal and Scott (2009), macroprudential policy is introduced as an additional cost (regulation premium) by financial intermediaries. This model outlines the impact of financial frictions and interaction of monetary and macroprudential policy changes in two countries the Caribbean, namely Jamaica and the Dominican Republic. The conclusions of the analysis can be extended to the region, given the similarities of the economies in the area. Under a credit shock, key macroeconomic variables from these two nations respond in similar ways with varying magnitudes. Differences across models depend on the presence of macroprudential policy and/or exchange rate regime. However, benefits from the implementation of macroprudential policies persist despite the current exchange rate regime. In countries with differing monetary frameworks, macroprudential policies help mitigate the effects of financial shocks. Our results will help policymakers and central banks of the region in enlightening the beneficial effects of implementing macroprudential regulation along with monetary policy to help mitigate external shocks' deleterious effects.

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Appendix.

Table 1 Appendix : Common Parameters

Coefficient	Description	Value
□	Inverse of the intertemporal elasticity of substitution	2
X	Utility weight of labor supply	0.25
□	Firsch elasticity of labor supply	0.33
γ	Elasticity of substitution between domestic and foreign goods	1
η	Share of capital in production	0.35
λ	Elasticity of substitution between domestic goods	11
δ	Annual depreciation rate	0.025
Ω	Share of entrepreneurial labor	0.01
Ψ_I	Investment adjustment cost	12
Ψ_D	Responsiveness of Household's premium to debt/GDP	0.0075
Ψ_H, Ψ_F	Price adjustment costs	120
ω	Degree of interest smoothing	0.5
Φ	Default premium	0.02
ρ_Φ	Exogenous risk premium shock	
α	Degree of openness	0.5