# Capital Flow Management when Capital Controls Leak

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VERY PRELIMINARY AND INCOMPLETE:

**Abstract**

What are the implications of limited capital controls enforcement for the optimal design of capital flow management policies? We address this question in an environment where pecuniary externalities call for prudential capital controls, but financial regulators lack the ability to enforce them on the "shadow economy." While regulated agents reduce their risk-taking decisions in response to capital controls, *unregulated* agents respond by taking more risk, thereby undermining the effectiveness of the controls. We characterize the choice of a planner who sets capital controls optimally, taking into account the leakages arising from limited regulation enforcement. We find that leakages do not necessarily make macroprudential policy on the regulated sphere less desirable, and that the welfare gains from regulation accrue disproportionately to unregulated agents.

**Keywords:** Macroprudential policy, financial crises, capital controls, limited regulation enforcement

# 1 Introduction

Central banks in emerging markets have responded to the recent surge in capital inflows by pursuing active capital flow management policies. The hope is that current efforts to curb capital inflows will reduce the vulnerability of the economy to sudden reversals in capital flows. While this macroprudential view of capital controls has gained considerable grounds in academic and policy circles, the debate about their effectiveness remains unsettled.[1] In fact, a growing empirical literature argues that there are important leakages in the implementation of capital controls, casting doubt on the effectiveness of such policies in fostering macroeconomic and financial stability.[2]

Against this backdrop, the literature has not addressed what are the precise consequences of imperfect regulation enforcement of capital controls: To what extent do leakages in regulation undermine the effectiveness of capital controls? Are capital controls desirable in the presence of imperfect regulation enforcement?

To tackle these questions, we use a stylized dynamic model of endogenous sudden stops, inspired by Mendoza (2002) and Bianchi (2011), where households are subject to an occasionally binding credit constraint that links their credit market access to the value of their current income, composed of tradable goods and non-tradable goods. When the economy has accumulated a large stock of debt and an adverse shock hits, the economy falls into a vicious circle by which a contraction in capital flows and the real exchange rate mutually reinforce each other. Because households fail to internalize that higher borrowing leads to a higher exposure to these systemic episodes, this creates a pecuniary externality that can be corrected using appropriately designed capital controls (see e.g. Bianchi (2011) and Korinek (2011)). The existing literature, however, has restricted to the case where capital controls are perfectly enforceable.

In our model, the financial regulator can only enforce capital controls on a subset of the population. We show that unregulated agents respond to tighter regulation in the economy, i.e. higher capital controls, by taking more risk, due to an implicit insurance provided by

[1] For the views of the IMF see Ostry et al. (2010).

[2] See for example Klein (2012) Forbes, Fratzscher, and Straub (2013), Magud, Reinhart, and Rogoff (2011).

regulated agents. As the financial regulator tightens regulation on the "regulated sphere," this reduces overall risk-taking decisions, given borrowing decisions of unregulated agents. Unregulated agents, however, perceive now that crises are less likely and hence respond by taking more debt. That is, they reduce their precautionary savings as the likelihood of a severe contraction in their borrowing capacity falls with higher capital controls. As a result, these leakages in regulation undermine the effectiveness of capital controls.

In our normative analysis, we consider a financial regulator, subject to the same credit market frictions as the private economy, who chooses directly borrowing decisions of regulated agents. On the other hand, borrowing decisions remain a private choice for unregulated agents. A key aspect of the financial regulator's problem is that it internalizes the leakages from tighter regulation on the unregulated sphere.

We show that the planner's decision to impose capital controls on the regulated sphere when the economy is exposed to the risk of a future financial crisis results from the resolution of a tradeoff that involves a key feedback mechanism. On the one hand, capital controls on the regulated sphere are socially desirable because they correct a pecuniary externality that causes an inefficiency due to a constraint linking credit limits to a market price. The controls reduce the economy's indebtedness ahead of potential financial crises, thereby making such crises less likely to occur and less severe if they occur. On the other hand, capital controls on the regulated sphere encourage more borrowing by the unregulated sphere, and this extra borrowing by the unregulated sphere needs to be compensated by the planner through tighter capital controls and therefore even less borrowing by the regulated sphere. This lower borrowing by the regulated sphere induces even more borrowing by the unregulated sphere, fuelling a vicious circle. The feedback loop between the borrowing patterns of the two spheres drives a wedge between the marginal utilities of these two sets of agents: relative to unregulated agents, regulated agents save "too much" ahead of potential future crises and therefore over-consume in the future. The opening of this wedge is costly to the planner from an allocative efficiency perspective. Therefore, in deciding about the optimal extent of capital controls, the planner trades off the benefits arising from the correction of an inefficiency due to a pecuniary externality with the costs arising from the creation of an otherwise non-existing allocative inefficiency.

Our results indicate that the spillover effects are such that the unregulated sphere responds to capital controls on the regulated sphere by borrowing unambiguously more than under laisser-faire. The results also indicate that the welfare gains from capital controls accrue disproportionately to unregulated agents. This is explained by the non-discriminatory character of the planner's financial crisis prevention policy, that operates through the stabilization of a market price. The planner's intervention on the borrowing of regulated agents entails costs and benefits. The costs arise from lower consumption by regulated agents (due to lower borrowing) when the economy is in a state where it is exposed to the risk of a future crisis. The benefits take the form of a lower probability of occurrence of such crises. Unlike regulated agents who pay a cost in exchange for enjoying the benefits, unregulated agents enjoy the benefits without incurring any cost.

This paper relates to the growing literature on capital controls and macroprudential policies. A first strand of this literature examines pecuniary externalities due to incomplete markets and prices that affect financial constraints.[3] In particular, we build on Bianchi (2011)'s normative analysis but consider the case where controls can be enforced only on a fraction of the population. We show that capital controls remain largely effective even in the presence of significant leakages and spillovers from regulated to unregulated agents. Spillovers from regulated to unregulated agents are also analyzed in Bengui (2013). He shows in a stylized two-country model of liquidity demand that a tightening of liquidity regulation at home encourages risk-taking by unregulated agents abroad. Instead, we consider the optimal macroprudential policy followed by a social planner that considers how leakages from financial regulation can lead to higher risk-taking in domestic financial markets.

A second strand of the literature examines prudential capital controls for macroeconomic stabilization in the presence of nominal rigidities. In Farhi and Werning (2012) and Schmitt-Grohé and Uribe (2013), there is a wedge between the private and social value of income due to Keynesian effects that arise when monetary policy is unable to achieve full economic stabilization. These papers also assumes that capital controls are perfectly enforceable.

[3]Examples include Caballero and Krishnamurthy (2001), Lorenzoni (2008), Korinek (2011), Bianchi (2011), **?**,Jeanne and Korinek (2011), Benigno, Chen, Otrok, Rebucci, and Young (2013), Bengui (2013).

# 2 Model

## 2.1 Economic Environment

The economy is populated by a continuum of agents of one of two types $i = \{U, R\}$, present in respective proportions $\gamma$ and $1-\gamma$, who live for three dates: $t = 0, 1, 2$. Both types of agents have identical preferences and endowments. Preferences are given by:

$$U_i = \omega c_{i0}^T + \mathbb{E}_0 \left[\beta \ln\left(c_{i1}(s)\right) + \beta^2 \ln\left(c_{i2}(s)\right)\right]. \tag{1}$$

with

$$c = \left(c^T\right)^{\omega} \left(c^N\right)^{1-\omega}.$$

$\mathbb{E}[\cdot]$ is the expectation operator and $\beta < 1$ is a discount factor. Date 0 utility linear in tradable consumption $c^T$, while date 1 and 2 utility is logarithmic in the consumption basket $c$, which is a Cobb-Douglas aggregator with unitary elasticity of substitution between tradable goods $c^T$ and nontradable goods $c^N$. $\omega$ is the share of tradables in total consumption. Agents receive endowments of tradable goods and nontradable goods of $\left(y_t^T(s), \bar{y}^N\right)$ at date 1 and 2, but do not receive any endowment at date 0. The date 1 endowment of tradables $y_1^T(s)$ is a random variable depending on the event $s \in S$, which can be interpreted as the aggregate state of the economy. We define $\bar{y}^T \equiv E_0\left[y_1^T(s)\right]$ and for simplicity, we assume that $y_2^T(s)$ is a constant equal to $\bar{y}^T$, and that $\bar{y}^N = 1$.

Agents have access to a single one period, non-state contingent bond denominated in units of tradable goods that pays a fixed interest rate $r$, determined exogenously in the world market. We assume that domestic agents are as patient as international investors, i.e. that $\beta(1+r) = 1$. Normalizing the price of tradables to 1 and denoting the price of nontradables by $p^N$, the budget constraints are:

$$c_{i0}^T + b_{i1} = 0 \tag{2}$$

$$c_{i1}^T(s) + p_1^N(s)c_{i1}^N(s) + b_{i2}(s) = (1+r)b_{i1} + y_1^T(s) + p_1^N(s)\bar{y}^N \tag{3}$$

$$c_{i2}^T(s) + p_2^N(s)c_{i2}^N(s) = (1+r)b_{i2}(s) + \bar{y}^T + p_2^N(s)\bar{y}^N \tag{4}$$

where $b_{t+1}$ denotes bond holdings an agent chooses at the beginning of period $t$.

We capture the phenomenon of credit market imperfections by assuming that at date 1, agents are subject to a credit constraint preventing them to borrow more than a fraction $\kappa$ of their current income:

$$b_{i2}(s) \geq -\kappa \left( p_1^N(s)\bar{y}^N + y_1^T(s) \right). \tag{5}$$

[Add discussion of credit constraint]

Agents choose consumption and savings to maximize their utility (1) subject to budget constraints (2), (3), (4), and to their credit constraint (5), taking $p_1^N(s)$ and $p_2^N(s)$ as given.

An agent's optimality conditions are given by

$$p_t^N(s) = \frac{1-\omega}{\omega} \frac{c_{it}^T(s)}{c_{it}^N(s)} \tag{6}$$

$$\omega = \beta(1+r)E_0 \left[ \frac{\omega}{c_{i1}^T(s)} \right] \tag{7}$$

$$\frac{\omega}{c_{i1}^T(s)} = \beta(1+r)\frac{\omega}{c_{i2}^T(s)} + \mu_{i1}(s) \tag{8}$$

$$b_{i2}(s) + \kappa \left[ p_1^N(s)\bar{y}^N + y_1^T(s) \right] \geq 0, \qquad \text{with equality if } \mu_{i1}(s) > 0. \tag{9}$$

where $\mu_{i1}(s)$ is the agent's non-negative multiplier associated with his date 1 credit constraint. Equation (6) is a static optimality condition equating the marginal rate of substitution between tradable and nontradable goods to their relative price. Equation (7) is the Euler equation for bonds at date 0, and equation (8) is the Euler equation for bonds at date 1. When the credit constraint is binding, there is a wedge between the current shadow value of wealth and the expected value of reallocating wealth to the next period, given by the shadow price of relaxing the credit constraint $\mu_{i1}(s)$. Equation (9) is the complementary slackness condition.

If an agent is unconstrained at date 1, he chooses a consumption plan given by

$$c_{i1}^T(s) = c_{i2}^T(s) = \frac{\omega}{1+\beta} we_{i1}(s), \quad c_{i1}^N(s) = \frac{1-\omega}{1+\beta}\frac{we_{i1}(s)}{p_1^N(s)}, \quad \text{and} \quad c_{i2}^N(s) = \frac{1-\omega}{1+\beta}\frac{we_{i1}(s)}{p_2^N(s)} \tag{10}$$

where $we_{i1}(s)$ is the agent's date 1 lifetime wealth

$$we_{i1}(s) \equiv (1+r)b_{i1} + y_1^T(s) + p_1^N(s)\bar{y}^N + \frac{\bar{y}^T + p_2^N(s)\bar{y}^N}{1+r}.$$

To finance this consumption plan, the agent borrows the shortfall between his expenditures $\frac{1}{1+\beta} we_{i1}(s)$ and cash on hand $(1+r)b_{i1} + y_1^T(s) + p_1^N(s)$ at date 1:

$$b_{i2}(s) = b_{i2}^{unc}(s) \equiv \frac{\beta}{1+\beta}\left[(1+r)b_{i1} + y_1^T(s) + p_1^N(s)\bar{y}^N - \frac{\bar{y}^T + p_2^N(s)\bar{y}^N}{1+r}\right]. \tag{11}$$

An agent is constrained at date 1 if the bond position in (11) violates the credit constraint (5). In this case, he borrows the maximum amount:

$$b_{i2}(s) = b_{i2}^{con}(s) \equiv -\kappa\left[y_1^T(s) + p_1^N(s)\bar{y}^N\right] \tag{12}$$

and chooses a consumption plan given by

$$\begin{aligned} c_{i1}^T(s) &= \omega \tilde{we}_{i1}(s) & c_{i2}^T(s) &= \omega(1+r)\left[we_{i1}(s) - \tilde{we}_{i1}(s)\right] \\ c_{i1}^N(s) &= (1-\omega)\tilde{we}_{i1}(s) & c_{i2}^N(s) &= (1-\omega)(1+r)\left[we_{i1}(s) - \tilde{we}_{i1}(s)\right], \end{aligned} \tag{13}$$

where $\tilde{we}_{i1}(s)$ is the agent's date 1 constrained wealth

$$\tilde{we}_{i1}(s) \equiv (1+r)b_{i1} + (1+\kappa)\left[y_1^T(s) + p_1^N(s)\bar{y}^N\right],$$

which corresponds to the sum of actual date 1 wealth and the maximum amount that can be borrowed.

# 3 Decentralized equilibrium

A decentralized equilibrium of the model is a set of decisions $\{c_{i0}^T, b_{i1}\}_{i\in\{U,R\}}$, decision rules $\{c_{i1}^T(s), c_{i2}^T(s), c_{i1}^N(s), c_{i2}^N(s), b_{i2}(s)\}_{i\in\{U,R\}}$ and prices $p_1^N(s), p_2^N(s)$ such that (1) given prices, the agents decisions are optimal, and (2) markets for the tradable and nontradable goods clear at all date. In what follows we proceed by backward induction. We first analyze the date 1 continuation equilibrium for given date 0 bond choices, and we then turn to the date 0 equilibrium borrowing decisions.

## 3.1 Date 1 continuation equilibrium

The nontradable goods market clearing condition for $t = 1, 2$ is

$$\gamma c_{Ut}^{N}(s) + (1-\gamma) c_{Rt}^{N}(s) = \bar{y}^{N} = 1. \tag{14}$$

and the aggregation of the two sets of agents' intertemporal budget constraints yield economy's intertemporal resource constraint

$$C_1^T(s) + \frac{C_t^T(s)}{1+r} = (1+r)\left[\gamma B_{U1} + (1-\gamma) B_{R1}\right] + y_1^T(s) + \frac{\bar{y}^T}{1+r} \tag{15}$$

where $C_t^T(s) \equiv \gamma C_{Ut}^T(s) + (1-\gamma) C_{Rt}^T(s)$ is aggregate tradable consumption and upper case letters with $U$ or $R$ subscripts denote aggregates over an agent type.

Combining the nontradable market clearing condition (14) with the agents' static optimality condition (6) delivers a simple expression for the equilibrium price of nontradables:

$$p_t^N(s) = \frac{1-\omega}{\omega} C_t^T(s). \tag{16}$$

Hence, the equilibrium price of nontradables is proportional to the economy's absorption of tradables. Intuitively, when aggregate consumption of tradables is high, nontradables are relatively scarce and their relative price is high. All else equal, an increase in $c_{R1}^T$ generates in equilibrium an increase in $p_1^N$, which by equation (5) increases the collateral value for all agents. Similarly, a reduction in $c_{U1}^T$ reduces the collateral value for all agents. This mechanism will be a key source of interaction between the behavior of the regulated and unregulated spheres in the regulated equilibrium considered below.

At date 1, the economy's aggregate state variables are given by the tradable goods endowment $y_1^T(s)$ and by the respective aggregate bond positions of type $U$ and type $R$ agents, $B_{U1}$ and $B_{R1}$. Depending on which set(s) of agents is (are) credit constrained, the economy can be in four regions at date 1:

*cc* Both types of agents are constrained, and equilibrium is given by the system of equations (12), (13), (14), (15) and (16).

*cu* $U$ agents are constrained, $R$ agents are unconstrained, and equilibrium is given by the system of equations (12) and (13) for $i = U$, (10) and (11) for $i = R$, (14), (15) and (16).

*uc* $U$ agents are unconstrained, $R$ agents are constrained, and equilibrium is given by the system of equations (12) and (13) for $i = R$, (11) and (10) for $i = U$, (14), (15) and (16).

*uu* Both types of agents are unconstrained, and equilibrium is given by the system of equations (10), (11), (14), (15) and (16).

Conveniently, in each of these cases the system of equations is block recursive in a linear system in $C_1^T(s)$, $C_2^T(s)$, $p_1^N(s)$ and $p_2^N(s)$, and can therefore be solved analytically.

An individual's credit constraint set is defined as

$$\mathcal{Q}(b_{i1}; B_{U1}, B_{R1}, x) = \left\{ y_1^T(s) \in \mathbb{R}^+ | b_{i2}^{unc}\left(b_{i1}; y_1^T(s), B_{U1}, B_{R1}, x\right) < b_{i2}^{con}\left(b_{i1}; y_1^T(s), B_{U1}, B_{R1}, x\right) \right\}.$$

where $x \in \{cc, uc, cu, uu\}$ denotes the region in which the economy is and determines the mapping between $(y_1^T(s), B_{U1}, B_{R1})$ and $(p_1^N(s), p_2^N(s))$ relevant to compute $b_{i2}^{unc}$ and $b_{i2}^{con}$. The four regions can hence be represented by the following sets:

$$\mathcal{X}^{cc}(B_{U1}, B_{R1}) = \mathcal{Q}(B_{U1}; B_{U1}, B_{R1}, cc) \cap \mathcal{Q}(B_{R1}; B_{U1}, B_{R1}, cc), \tag{17}$$

$$\mathcal{X}^{uc}(B_{U1}, B_{R1}) = \mathcal{Q}^c(B_{U1}; B_{U1}, B_{R1}, uc) \cap \mathcal{Q}(B_{R1}; B_{U1}, B_{R1}, uc), \tag{18}$$

$$\mathcal{X}^{cu}(B_{U1}, B_{R1}) = \mathcal{Q}(B_{U1}; B_{U1}, B_{R1}, cu) \cap \mathcal{Q}^c(B_{R1}; B_{U1}, B_{R1}, cu), \tag{19}$$

$$\mathcal{X}^{uu}(B_{U1}, B_{R1}) = \mathcal{Q}^c(B_{U1}; B_{U1}, B_{R1}, uu) \cap \mathcal{Q}^c(B_{R1}; B_{U1}, B_{R1}, uu). \tag{20}$$

These sets have some intuitive properties.

**Lemma 1.** *$\mathcal{X}^{cc}$, $\mathcal{X}^{uc}$, $\mathcal{X}^{cu}$ and $\mathcal{X}^{uu}$ are disjoint, and their union is $\mathbb{R}^+$.*

Lemma 1 says that the economy is always in one and only one of the four regions described above.

**Lemma 2.** *If $B_{U1} \leq B_{R1}$ (resp. $B_{U1} > B_{R1}$), then there exists some thresholds $a_y$ and $b_y$ with $0 \leq a_y \leq b_y$ such that for $y_1^T(s) < a_y$, $y_1^T(s) \in \mathcal{X}^{cc}$, for $a_y \leq y_1^T(s) < b_y$ $y_1^T(s) \in \mathcal{X}^{cu}$ (resp. $y_1^T(s) \in \mathcal{X}^{uc}$) and for $y_1^T(s) \geq b_y$ $y_1^T(s) \in \mathcal{X}^{uu}$. Further, $a_y = b_y$ if and only if $B_{U1} = B_{R1}$.*

Lemma 2 says that for a given pair $(B_{U1}, B_{R1})$, the regions are ordered along the real line, that the poorest type of agents is never unconstrained when the other type is constrained, and that when both types of agents have the same wealth only the symmetric regions $cc$ and $uu$ can arise.

### 3.2 Date 0 decentralized equilibrium

In a decentralized equilibrium at date 0, bond choices are symmetric $B_{U1} = B_{R1} \equiv B_1$, and they are characterized by the representative agent's Euler Equation

$$1 = E_0\left[\frac{1}{C_1^T(y_1^T(s), B_1, B_1)}\right]. \tag{21}$$

# 4 Regulated Equilibria

We now consider a planner who can tax borrowing choices by all agents or by a subset of agents at date 0, and rebates the tax proceeds to the set of agents he taxes.

### 4.1 Capital controls without leakages

**Problem 1** (Planner's problem without leakages (with taxes))**.**

$$\max_{\{\tau_i, T_i, c_{i0}^T, b_{i1}, c_{i1}^T(s), c_{i2}^T(s), c_{i1}^N(s), c_{i2}^N(s), b_{i2}(s)\}_{i\in\{U,R\}}, p_1^N, p_2^N} \gamma U_U + (1-\gamma) U_R \tag{22}$$

*subject to*

$$
\begin{aligned}
1 &= (1+\tau_i)E_0\left[\frac{1}{c_{i1}^T(y_1^T(s), b_{U1}, b_{R1})}\right] && (23)\\
c_{i1}^T(s) + p_1^N(s)c_{i1}^N(s) + b_{i2}(s) &= (1+r)(1+\tau_i)b_{i1} + y_1^T(s) + p_1^N(s)\bar{y}^N + T_i && (24)\\
\tau_i B_{i1} + T_i &= 0 && (25)
\end{aligned}
$$

*for $i = \{U, R\}$, and (2), (4), (6), (8).*

We observe that after combining (25) with (24), the taxes only appear in the private Euler equation (23). The allocations that solve problem 1 are therefore identical to the ones that solve the following problem where the planner chooses allocations and prices directly.

**Problem 2** (Planner's problem without leakages)**.**

$$
\max_{\{c_{i0}^T, b_{i1}, c_{i1}^T(s), c_{i2}^T(s), c_{i1}^N(s), c_{i2}^N(s), b_{i2}(s)\}_{i\in\{U,R\}}, p_1^N, p_2^N} \gamma U_U + (1-\gamma)U_R \tag{26}
$$

*subject to (2), (4), (6), (8), (9) and (14).*

The planner's Euler equation is given by

$$
1 = \beta\,(1+r)\,E_0\frac{1}{c_{i1}^T} + \kappa\frac{1-\omega}{\omega}E_0\left[\left(\mu_{R1} + \frac{\gamma}{1-\gamma}\mu_{U1}\right)\frac{\partial C_1^T}{\partial b_{i1}}\right] \tag{27}
$$

The first term on the right-hand side corresponds to the private valuation of wealth, also present in (7). The second term is an extra term that reflects the internalization by the planner of a pecuniary externality. This term is unambiguously positive, meaning that the planner chooses a higher level of savings level (a lower debt level) than private agents at date 0. To implement a higher level of savings, the planner imposes a positive tax on debt.

## 4.2 Capital controls with leakages

**Problem 3** (Planner's problem with leakages (with taxes))**.**

$$
\max_{\{c_{i0}^T, b_{i1}, c_{i1}^T(s), c_{i2}^T(s), c_{i1}^N(s), c_{i2}^N(s), b_{i2}(s)\}_{i\in\{U,R\}}, \tau_R, T_R, p_1^N, p_2^N} \gamma U_U + (1-\gamma)U_R \tag{28}
$$

*subject to*

$$
\begin{aligned}
1 &= (1+\tau_R)E_0\left[\frac{1}{c^T_{R1}(y^T_1(s),b_{U1},b_{R1})}\right] && (29)\\
c^T_{R1}(s)+p^N_1(s)C^N_{R1}(s)+b_{R2}(s) &= (1+r)(1+\tau_R)b_{R1}+y^T_1(s)+p^N_1(s)\bar{y}^N+T_R && (30)\\
\tau_R B_{R1}+T_R &= 0 && (31)
\end{aligned}
$$

*and (2), (4), (6), (7) for $i=U$, (8), (9) and (14).*

We again observe that after combining (31) with (30), the tax only appears in the private Euler equation (29). The allocation that solves problem 3 are therefore identical to the ones that solve the following problem where the planner chooses allocations and prices directly.

**Problem 4** (Planner's problem with leakages)**.**

$$
\max_{\{c^T_{i0},b_{i1},c^T_{i1}(s),c^T_{i2}(s),c^N_{i1}(s),c^N_{i2}(s),b_{i2}(s)\}_{i\in\{U,R\}},p^N_1,p^N_2} \gamma U_U+(1-\gamma)U_R \tag{32}
$$

*subject to (2), (4), (6), (7) for $i=U$, (8), (9) and (14).*

The planner's Generalized Euler equation is given by

$$
\begin{aligned}
1 \;=\; & \beta\,(1+r)\,E_0\frac{1}{c^T_{R1}}+\kappa\frac{1-\omega}{\omega}E_0\left[\left(\mu_{R1}+\frac{\gamma}{1-\gamma}\mu_{U1}\right)\left(\frac{\partial C^T_1}{\partial b_{R1}}+\frac{\partial C^T_1}{\partial b_{U1}}\frac{\partial b_{U1}}{\partial b_{R1}}\right)\right]\\
& +(1-\omega)\,E_0\left[\left(\frac{1}{c^T_{R1}}-\frac{1}{c^T_{U1}}\right)\left(1-c^N_{R1}\right)\left(\frac{\partial C^T_1}{\partial b_{R1}}+\frac{\partial C^T_1}{\partial b_{U1}}\frac{\partial b_{U1}}{\partial b_{R1}}\right)\right]\\
& +(1-\omega)\,E_0\left[\left(\frac{1}{c^T_{R2}}-\frac{1}{c^T_{U2}}\right)\left(1-c^N_{R2}\right)\left(\frac{\partial C^T_2}{\partial b_{R1}}+\frac{\partial C^T_2}{\partial b_{U1}}\frac{\partial b_{U1}}{\partial b_{R1}}\right)\right]
\end{aligned}
$$

The first term on the first line of the right-hand side correspond to the private valuation of wealth. The second term reflects the internalization by the planner of a pecuniary externality. However, in contrast to the case without leakages, it now embeds the unregulated agents' response to the borrowing choice of the planner for the regulated agents, through the derivative $\frac{\partial b_{U1}}{\partial b_{R1}}$. In addition, the third and fourth terms on the second and third lines reflect the opening of a new wedge between the marginal rates of substitutions of regulated and unregulated agents.

**Proposition 1** (Spillover effects)**.** *The unregulated agents respond to less borrowing of regulated agents by borrowing more, i.e.* $\frac{\partial b_{U1}}{\partial b_{R1}} < 0$.

### 4.3 Size of optimal tax

### 4.4 Effectiveness of controls

### 4.5 Welfare effects of controls

## 5 Conclusion

To be added.

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# A Proofs

To be added.