Vinculando el Consumo Público al Sobreendeudamiento Privado

Franco Degiuseppe

Primer Premio / Categoría Jóvenes Profesionales

17° Premio de Investigación Económica

"Dr. Raúl Prebisch" 2025

BANCO CENTRAL
DE LA REPÚBLICA ARGENTINA

Linking Public Consumption to Private Overborrowing

Franco Degiuseppe

(Universidad de Buenos Aires – Universidad Torcuato Di Tella)

Abstract

We study the interaction between public consumption and private external debt in a SOE with a flow collateral constraint. While standard models (e.g., Bianchi AER 2011) show that households overborrow by not internalizing general equilibrium effects on the real exchange rate, this paper highlights how public consumption could amplify these inefficiencies. Moreover, it explores how a Ramsey planner can implement optimal capital control taxes to address these distortions.

1 Introduction

As extensively documented in the literature, emerging market economies that engage in global capital markets are particularly vulnerable to cyclical fluctuations in capital flows. Periods of optimism are typically marked by large inflows, while episodes of financial stress often trigger abrupt reversals, frequently culminating in sudden stops and widespread financial instability. In this context, Reinhart and Rogoff (2009) present extensive historical evidence linking capital market liberalization to financial crises. These dynamics naturally raise the question of whether economies tend to overborrow during booms and engage in excessive deleveraging during busts. As Korinek (2011) emphasizes, the volatility inherent in liberalized capital markets has resulted in significant welfare losses—particularly in terms of consumption—prompting growing concern among policymakers and the public alike.

In the aftermath of the 2008 global financial crisis, Bianchi (2011) tackled the issue of excessive borrowing. His analysis builds on the observation that persistent increases in debt levels are often followed by abrupt financial disruptions. This recurring pattern raises critical questions: why does the private sector become so vulnerable to the adverse effects of financial crises, and what policy measures can mitigate this exposure?

Taking the above into consideration, as Chi et al. (2025) state, a central question in open economy macroeconomics is whether, when left to their own devices, countries overborrow. This question has been largely analized in the context of models in which households are subject to a collateral constraint, whereby debt is limited by a fraction of income (the collateral). The central insight is that individually optimal borrowing decisions can collectively result in excessive borrowing at the societal level, especially when financial constraints amplify economic fluctuations. In boom periods, rising collateral values allow agents to borrow more. This additional borrowing, in turn, pushes collateral values even higher, fueling further borrowing and amplifying the expansion in aggregate demand. Conversely, during downturns, the value of collateral declines. When collateral constraints become binding, a financial crisis may ensue: agents are forced to deleverage, often through fire sales of assets, which depresses collateral prices even further—a mechanism known as Fisherian deflation. This triggers additional deleveraging, accelerating the contraction of aggregate demand for goods and services and leading to abrupt current-account reversals, or sudden stops.

The standard workhorse model, originally introduced by Mendoza (2002) and later established as standard by Bianchi (2011), is a representative-agent DSGE framework for a small open economy (SOE) featuring tradable and nontradable goods sectors. The model includes a collateral constraint in which agents can pledge a fraction of their endowments in both sectors as collateral. When making consumption and borrowing decisions, agents take the relative price of nontradable goods as given. While they form rational expectations about the evolution of macroeconomic variables, they fail to internalize the general equilibrium effects of their borrowing on prices. This gives rise to a pecuniary externality, leading to an inefficient allocation relative to the social planner's solution. Consequently, there is scope for welfare-improving policy interventions, such as a Pigouvian tax on external borrowing.

In this class of models, asset markets are incomplete, and agents face limited insurance opportunities against adverse shocks. As a result, when agents have accumulated high levels of debt and an adverse shock occurs, the economy experiences typical features of emerging market crises: a collapse in consumption, a real exchange rate depreciation, and the activation of the Fisherian debt-deflation mechanism, captured in a violent reverse of the current account.

These papers ultimately aim to quantify the inefficiencies that arise in emerging economies and to propose policy tools that can restore efficiency. As previously noted, one such tool is a tax on external borrowing. This approach aligns closely with the macroprudential literature. From a welfare-theoretic perspective, prudential controls on capital flows to emerging markets can be desirable, as they help mitigate the frequency and severity of financial crises by reducing the pecuniary externalities associated with them. As emphasized by Korinek (2011), these controls correct the distorted incentives that lead emerging market agents to take excessive risks. The term prudential underscores the preventive nature of such policies—they are intended to limit the buildup of financial vulnerabilities before a crisis unfolds. For instance, Schmitt-Grohe & Uribe (2017) examine the optimal timing of capital control policy and how it should respond to the business cycle.

From an alternative optimal policy perspective, Benigno et al. (2016) employ the same theoretical framework to show that if ex-post interventions—such as defending the real exchange rate (RER)—are effective in containing or resolving financial crises, then ex-ante measures like capital controls may not be necessary. Their findings suggest that when financial stability is the sole objective of policy intervention, the optimal strategy focuses on supporting the value of collateral, thereby sustaining agents' borrowing capacity during crisis periods. One example of such RER-supporting policies is the use of consumption taxes or subsidies.

Chi et al. (2025) adopt a different approach by introducing a banking intermediation channel into the standard open-economy model with collateral constraints. In their framework, foreign lending is intermediated by domestic banks rather than directly accessed by households. This modification alters the core prediction of the overborrowing literature: the unregulated economy underborrows relative to the social optimum. The mechanism arises because, during contractions, optimal remuneration of bank reserves allows the government to act as a lender of last resort, sustaining external borrowing and mitigating liquidity shortages.

Main idea and Empirical evidence

One channel that has received relatively little attention in the literature is the role of public consumption in influencing the value of collateral and, consequently, its potential to amplify financial frictions. Most models introduce the government primarily as a policy instrument—for example, to impose a Pigouvian tax that corrects the inefficiency generated by pecuniary externalities. However, a natural question arises: what if the government itself contributes to the amplification of these inefficiencies?

As it is widely accepted in the literature, public consumption is typically biased toward nontradable goods (e.g., services). When the government increases its spending—particularly in booms—this raises demand for nontradables, which in turn drives up their relative price (Froot & Rogoff (1995)). As a result, the value of collateral, which often includes nontradable endowments, also increases. This dynamic effectively leads to a real exchange rate appreciation. Higher collateral values expand agents' borrowing capacity, encouraging further debt accumulation. Interestingly, instead of mitigating financial vulnerabilities, public consumption may exacerbate them by fueling the same mechanism that underlies overborrowing and amplifying the boom-bust cycle. This suggests that fiscal policy, depending on its composition, may play a dual role: it can be both a potential solution and a source of inefficiency in financially constrained economies.

In Figure 1 we can observe empirical evidence in line with this issue. We use data for 31 countries from the International Debt Statistics collected by the World Bank[1] to obtain an empirical measure of external private debt as share of GDP. Also, data from the World Development Indicators collected by the World Bank is used to characterize public consumption as share of GDP.

Both series cover data for the 1960–2024 period. As an empirical criterion, only countries with at least 30 annual observations were considered. In addition, outliers with a private external debt-to-output ratio below 4% or above 50% were excluded. Based on this sample, a positive relationship emerges between public consumption (as share of GDP) and private external debt (as share of GDP), with a correlation of 0.60.

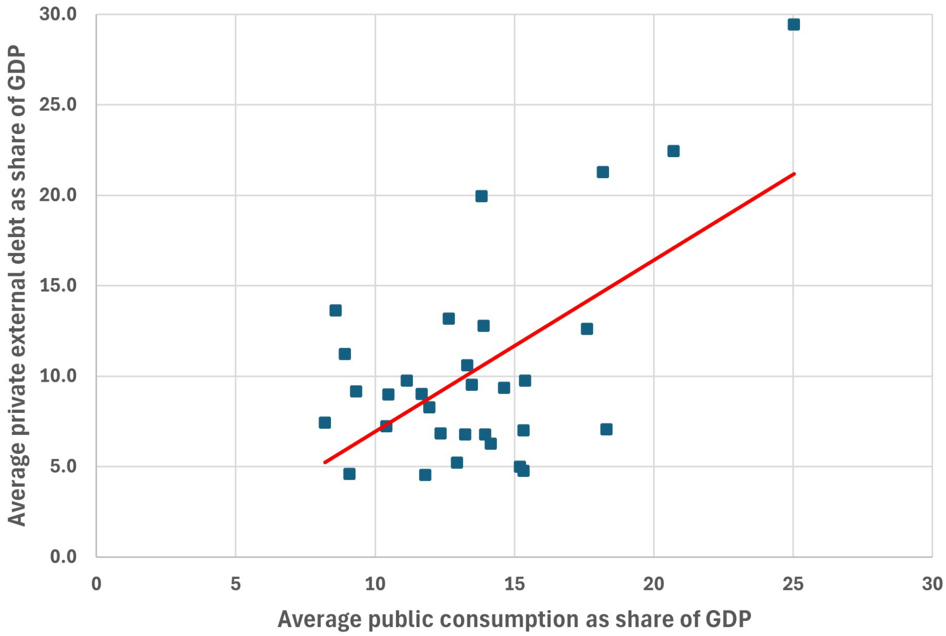

Figure 1: Public Consumption and Private External Debt

The remainder of the paper is organized as follows. Section 2 develops the analytical framework by presenting the competitive equilibrium and contrasting it with the constrained-efficient allocation that emerges under Ramsey-optimal capital controls. Section 3 describes the calibration strategy, applying the model to Argentine data. Section 4 reports the quantitative results, highlighting the role of public consumption in amplifying overborrowing dynamics. It also studies the behavior of the economy around financial crises for both the unregulated economy and the Ramsey-economy. Finally, Section 5 summarizes the main findings and discusses their implications for the design of macroprudential and fiscal policy in emerging market economies with financial constraints.

[1] More precisely, the data describes non-publicly guaranteed external debt. This is, indeed, an advantage, since some countries have large publicly owned companies that issue debt internationally. The list of countries in the chart is composed of the following: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, El Salvador, Ghana, Guatemala, Honduras, Indonesia, Jamaica, Kenya, Mauritius, Mexico, Moldova, Niger, North Macedonia, Papua New Guinea, Paraguay, Peru, Philippines, Senegal, South Africa, Thailand, Turkiye, Ukraine, Uzbekistan, Zimbabwe.

2 The Model

2.1 Analytical Framework

The analytical framework follows the standard Bianchi (2011) model in the literature, also drawing on the approach proposed by Schmitt-Grohe & Uribe (2017).
Consider a representative-agent model in an small-open economy, with an infinite horizon.
The economy is populated by a large number of identical households exhibiting the following utility function

$$U = \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\} \tag{1}$$

where c_t denotes consumption in period t, $u(\cdot)$ denotes an increasing and concave period utility function, and $\beta \in (0,1)$ denotes the subjective discount factor. The period utility function takes the CRRA form

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma}$$

with $\sigma > 0$. Consumption is assumed to be a composite of tradable and nontradable goods, taking the following CES form

$$c_t = A(c_t^T, c_t^N) \equiv \left[a(c_t^T)^{1-1/\xi} + (1-a)(c_t^N)^{1-1/\xi} \right]^{\frac{1}{1-1/\xi}} \tag{2}$$

with $\xi > 0$, $a \in (0,1)$, and where c_t^T denotes consumption of tradables in period t and c_t^N denotes consumption of nontradables in period t.

Households are assumed to have access to a one-period internationally-traded bond denominated in terms of tradable goods, which pays the interest rate $r_t > 0$ in period t. As it is standard in this literature, it is assumed that $\beta(1+r_t) < 1$ (impatient agents). From now on, we will assume a constant international interest rate: $r_t = r \ \forall t$. The household's sequential budget constraint is given by

$$c_t^T + p_t c_t^N + d_t = y_t^T + p_t y_t^N + q d_{t+1} - T_t \tag{3}$$

where p_t denotes the relative price of nontradables in terms of tradables, d_t denotes the amount of debt assumed in period $t-1$ (and due in period t) and $q = (1+r)^{-1}$ denotes the discount price of issued debt. We will consider only positive values for output, such as $y_t^T > 0$ and $y_t^N > 0$ which denote the endowments of tradables and nontradables in period t, respectively.
Access to international financial markets is not only incomplete but also imperfect in the sense that, by assumption, the amount that each household can borrow is limited by a fraction of the current income. In particular, the collateral constraint is written as

$$d_{t+1} \leq \kappa \left(y_t^T + p_t y_t^N \right) \tag{4}$$

where $\kappa > 0$ is the borrowing parameter. The pecuniary externality arises because of the presence of the relative price of nontradables, p_t, on the RHS of the collateral constraint (4). Each individual household takes p_t as exogenously determined, even though, collectively, the absorption of goods by households is a determinant of the relative price.
At the empirical level, Bianchi (2011) suggests that a specification in terms of current income is consistent with evidence on the determinants of access to credit markets, on lending criteria and guideliness used in mortgage and consumer financing (e.g., Jappelli & Pagano (1989)). Moreover, the assumption that nontradable goods can be pledged as collateral is consistent with the evidence reported by Ranciere et al. (2005) on the use of international credit to finance booms in the nontradable sector.

Households are also subject to the standard no-Ponzi-games constraint:

$$\lim_{t\to\infty} (1+r)^{-t} d_t \leq 0 \tag{5}$$

In addition, households pay lump-sum taxes T_t which are used to finance public consumption, allocated to nontradable goods. The government exhibits a balanced budget every period:

$$p_t g_t^N = T_t \tag{6}$$

Public consumption will follow a first-order Markov process, and taxes are endogenously adjusted to satisfy the government's budget constraint (6).

2.2 Optimality Conditions

Households choose sequences $\{c_t, c_t^T, c_t^N, d_{t+1}\}$ to maximize equation (1) subject to (2) - (5), taking as given the path of relative nontradable price, endowments and public consumption. The first-order conditions of this problem are (2) - (4) coupled with

$$u'(A(c_t^T, c_t^N))\ A_1(c_t^T, c_t^N) = \lambda_t \tag{7}$$

$$(q - \mu_t)\,\lambda_t = \beta\ \mathbb{E}_t \lambda_{t+1} \tag{8}$$

$$p_t = \frac{1-a}{a}\left(\frac{c_t^T}{c_t^N}\right)^{1/\xi} \tag{9}$$

$$\mu_t \geq 0 \tag{10}$$

$$\mu_t\left[\kappa(y_t^T + p_t y_t^N) - d_{t+1}\right] = 0 \tag{11}$$

and the transversality condition

$$\lim_{t\to\infty} \frac{d_t}{(1+r)^t} = 0 \tag{12}$$

where $\beta^t \lambda_t$ and $\beta^t \lambda_t \mu_t$ denote the Lagrange multipliers of the sequential budget constraint (3) and the collateral constraint (4), respectively.

From now on, we will assume a deterministic constant nontradable output, such that $y_t^N = y^N\ \forall t$. On the other hand, tradable output y_t^T will follow a first-order Markov process. Further details will be provided in the calibration subsection.

2.3 Equilibrium Definition

Definition 1 (Competitive Equilibrium) *Given a sequence of exogenous processes for tradable output and public consumption* $\{y_t^T, g_t^N\}_{t=0}^{\infty}$ *and a initial debt level* d_0*, a competitive equilibrium for this economy consists of a set of allocations and prices* $\{c_t, c_t^T, c_t^N, d_{t+1}, \lambda_t, \mu_t, p_t\}$ *such that*

#1 Allocations solve the household's problem, given prices

#2 The market for nontradable goods clears

$$c_t^N + g_t^N = y^N \tag{13}$$

Combining the market clearing condition for nontradables goods (13) with (3) and (6), we get that

$$c_t^T + d_t = y_t^T + q d_{t+1} \tag{14}$$

which allows us to determine the evolution of the current account of the economy.
Using our CRRA-form utility, equation (7) is explicitly given by

$$a\ (c_t)^{(1/\xi)-\sigma}\ (c_t^T)^{-1/\xi} = \lambda_t \tag{7'}$$

And take into account that, after using (13), equation (9) is now described by

$$p_t = \frac{1-a}{a}\left(\frac{c_t^T}{y^N - g_t^N}\right)^{1/\xi} \tag{9'}$$

From equation (9'), we observe that an increase in government's expenditure raises the relative price of nontradable goods (real appreciation) by expanding their demand. In this small open economy, when the collateral constraint is not binding, fluctuations in p_t have no effect on the allocation of tradable consumption or the level of external debt. In such cases, the Euler equation (8), combined with equation (7') and the aggregate resource constraint (14), jointly determine the path of borrowing and tradable consumption.

In contrast, when the collateral constraint is binding, variations in p_t directly influence the household's borrowing capacity and, consequently, their consumption of tradables. Since the value of collateral depends on the relative price of nontradables, which is in turn affected by government's expenditure, public consumption shifts the effective threshold at which the constraint becomes binding. Therefore, even when the constraint binds with equality, an increase in public expenditure leads to a real appreciation, thereby relaxing the collateral constraint and allowing for additional borrowing.

Moreover, the government influences the marginal utility of borrowing even when the collateral constraint is not binding, except in the particular case where the intra- and intertemporal elasticities of substitution are equal. This fact can be observed in equation (7'). When the intratemporal elasticity exceeds the intertemporal one ($\xi > \frac{1}{\sigma}$), an increase in public consumption raises the marginal utility of borrowing, because c_t is decreasing in g_t^N. Holding other factors constant, a temporary fiscal expansion therefore encourages additional external borrowing.

The discussion concerning the value of ξ is of great importance. As noted by Mendoza (2005), empirical studies for developing countries typically find that the elasticity of substitution between tradable and non-tradable goods is less than unity, ranging between 0.4 and 0.83. Following this evidence, Bianchi (2011) sets $\xi = 0.83$ as a conservative benchmark. This parameter governs the sensitivity of the real exchange rate to shocks in, for example, public consumption. Specifically, a smaller value of ξ implies that tradables and non-tradables are poor substitutes, so a given increase in public consumption of non-tradables (g_t^N) leads to a sharper rise in their relative price (p_t). For instance, it is easy to measure this sensitivity by calculating $\frac{\partial \ln p_t}{\partial \ln g_t^N} = \frac{1}{\xi}\frac{g_t^N}{y^N - g_t^N} \geq 0$, which is interpreted as the percentage change in the relative price of non-tradables in response to a 1% increase in public consumption (for a given c_t^T). The adjustment to such a shock therefore occurs mostly through *prices* rather than quantities, amplifying real appreciation and strengthening the collateral channel when borrowing constraints depend on $p_t y_t^N$. Conversely, when ξ is larger—indicating greater substitutability between tradables and non-tradables—agents can more easily shift consumption across goods, so equilibrium requires only a mild increase in p_t. In this case, the real exchange rate responds less to fiscal shocks, and the associated collateral effects are considerably weaker.

A theoretical interesting benchmark arises when $\xi = 1$, corresponding to a Cobb–Douglas aggregator. In this case, the effects of substitution and income exactly offset each other: the expenditure shares on tradable and non-tradable goods remain constant, and changes in public consumption of non-tradables do not alter the intratemporal allocation beyond a proportional adjustment. As a result, the real exchange rate would move moderately, lying between the extremes of the high- and low-elasticity cases.

Equilibrium Characterization

The equilibrium for this economy is a set of processes $\{c_t, c_t^T, d_{t+1}, \mu_t\}$ satisfying

$$c_t = \left[a(c_t^T)^{1-1/\xi} + (1-a)(y^N - g_t^N)^{1-1/\xi}\right]^{\frac{1}{1-1/\xi}} \tag{EQ.1}$$

$$(q - \mu_t)\,(c_t)^{(1/\xi)-\sigma}\,(c_t^T)^{-1/\xi} = \beta\,\mathbb{E}_t\,(c_{t+1})^{(1/\xi)-\sigma}\,(c_{t+1}^T)^{-1/\xi} \tag{EQ.2}$$

$$c_t^T + d_t = y_t^T + q d_{t+1} \tag{EQ.3}$$

$$d_{t+1} \leq \kappa\left[y_t^T + \frac{1-a}{a}\left(\frac{c_t^T}{y^N - g_t^N}\right)^{1/\xi} y^N\right] \tag{EQ.4}$$

$$\mu_t \geq 0 \tag{EQ.5}$$

$$\mu_t\left\{\kappa\left[y_t^T + \frac{1-a}{a}\left(\frac{c_t^T}{y^N - g_t^N}\right)^{1/\xi} y^N\right] - d_{t+1}\right\} = 0 \tag{EQ.6}$$

given the values of $\{r, y^N\}$, exogenous driving forces $\{y_t^T, g_t^N\}$ and a initial condition d_0.

The fact that c_t^T appears on the RHS of (EQ.4) means that during contractions in which the aggregate absorption of tradable falls, the collateral constraint endogenously tightens. Individual agentes fail to internalize that such movements in aggregate absorption are in part cause by their own expenditure choices. This is the nature of the pecuniary externality in this model.

2.4 Constrained Efficiency

As emphasized by Bianchi (2011), the presence of the relative price of nontradable goods in the collateral constraint gives rise to a pecuniary externality that renders the resulting allocation generally suboptimal. This suboptimality arises not only when compared to an allocation without a collateral constraint, but also relative to the best feasible allocation within the set that satisfies the constraint. Consequently, the existence of the collateral constraint justifies the potential for welfare-enhancing policy intervention.
In line with the existing literature, we explore optimal capital control policies. In this framework, a capital control takes the form of a tax on external borrowing—the variable most directly influenced by the pecuniary externality. The optimal policy effectively internalizes this externality, leading the representative household to act as though it recognizes that its borrowing decisions affect the relative price of nontradables and, in turn, the value of collateral.

Following the approach proposed by Schmitt-Grohé & Uribe (2017), we will assume that the government is benevolent in the sense that it seeks to maximize the well-being of the representative household. It is implicitly that the government has the ability to commit to policy promises. That is, it will be characterized the Ramsey-optimal capital control policy.
To this end, let τ_t be a proportional tax on debt acquired in period t. If $\tau_t > 0$, it represents a proper capital control tax, whereas if it is negative it has the interpretation of a borrowing subsidy. The revenue from capital control taxes is given by $(\tau_t \, qd_{t+1})$, such that we leave out now the lump-sum taxation structure used before. To close the government budget constraint, we will consider a term given by ℓ_t, where it represents lump-sum transfers (lump-sum taxes if $\tau_t < 0$) given to the household. This term will endogenously adjust each period.

$$\tau_t \, qd_{t+1} = p_t g_t^N + \ell_t \tag{15}$$

The new household's sequential budget constraint becomes

$$c_t^T + p_t c_t^N + d_t = y_t^T + p_t y_t^N + (1 - \tau_t) \, qd_{t+1} + \ell_t \tag{16}$$

Note that the gross interest rate on foreign borrowing perceived by the private households is no longer $1 + r$, but $\frac{1+r}{1-\tau_t}$ instead. Then, all other thing equal, the higher is τ_t, the higher is the effective interest rate. Changes in τ_t can encourage or discourage borrowing. The Euler Equation previously given by (8) now becomes

$$[q(1 - \tau_t) - \mu_t] \, \lambda_t = \beta \, \mathbb{E}_t \, \lambda_{t+1}$$

such that a higher τ_t implies a lower marginal utility of borrowing.

In this new context, a competitive equilibrium in the economy with capital control taxes is then a set of processes $\{c_t^T, d_{t+1}, \lambda_t, \mu_t, p_t\}$ satisfying the following system of equations

$$u'(A(c_t^T, y^N - g_t^N)) \; A_1(c_t^T, y^N - g_t^N) = \lambda_t \tag{17}$$

$$[q(1 - \tau_t) - \mu_t] \, \lambda_t = \beta \, \mathbb{E}_t \, \lambda_{t+1} \tag{18}$$

$$p_t = \frac{A_2(c_t^T, y^N - g_t^N)}{A_1(c_t^T, y^N - g_t^N)} \tag{19}$$

$$c_t^T + d_t = y_t^T + qd_{t+1} \tag{20}$$

$$d_{t+1} \leq \kappa(y_t^T + p_t y^N) \tag{21}$$

$$\mu_t \geq 0 \tag{22}$$

$$\mu_t \left[\kappa(y_t^T + p_t y^N) - d_{t+1}\right] = 0 \tag{23}$$

given a policy process τ_t, the values of $\{r, y^N\}$, exogenous driving forces $\{y_t^T, g_t^N\}$ and a initial condition d_0. Recall, also, that the composite consumption basket is given by $c_t = A(c_t^T, y^N - g_t^N)$, such that the market for nontradable goods is already cleared.

Definition 2 (Ramsey-Optimal Competitive Equilibrium) *The Ramsey-Optimal Competitive Equilibrium for this economy is a set of processes $\{\tau_t, c_t^T, d_{t+1}, \lambda_t, \mu_t, p_t\}$ that maximizes*

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(A(c_t^T, y^N - g_t^N)) \tag{24}$$

subject to (17) - (23), given the values of $\{r, y^N\}$, exogenous driving forces $\{y_t^T, g_t^N\}$ and initial condition d_0.

In the welfare function (24) it was replaced the consumption of nontradable goods with the ex-post public consumption endowment of nontradable goods, because the Ramsey planner takes into account than in a competitive equilibrium this market clears at all times.
The above equilibrium conditions look like a formidable set of constraints. Fortunately, it is possible to reduce the set of constraints considerably, as Schmitt-Grohé & Uribe (2017) showed.

Proposition 1 (Constrained Efficient Allocation) *Any processes $\{c_t^T, d_{t+1}\}$ maximizing (24) satisfy equilibrium conditions (17) - (23) if and only if they satisfy (20) and*

$$d_{t+1} \leq \kappa \left[y_t^T + \frac{1-a}{a} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi} y^N \right] \tag{25}$$

given the values of $\{r, y^N\}$, exogenous driving forces $\{y_t^T, g_t^N\}$ and a initial condition d_0.

Proof 1 (Constrained Efficient Allocation) *We will show the equivalence between the Ramsey-optimal competitive equilibrium (ROCE) described before and the Constrained efficient allocation (CEA) proposed.*

- *ROCE $\Longrightarrow$ CEA*
  Suppose that c_t^T and d_{t+1} satisfy (17) - (23). We must establish that (20) and (25) are also satisfied. Obviously, (20) holds by design. Combining (19) with (21) yields (25).
- *ROCE $\Longleftarrow$ CEA*
  Suppose that c_t^T and d_{t+1} satisfy (20) and (25). We must establish that (17) - (23) are also satisfied. The resource constraints (20) holds by design.
  Then, pick p_t in order to satisfy (19). Note that this is possible because c_t^T is given. Now, we can eliminate p_t from (21). The resulting expression is (25), establishing that (21) holds.
  Next, pick λ_t in order to satisfy (17). Again, this is possible because c_t^T is given.
  Now, WLOG, we can set $\mu_t = 0$ for all t. It follows immediately that the nonnegativity condition (22) and the slackness condition (23) are satisfied.
  Finally, pick τ_t to ensure that (18) holds. That is,

$$\tau_t = 1 - \beta(1+r)\ \mathbb{E}_t \frac{u'(A(c_{t+1}^T, y^N - g_{t+1}^N))\ A_1(c_{t+1}^T, y^N - g_{t+1}^N)}{u'(A(c_t^T, y^N - g_t^N))\ A_1(c_t^T, y^N - g_t^N)} \tag{26}$$

A clarification is warranted regarding why the Lagrange multiplier μ_t can be set to zero at all times in the preceding proof, as Schmitt-Grohé & Uribe (2017) explains. The fact that μ_t can be chosen to be zero throughout does not imply that the collateral constraint never binds in equilibrium. Rather, it indicates that the policymaker can implement a capital control policy such that, even when the collateral constraint is binding, individual agents behave as if their debt choices would be the same regardless of the presence of the constraint. In other words, although the collateral constraint is binding, households—given the taxes they face—do not perceive it as restrictive.
It is important to note that the Lagrange multiplier μ_t need not always be zero. Specifically, one could adopt a tax policy under which the private sector's Lagrange multiplier μ_t is strictly positive in the states where the collateral constraint binds. In this sense, both μ_t and τ_t are indeterminate in equilibrium states where the collateral constraint is active. The proof of this result is straightforward: if the collateral constraint binds,

then the slackness condition (23) holds regardless of the value of μ_t. Moreover, since the Euler equation (18) includes both τ_t and μ_t, any pair of values that satisfies the equation and the non-negativity condition $\mu_t \geq 0$, given the process λ_t, constitutes a valid solution. None of the other equilibrium conditions in the system (17)–(23) involve either μ_t or τ_t, thereby establishing that these variables are indeterminate in the states where the collateral constraint binds.

Taking all into consideration, the Ramsey problem is stated as

$$\max_{\{c_t^T>0,\ d_{t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(A(c_t^T, y^N - g_t^N)) \quad \text{s.t.} \tag{24}$$

$$c_t^T + d_t = y_t^T + q d_{t+1} \tag{20}$$

$$d_{t+1} \leq \kappa \left[y_t^T + \frac{1-a}{a} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi} y^N \right] \tag{25}$$

A discussion of several key issues regarding the formulated Ramsey problem is in order.

#1 The Ramsey problem is time consistent. The reason for this fact is that in any given period t, the constraints (20) and (25) involve only variables that are either predetermined in period t (d_t), exogenous (y_t^T, g_t^N), or chosen in period t (c_t^T, d_{t+1}), but they do not involve endogenous variables that will be determined in future periods.

#2 The constraints of the Ramsey planner's problem may not be a convex set. That is, if two pairs (c_t^T, d_{t+1}) satisfy both constraints given d_t, then a linear combination of these two pairs may not. This is because the RHS of (25) is convex in c_t^T for $\xi < 1$. Nonetheless, generically, the Ramsey allocation is unique because it is the outcome of a maximization problem.

#3 The Ramsey planner internalizes the pecuniary externality. He understands that individual consumption of tradables affects the relative price of nontradables, and therefore also the value of collateral. This is evident from the fact that c_t^T appears on the RHS of (25). Therefore, endowing the Ramsey planner with a single distorting policy instrument (in this case, τ_t), allows him to induce agents to fully internalize the pecuniary externality.

Given the Ramsey allocation $\{c_t^T, d_{t+1}\}$, it is possible to obtain the relative price of nontradables in the associated competitive equilibrium $\{p_t\}$ from (19) and the private marginal utility of wealth $\{\lambda_t\}$ from (17). If the collateral constraint is binding, then τ_t is indeterminate. Because the household's Lagrange multiplier on the collateral constraint must be nonnegative ($\mu_t \geq 0$), equation (18) implies that τ_t is bounded above by the RHS of (26), such that $\tau_t < 1$.

In states in which the collateral constrain is slack under the Ramsey allocation, the Ramsey-optimal capital control tax τ_t is given by (26). Alternatively, one can express the optimal capital control tax in terms of the Ramsey planner's Lagrange multipliers on the resource and collateral constraints, respectively. To see this, we will characterize the first-order conditions of the Ramsey problem.

$$u'(A(c_t^T, y^N - g_t^N))\ A_1(c_t^T, y^N - g_t^N) + \lambda_t^R \mu_t^R \kappa\ \frac{1-a}{a}\frac{1}{\xi} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi - 1} = \lambda_t^R \tag{RP.1}$$

$$q\lambda_t^R = \beta \mathbb{E}_t \lambda_{t+1}^R + \lambda_t^R \mu_t^R \tag{RP.2}$$

$$\kappa \left[y_t^T + \frac{1-a}{a} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi} y^N \right] - d_{t+1} \geq 0 \tag{RP.3}$$

$$\mu_t^R \geq 0 \tag{RP.4}$$

$$\mu_t^R \left\{ \kappa \left[y_t^T + \frac{1-a}{a} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi} y^N \right] - d_{t+1} \right\} = 0 \tag{RP.5}$$

$$c_t^T + d_t = y_t^T + q d_{t+1} \tag{RP.6}$$

where λ_t^R denotes the Lagrange multiplier on the resource constraint, and $\lambda_t^R \mu_t^R$ denotes the Lagrange multiplier on the collateral constraint. Combining (17) and (RP.1) one obtains

$$\lambda_t + \lambda_t^R \mu_t^R \kappa \, \frac{1-a}{a} \frac{1}{\xi} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi - 1} = \lambda_t^R \tag{27}$$

which says that the marginal utility of income of the Ramsey planner (λ_t^R) is the same as the marginal utility of income of the private household (λ_t), evaluated at the Ramsey allocation, in states in which the collateral constraint under the Ramsey policy is slack ($\mu_t^R = 0$), and exceeds λ_t in states in which the collateral constraint is binding under the Ramsey policy ($\mu_t^R > 0$). Then, we have shown that $0 < \lambda_t \leq \lambda_t^R$.
Suppose that in period t the collateral constraint is slack under the Ramsey plan. Then, by (RP.5) it must be the case that $\mu_t^R = 0$. Hence, $\lambda_t = \lambda_t^R$. Using (19) to replace p_t in (21), we have that (21) also holds with strict inequality. Therefore, (23) is only satisfied if $\mu_t = 0$. Using these elements, we can reexpress (RP.2) and (18) as

$$q\lambda_t = \beta \; \mathbb{E}_t \lambda_{t+1}^R$$

and

$$(1 - \tau_t) q \lambda_t = \beta \; \mathbb{E}_t \lambda_{t+1}$$

respectively. Dividing the first expression by the second one,

$$\frac{1}{1 - \tau_t} = \frac{\mathbb{E}_t \lambda_{t+1}^R}{\mathbb{E}_t \lambda_{t+1}} \tag{28}$$

such that $\frac{1}{1-\tau_t} \geq 1 \Longrightarrow \tau_t \geq 0$, as we have already shown that $0 < \lambda_t \leq \lambda_t^R \; \forall t$.
Let Ψ_t be the partial derivative of the value of collateral with respect to tradable consumption in period t

$$\Psi_t \equiv \frac{1-a}{a} \frac{1}{\xi} \left(\frac{c_t^T}{y^N - g_t^N} \right)^{1/\xi - 1} > 0 \tag{29}$$

Finally, use (27) to replace λ_{t+1} in (28) together with the definition of Ψ_t in (29) such that

$$\frac{1}{1 - \tau_t} = \frac{\mathbb{E}_t \; \lambda_{t+1}^R}{\mathbb{E}_t \; \lambda_{t+1}^R (1 - \mu_{t+1}^R \; \Psi_{t+1})} \tag{30}$$

From (30) we can observe that when the collateral constraint is slack in the current state and in all immediate successor states to the current state (that is, when $\mu_{t+1}^R = 0$), the optimal capital control tax in the current state is zero: $\tau_t = 0$. That is, the optimal policy requires no intervention.

Secondly, the fact that $\tau_t \geq 0$ proves that the pecuniary externality induced by the collateral constraint calls for positive capital control taxes on average, as long as the collateral constraint is binding in some states in the ergodic distribution of the Ramsey-optimal allocation. This leads Schmitt-Grohé & Uribe (2017) to argue that optimal capital controls are essentially *macroprudential*.

Third, if taxes are bounded below by zero and positive on average, the interest rate perceived by households in the economy with optimal capital control taxes is greater or equal than the interest rate faced by households in the unregulated economy. Thus, debt is expected to be lower under the Ramsey economy compared to the unregulated setting, where the latter exhibits what is commonly referred to as *overborrowing*.

Finally, consider the effect of a temporary increase in public consumption. As it was previously discussed, when the collateral constraint remains slack, the optimal policy requires no intervention, as the shadow value of collateral does not modify incentives in terms of borrowing. Nevertheless, if the collateral constraint is binding, a public consumption shock relaxes the borrowing condition. As a result, the gap between the marginal utility of income of the Ramsey planner and the corresponding to the private household (evaluated at the Ramsey allocation) expands, increasing the inefficiency of the economy.

3 Quantitative Exploration

This section presents the model calibration and provides a quantitative analysis of both the unregulated economy (competitive equilibrium) and the Ramsey economy (the one with capital control taxes).

3.1 Calibration

As discussed earlier, the exogenous driving forces of the model are the tradable output and public consumption. The empirical measure for tradable output is the sum of Argentina's real GDP in agriculture, fishing, mining, and manufacturing, while public consumption is measured using Argentina's national accounts data (NEA). Both series are obtained from INDEC (National Institute of Statistics and Census, Argentina) and are expressed in real terms. Each series was detrended using the Hodrick–Prescott filter with a smoothing parameter $\lambda = 100$, appropriate for annual data covering the period 1993–2024.

The following table reports unconditional moments for these driving processes:

Statistic	y^T	g^N
Std. Dev.	5.4%	3.9%
Serial Corr.	0.4	0.7
Corr(y^T, g^N)	0.6	

Table 1: Tradable output and Public consumption (Argentina, 1993-2024)

The cyclical component of tradable output exhibits higher volatility than public consumption, with standard deviations of 5.4% and 3.9%, respectively. Public consumption is also more persistent, showing a first-order autocorrelation of 0.7 compared to 0.4 for tradable output. Finally, the correlation between both series is positive and relatively strong (0.6), indicating that periods of expansion in tradable output tend to coincide with higher levels of public spending.

Given these empirical properties, the model is calibrated at an annual frequency, where the time unit corresponds to one year. Both the tradable output and public consumption are treated as exogenous stochastic processes that represent the main sources of aggregate fluctuations in the economy. The natural logarithms of these variables are assumed to follow a bivariate first-order autoregressive process, which allows for both own and cross-dynamics between the two series, capturing the observed co-movement between tradable output and public consumption in the data.

Formally, the estimated law of motion is given by

$$\begin{bmatrix} \ln y_t^T \\ \ln g_t^N \end{bmatrix} = \begin{bmatrix} 0.5 & -0.2 \\ 0.3 & 0.5 \end{bmatrix} \begin{bmatrix} \ln y_{t-1}^T \\ \ln g_{t-1}^N \end{bmatrix} + \epsilon_t,$$

where ϵ_t represents the vector of innovations. The shocks are assumed to be independently and identically distributed with zero mean and the following variance–covariance matrix:

$$\epsilon_t \sim N\left(\mathbf{0}, \begin{bmatrix} 0.0024 & 0.0008 \\ 0.0008 & 0.0007 \end{bmatrix}\right).$$

This estimated process captures two key empirical regularities: first, the persistence of both series, as reflected in the relatively large diagonal coefficients; and second, the positive contemporaneous correlation between tradable output and public consumption shocks, as implied by the off-diagonal covariance terms. These features are consistent with the stylized fact that expansions in the tradable sector tend to be accompanied by increases in public expenditure, thereby amplifying aggregate fluctuations.

Figure 2 displays the cyclical components of tradable output and public consumption for Argentina over the period 1993–2024. Both series exhibit a clear procyclical pattern, moving broadly in tandem with aggregate fluctuations. However, public consumption appears notably smoother and more persistent than tradable output, suggesting that this component of fiscal expenditure reacts to the business cycle with lower volatility and stronger inertia. This behavior is consistent with the empirical evidence summarized in the previous table, where public consumption shows a smaller standard deviation and a higher first-order autocorrelation than tradable output.

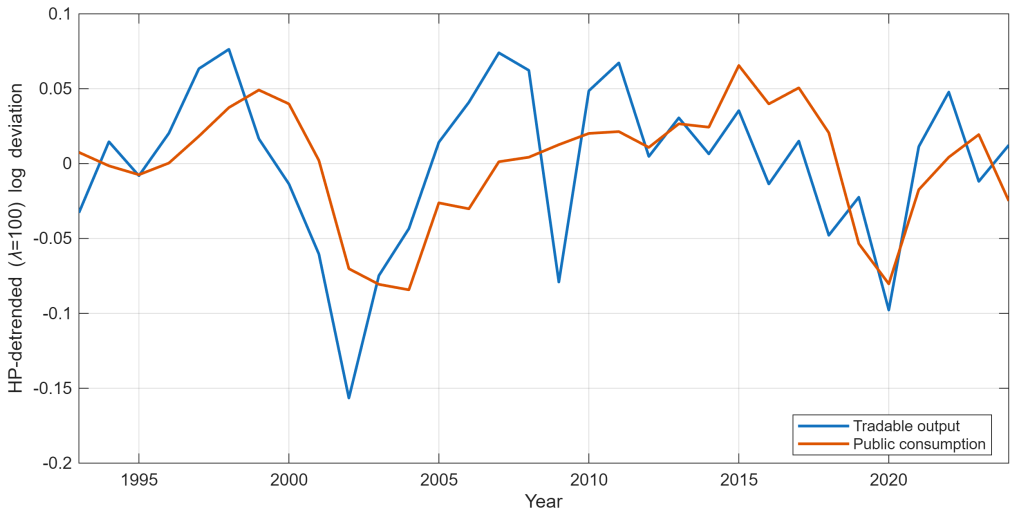

Figure 2: Cyclical components of tradable output and public consumption (Argentina, 1993-2024)

To solve the model numerically, the stochastic processes for tradable output and public consumption are discretized into a finite Markov chain. The logarithm of tradable output, $\ln(y^T)$, is represented by six evenly spaced grid points ranging from -0.17 to 0.17, while the logarithm of public consumption, $\ln(g^N)$, is approximated by eight grid points between -2.17 and -1.92, whose average level corresponds to a mean of $g^N = 0.13$. This configuration yields $6 \times 8 = 48$ possible combinations (y^T, g^N) in the exogenous state space.

The transition probability matrix (TPM) associated with these processes is obtained using the simulation-based approach proposed by Schmitt-Grohe & Uribe (2009). This method consists in simulating a long time series of one million observations from the estimated bivariate AR(1) system and assigning each simulated pair to its closest discrete state by minimizing the Euclidean distance. One of the advantages of this method is that it does not impose normality on the innovation of the VAR process. States that are never visited in the simulation are discarded, resulting in a total of 44 states with strictly positive probability.

The endogenous state space for debt, represented by $(d_t/(1+r))$, is defined over a uniform grid of 800 points ranging from 0.4 to 1.02, following the calibration strategy of Bianchi (2011). Combining the exogenous and endogenous dimensions yields a total grid of $44 \times 800 = 35{,}200$ points, which is used in the computation of the recursive equilibrium allocations.

Parameter	Value	Description
κ	$0.32(1+r)$	Parameter of collateral constraint
σ	2	Inverse of intertemporal elasticity of consumption
β	0.91	Subjective discount factor
r	0.04	Interest rate (annual)
ξ	0.83	Elasticity of substitution between tradable and nontradable goods
a	0.31	Weight on tradables in CES aggregator
y^N	1	Nontradable output
y^T	1	Steady-state tradable output

Table 2: Calibration

The rest of the calibration (Table 2) is also taken from Bianchi (2011), which is the same that Schmitt-Grohe & Uribe (2017) employ in the case of the economy with endowment shocks.

3.2 Quantitative Results

Following Schmitt-Grohe & Uribe (2017), the unregulated economy was numerically solved iterating over the Euler Equation, whereas the Ramsey equilibrium was solved by value function iteration.

3.2.1 Additional Overborrowing

The first crucial result concerns the degree of overborrowing displayed by the Unregulated Economy relative to the Ramsey Economy. The following table summarizes the main differences between this paper and the benchmark results in Bianchi (2011) and Schmitt-Grohe & Uribe (2017).

	BIANCHI 2011	SGU 2017	THIS PAPER
Exogenous state space	(y^T, y^N)	(y^T, r)	(y^T, g^N)
Exogenous grid points	4×4	21×11	6×8
Endogenous grid points	800	800	800
Debt-to-output ratio (Unregulated economy)	29.2	29.3	27.6
Debt-to-output ratio (Ramsey economy)	28.6	28.3	26.2
Overborrowing	0.6 pp	1 pp	1.4 pp

Table 3: Additional overborrowing in the model with public consumption

Note: debt-to-output ratio (%) is obtained as the unconditional mean of $\frac{(q_t \; d_{t+1})}{y_t}$

The main difference between this paper and Bianchi (2011) lies in the calibration of the exogenous shocks and their propagation mechanisms. While the standard model considers shocks to tradable and non-tradable endowments, this model replaces the latter with public consumption, introducing a fiscal channel that affects aggregate non-tradable demand (and its relative price) through public consumption, while keeping the supply side unchanged. Under Bianchi's calibration, the pecuniary externality generated by collateral constraints leads to an overborrowing of 0.6 percentage points of output, as private agents fail to internalize the general-equilibrium effects of their borrowing decisions on the real exchange rate.

The alternative framework in Schmitt-Grohé & Uribe (2017) builds upon Bianchi's setup[2], but expands the exogenous state space to include the world interest rate instead of non-tradable output, leading to a much denser grid with 231 gross exogenous points. Despite these changes, the underlying mechanisms remain similar: collateral constraints generate a pecuniary externality that induces overborrowing. Under this specification, overborrowing rises slightly to 1 percentage point, driven by the more volatile external environment and the endogenous response of the interest rate.

In contrast, the current model exhibits the largest degree of overborrowing (1.4 pp) when public consumption is introduced as the key exogenous driver. The fiscal channel amplifies the inefficiency identified in both previous studies. During booms, pro-cyclical public spending increases the demand for non-tradable goods, appreciates the real exchange rate, and encourages excessive borrowing. During downturns, fiscal retrenchment exacerbates the contraction, triggering asset fire sales and making the economy more vulnerable to sudden stops. Hence, fiscal policy, through its cyclical stance, magnifies the inefficiency associated with private borrowing decisions, leading to quantitatively stronger overborrowing than in both benchmark models.

Figure 3 displays the ergodic distribution of private external debt under the unregulated and Ramsey equilibria. The blue solid line represents the decentralized (unregulated) economy, while the orange dashed line corresponds to the Ramsey allocation. Both distributions are concentrated around their respective steady states, but the unregulated economy shows a clear shift to the right, indicating a higher average level of external debt. The distribution is also more dispersed, reflecting greater volatility in borrowing and a higher frequency of states near the collateral constraint. In contrast, the Ramsey equilibrium exhibits a more concentrated and symmetric distribution, with lower average indebtedness and reduced dispersion,

[2] In Schmitt-Grohé & Uribe (2017), the authors aim to answer whether optimal capital controls should be countercyclical. To this end, they employ the baseline model developed by Bianchi (2011), which they successfully replicate. The same baseline is adopted in this paper, but with a different exogenous state space. Alternatively, they also consider a version of the model with shocks to the world interest rate instead of non-tradable income. The rest of the calibration remains identical, with the discount factor β adjusted to match relative impatience. Within this alternative framework, some quantitative results differ, the most relevant for the present analysis being the level of overborrowing, which falls by about one percentage point.

consistent with the planner's policy that smooths debt dynamics over the cycle. This difference illustrates how prudential capital controls in the Ramsey allocation effectively limit excessive borrowing in good times and mitigate the severity of deleveraging episodes during downturns.

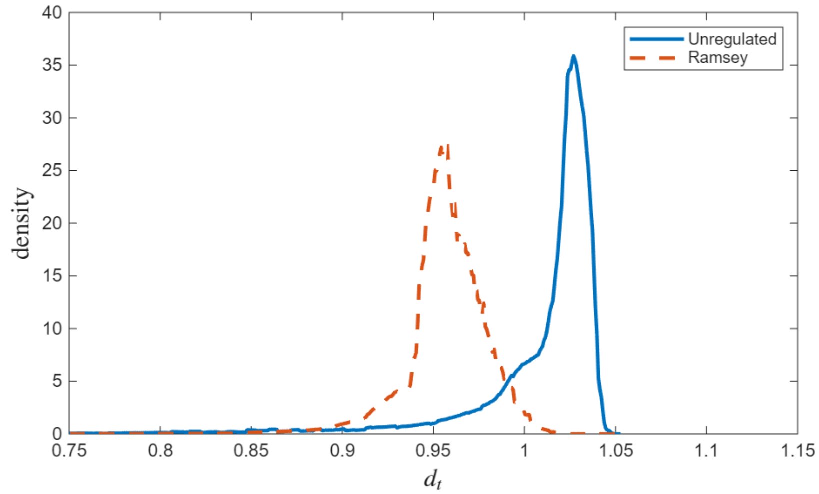

Figure 3: Ergodic Distribution of Debt

3.2.2 Optimal Ramsey Policy

The Ramsey allocation introduces an optimal tax on capital inflows designed to mitigate the inefficiencies arising from collateral constraints. The primary role of this policy is to prevent episodes in which the constraint becomes binding, thereby reducing the frequency and severity of financial crises. Table 4 summarizes the key statistics. In the unregulated economy, crises—defined as periods in which the collateral constraint binds—occur on average every 24 years, representing about 4.1 percent of total simulated periods. Under the Ramsey allocation, however, the frequency of crises drops dramatically: a binding constraint arises only once every 220 years, or roughly 0.5 percent of the total simulations. This sharp reduction highlights the effectiveness of prudential capital controls in stabilizing borrowing dynamics and insulating the economy from sharp deleveraging episodes.

	Unregulated	Ramsey
Frequency of crises	24 years	220 years
Crises as % of total simulations	4.1	0.5

Table 4: Optimal Policy and Financial Crises

The optimal tax policy implied by the Ramsey planner is both quantitatively significant and pro-cyclical. As shown in Table 5, the average tax on capital inflows is around 4.46 percent, with a median value of 2.03 percent. The tax is strongly negatively correlated with output (–0.94), meaning that it increases in recessions and declines during booms. This pattern reflects the planner's precautionary motive: in downturns, when the value of collateral declines and the economy faces a higher risk of hitting the constraint, the planner raises taxes on borrowing to discourage excessive external debt accumulation. Conversely, in good times, lower taxes allow for a smoother intertemporal allocation of consumption without jeopardizing financial stability.

In equilibrium, the Ramsey planner continuously balances two opposing objectives: permitting households to front-load consumption through external borrowing, and avoiding situations in which debt levels amplify downturns through binding collateral constraints. The resulting policy is therefore inherently state-dependent (tightening borrowing conditions in bad times and relaxing them in good times) capturing the essence of prudential capital control design in small open economies with financial frictions.

Optimal capital control taxes	
Mean(τ)	4.46%
Median(τ)	2.03%
Correlation with output	-0.94

Table 5: Optimal Capital Control Taxes

In this framework, the optimal capital control policy takes a pro-cyclical form. The planner increases the tax rate precisely when the economy deteriorates, using it as a stabilizing tool rather than a cyclical amplifier. The intuition is that during recessions, a fall in the value of collateral heightens the probability of a binding borrowing constraint. By tightening external borrowing conditions at that stage, the planner prevents an abrupt deleveraging process and avoids the amplification effects associated with fire sales and Fisherian deflation. Hence, the pro-cyclicality of the optimal tax is a deliberate feature of the prudential design: it acts as insurance against systemic crises rather than as a countercyclical demand-management instrument.

From a broader perspective, the literature does not converge on a single pattern regarding the timing of optimal capital controls. In alternative setups, such as Schmitt-Grohé & Uribe (2017) with stochastic world interest rate shocks, the optimal tax is nearly acyclical, displaying little variation along the business cycle. This theoretical result is consistent with the empirical evidence presented by Fernández et. al. (2015), who find that, across a large sample of countries, capital account policies exhibit no systematic cyclical behavior and are, on average, statistically acyclical. Therefore, while the mechanism emphasized in this paper produces a pro-cyclical optimal response driven by the collateral channel and fiscal shocks, other frameworks with different sources of external risk imply a milder, acyclical pattern that aligns with the empirical record.

3.2.3 Financial Crises

Figure 4 illustrates the average behavior of key macroeconomic variables in a window of eleven periods centered around financial crises (defined as episodes in which the collateral constraint binds). Each line represents the mean across all simulated crisis windows in a time series of one million periods. For the capital control tax rate, the figure reports the median, since its distribution is highly skewed. Under the Ramsey policy, the tax is only defined when the collateral constraint is slack, i.e., outside crisis periods.

Financial crises in this framework reproduce the classic sudden stop pattern documented in the empirical literature. Three stylized facts emerge clearly: a sharp decline in aggregate output, a strong real depreciation, and a violent reversal of the current account. In the unregulated economy, the contraction in tradable output acts as the initial trigger of the crisis. As tradable income falls, agents attempt to borrow to smooth consumption, but this additional borrowing pressure causes the collateral constraint to bind, forcing an abrupt deleveraging process.

Public consumption plays a key amplifying role in this mechanism. Because fiscal spending is modeled as pro-cyclical, government demand rises in good times and falls sharply during downturns. When the economy enters a recession, the contraction in public consumption amplifies the decline in aggregate demand and accelerates the fall in the relative price of non-tradables. This additional compression of domestic demand magnifies the real depreciation and deepens the crisis through fire-sale and Fisherian deflation mechanisms: lower prices of non-tradable goods and collateral assets reduce borrowers' net worth, tightening financial constraints even further.

Consequently, output drops by roughly 24 percent, while the relative price of non-tradables collapses by around 30 percent, signaling a large real depreciation accompanied by fiscal retrenchment. The simultaneous fall in private and public absorption reinforces the negative feedback loop, amplifying both the depth and persistence of the crisis. The forced deleveraging translates into a steep decline in tradable consumption—around 25 percent on impact—and a sudden and violent reversal of the current account, which swings from deficit to large surplus. This behavior captures the essence of a sudden stop: capital inflows dry up, external financing disappears, and the adjustment occurs through a compression of domestic expenditure.

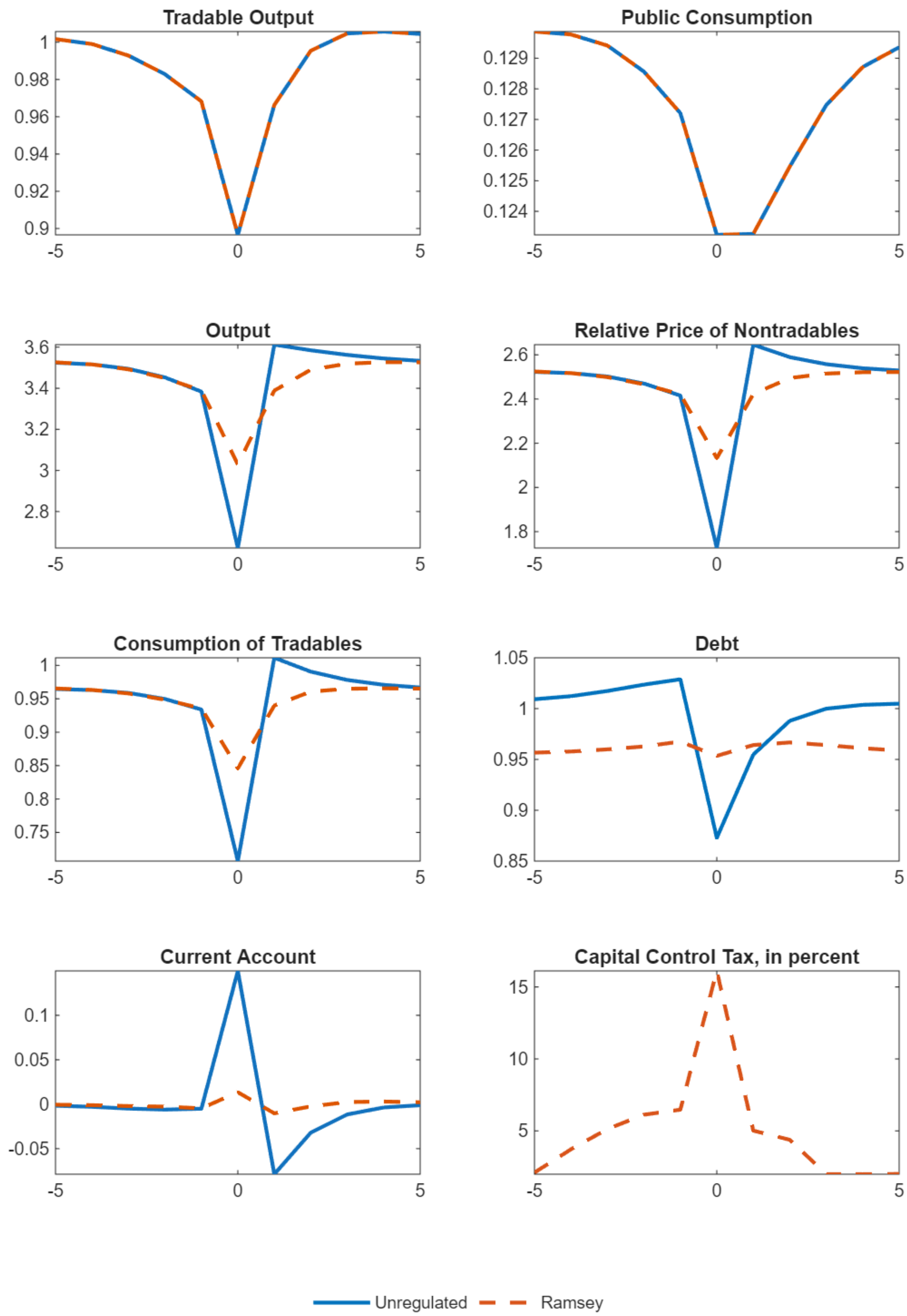

Figure 4: Behavior around Financial Crises

Under the Ramsey policy, these destabilizing dynamics are largely mitigated. The planner anticipates the risk of binding constraints and implements capital controls that adjust when the economy is beginning a crisis episode. As endowments and output deteriorate, the planner raises the tax on capital inflows, discouraging new borrowing and containing leverage in anticipation of adverse shocks. The tax rate peaks precisely at the onset of the downturn, when the likelihood of hitting the constraint is highest. As a result, the collateral constraint rarely binds in equilibrium, and the economy experiences only a mild and gradual adjustment of debt, output, and consumption.

The contrast between the two equilibrium is striking. In the decentralized economy, the lack of regulation allows excessive borrowing during expansions, which fuels real appreciation and sets the stage for a sudden stop when negative shocks arrive. In the Ramsey economy, by contrast, the planner's intervention smooths capital flows, prevents the collapse of the real exchange rate, stabilizes output, and significantly reduces the volatility of both consumption and external balances.

From a welfare perspective, the gains from the Ramsey allocation are substantial. Since the planner's intervention smooths borrowing and prevents abrupt deleveraging, the fall in tradable consumption during crises is significantly smaller than in the unregulated economy. While in the decentralized equilibrium households are forced to compress consumption by roughly 25 percent on impact, under the Ramsey policy the adjustment is mild and gradual, preserving intertemporal consumption smoothing. The lower volatility of consumption translates directly into higher welfare, as agents face smaller fluctuations in marginal utility and avoid the large welfare losses associated with sudden stops. In this sense, the optimal policy not only stabilizes macroeconomic aggregates but also delivers a considerable improvement in household welfare.

In short, the Ramsey policy effectively eliminates the self-reinforcing cycle of borrowing, real appreciation, and abrupt reversal that characterizes unregulated capital flows in small open economies. By acting preemptively (lowering capital controls during booms and raising them as the economy approaches a crisis), the planner prevents fire sales, moderates real depreciation, and ensures that the adjustment of the current account occurs gradually rather than through a disruptive collapse of domestic demand.

3.2.4 Sensitivity Analysis

As previously discussed, the parameter ξ governs the sensitivity of the real exchange rate and plays a key role in determining the extent of overborrowing in the economy. Here we analyze how overborrowing changes as ξ varies, noting that it reflects the degree of substitutability between tradable and non-tradable consumption.

ξ	Overborrowing	Unregulated: std(p_t)	Ramsey: std(p_t)
0.83	1.4 pp	15.1	8.2
0.70	1.6 pp	20.0	8.8
0.60	1.9 pp	22.0	10.0
0.50	2.1 pp	22.5	11.6
0.40	2.6 pp	25.4	13.9

Table 6: Sensitivity analysis for ξ

As expected, Table 6 shows that lower values of ξ amplify the volatility of the relative price of non-tradables. In the unregulated economy, the standard deviation of p_t increases from 15.1 to 25.4 as ξ decreases from 0.83 to 0.4 (empirically relevant range), reflecting a stronger real exchange rate response to shocks in public consumption that are typically accompanied by fluctuations in tradable endowments.. Under the Ramsey allocation, the volatility of p_t is substantially lower, but it also rises with lower ξ, ranging from 8.2 to 13.9.

The table also shows that overborrowing intensifies as ξ declines, increasing from 1.4 to 2.6 percentage points. This occurs because when tradables and non-tradables are poor substitutes, exgenous shocks produce larger movements in relative prices, which exacerbate the collateral externality in the decentralized equilibrium. At the same time, the planner can only partially smooth these amplified price dynamics through capital controls, leading to higher residual volatility even in the Ramsey case. Overall, a lower ξ magnifies both the financial and real amplification mechanisms of the model.

4 Conclusion

This paper contributes to the literature on small open economies with financial frictions by introducing public consumption as an additional source of macroeconomic volatility and amplification. Building on the framework of Bianchi (2011) and Schmitt-Grohe & Uribe (2017), the analysis demonstrates that when public consumption is biased toward non-tradable goods and follows a pro-cyclical pattern, it reinforces the pecuniary externality that drives overborrowing. The fiscal channel amplifies both the boom and the bust phases of the financial cycle: in good times, higher government spending raises the relative price of non-tradables and relaxes borrowing constraints, fueling excessive external debt accumulation; in bad times, fiscal retrenchment depresses domestic demand and exacerbates real depreciations, deepening the recession and magnifying sudden-stop dynamics.

Quantitatively, this amplification mechanism translates into a significantly higher degree of overborrowing compared to standard models. The gap between the unregulated and Ramsey equilibria reaches 1.4 percentage points of output, more than twice that obtained under Bianchi's calibration. The Ramsey planner's optimal intervention effectively neutralizes these inefficiencies by introducing capital control taxes that substantially reduce the frequency and severity of crises. In the absence of regulation, the collateral constraint binds roughly once every 24 years, whereas under the optimal policy the same event occurs only once every two centuries. This highlights the strong stabilizing power of prudential capital controls in economies vulnerable to external shocks.

The optimal tax implied by the Ramsey allocation is both quantitatively significant and pro-cyclical. The planner raises the tax in recessions—when the collateral value falls and the risk of constraint activation increases—and lowers it in booms to allow smoother intertemporal consumption. While such pro-cyclicality may seem counterintuitive from a traditional macroeconomic perspective, in this context it reflects a prudential motive: tightening borrowing conditions in bad times prevents excessive deleveraging and Fisherian deflation, thereby containing systemic risk.

From a policy standpoint, the results highlight the importance of coordination between instruments concerning fiscal and macroprudential policy in emerging market economies. Pro-cyclical fiscal behavior regarding public consumption can unintentionally undermine financial stability by amplifying collateral-driven cycles, suggesting that prudential capital controls should not be analyzed in isolation but as part of a broader strategy that includes fiscal policy.

5 References

- Arce, F. (2024). *Private Overborrowing under Sovereign Risk.* Federal Reserve Bank of Chicago, Working Paper.
- Arce, F., Bengui, J., Bianchi, J., & Dedola, L. (2025). *Financial Crises, Sovereign Risk, and the Effectiveness of Macroprudential Policies.* Forthcoming, Journal of Political Economy.
- Benigno, G., Chen, H., Otrok, C., Rebucci, A., & Young, E. R. (2016). *Optimal Capital Controls and Real Exchange Rate Policies: A Pecuniary Externality Perspective.* NBER Working Paper No. 22224.
- Bianchi, J. (2011). *Overborrowing and Systemic Externalities in the Business Cycle.* American Economic Review, 101(7), 3400–3426.
- Chi, C.-C., Schmitt-Grohé, S., & Uribe, M. (2025). *Optimal Bank Reserve Remuneration and Capital Control Policy.* American Economic Journal: Macroeconomics, 17(1), 203–244.
- Fernández, A., Rebucci, A., & Uribe, M. (2015). *Are Capital Controls Countercyclical?* Journal of Monetary Economics, 76, 1–14.
- Froot, K. A., & Rogoff, K. (1995). *Perspectives on PPP and long-run real exchange rates.* In G. Grossman & K. Rogoff (Eds.), Handbook of International Economics (Vol. 3, pp. 1647–1688). Elsevier.
- Jappelli, T., & Pagano, M. (1989). *Consumption and Capital Market Imperfections: An International Comparison.* The American Economic Review, 79(5), 1088–1105.
- Korinek, A. (2011). *The New Economics of Capital Controls Imposed for Prudential Reasons.* IMF Working Paper No. 11/298.
- Mendoza, E. G. (2002). *Credit, Prices, and Crashes: Business Cycles with a Sudden Stop.* American Economic Review, 100(5), 1941–1966.
- Mendoza, E. G. (2005). *Real Exchange Rate Volatility and the Price of Nontradable Goods in Economies Prone to Sudden Stops.* Economía, 6(1), 103–135.
- Ranciere, R., Tornell, A., & Westermann, F. (2005). *Systemic Crises and Growth.* NBER Working Paper No. 11076.
- Reinhart, C. M., & Rogoff, K. S. (2009). *This Time Is Different: Eight Centuries of Financial Folly.* Princeton University Press.
- Schmitt-Grohé, S., & Uribe, M. (2009, rev. 2014). *Finite-State Approximation of VAR Processes: A Simulation Approach.* Manuscript, Columbia University and NBER.
- Schmitt-Grohé, S., & Uribe, M. (2017). *Is Optimal Capital Control Policy Countercyclical in Open Economy Models with Collateral Constraints?* IMF Economic Review, 65(3), 498–527.
- Schmitt-Grohé, S., & Uribe, M. (2020). *Multiple Equilibria in Open Economies with Collateral Constraints.* Review of Economic Studies, 87(5), 2091–2130.
- Schmitt-Grohé, S., & Uribe, M. (2021). *Deterministic Debt Cycles in Open Economies with Flow Collateral Constraints.* Journal of Economic Theory, 192, 105195.
- Tauchen, G., & Hussey, R. (1991). *Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models.* Econometrica, 59(2), 371–396.