De-risking or Risk-Shifting? MDB Securitization and Climate Finance*

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Abstract

We develop a model of green securitization by a multilateral development bank (MDB) in which the MDB purchases seasoned green loans from local banks and requires reinvestment of proceeds in new climate-aligned projects under a capital-recycling conditionality. We find that such a mechanism can scale, de-risk and tilt banks' investment portfolios. Unlike standard originate-to-distribute securitization, which erodes monitoring by diluting skin-in-the-game, the reinvestment conditionality creates a continuation surplus that raises bank monitoring, reduces aggregate risk, even under imperfect monitoring. When greener projects are deemed riskier, the de-risking region concentrates precisely on the highest social-value assets, tilting the guaranteed portfolio toward greener projects without requiring any explicit green mandate.

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1 Introduction

Mobilizing private capital for climate investment in emerging market and developing economies (EMDEs) is one of the central challenges of international development finance. Closing the gap between the roughly $4 trillion per year currently invested in climate-aligned projects and the $9–10 trillion required by 2030 demands instruments that go

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beyond direct public lending.[1] Multilateral development banks (MDBs), with their preferred creditor status and low funding costs, occupy a unique position as intermediaries between international capital markets and local commercial banks that actually lend to green projects. Yet MDB balance sheets are finite and expanding them faces governance constraints. A key question is therefore not how much MDBs can lend directly, but how much private finance each dollar of MDB guarantee capacity can mobilize. A common answer has been to develop blended finance strategies – the use of public funding to crowd in or 'de-risk' private funding.[2] Yet 'derisking' can be a misnomer as it does not necessarily reduce aggregate risk but merely shifts it to the public sector.

In contrast, this paper studies a derisking mechanism that actually reduces aggregate risk. We develop a general-equilibrium model of banking with green securitization by an MDB and use it to formalize the mechanics of the Inter-American Development Bank's Reinvest+ initiative, a capital-recycling programme in which the MDB purchases seasoned green loans from local banks and requires reinvestment of the proceeds in new climate-aligned projects. We show that such an approach, under appropriate conditions, can deliver on three goals, namely scaling, derisking, and tilting investment portfolios.

Our first result is a green investment multiplier: each unit of MDB guarantee capacity generates $\mathcal{M} = 1 + \lambda \bar{s} \bar{P} > 1$ units of new green investment, where λ is bank leverage, $\bar{s}$ is the aggregate securitization rate, and $\bar{P}$ is the average purchase price of the securitized pool. The multiplier exceeds one because each unit of MDB capacity frees up bank equity that is then re-deployed at leverage λ into a new cohort of green loans. At baseline calibration, the multiplier is around 4-5 and can reach 6-7 with endogenous project entry.

Second, the mechanism delivers genuine de-risking, that is, a decline in aggregate risk. In contrast to the classic originate-to-distribute problem with securitization—selling loans reduces skin-in-the-game and lowers monitoring—the Reinvest+ conditionality creates a second-period reinvestment rent that can more than offset this loss. We show that when the leverage-amplified reinvestment profit exceeds the opportunity cost of selling—a condition depending on leverage, discount rates, and the EMDE premium—, banks respond to securitization by *increasing* monitoring effort. The de-risking region widens as leverage rises or rates fall, providing a clean link between macrofinancial conditions and the effectiveness of MDB guarantees. De-risking also survives unobservable monitoring: in an infinite-horizon extension where the MDB updates its price based on the bank's default history, a reputational rent restores monitoring incentives without contractual verifiability. The dynamic de-risking region strictly enlarges the static one, and as agents becomes infinitely patient, reputation fully substitutes for observability.

[1] See the Independent Expert Group on Climate Finance report (2023) and related G20 assessments. The funding gap is particularly acute in EMDEs, where private capital faces high perceived risk, thin local capital markets, and elevated country premia.

[2] SeeFlammer et al. (2024) for a detailed analysis of blended finance

A conceptual point deserves emphasis. Much of what passes for "de-risking" in blended finance is better described as *risk-shifting*: a first-loss tranche or guarantee transfers downside from the private investor to the public entity, leaving aggregate risk unchanged or even higher through moral hazard. Our result is categorically different. The reinvestment conditionality reverses the moral hazard: because monitoring raises the MDB's purchase price—which raises reinvestment capital—which earns a leveraged return, the bank's privately optimal response is to *increase* monitoring. Aggregate default probability falls relative to the no-MDB counterfactual. This is efficiency-improving risk reduction, not redistribution. The distinction is policy-relevant: risk-shifting is a publicly-funded subsidy with no efficiency gain; genuine de-risking reduces the social cost of financing green investment.

Third, the MDB mechanism tilts investment portfolio toward greener assets. We show that the reinvestment surplus is monotonically increasing in bank type (riskiness): riskier banks have higher period-1 lending profits when de-risked, so the mechanism bites hardest for the highest-risk types. When, in addition, riskier bank types finance greener projects, the de-risking region concentrates precisely on the greenest assets. The MDB mechanism therefore self-selects toward the highest social-value projects without any explicit green mandate, generating a green composition ratio of up to 1.59 in our calibration. A budget-neutral green-targeted guarantee that conditions securitization rates on environmental quality ratings can further raise welfare by 7–9% of the MDB's total contribution.

Our paper's main contributions is to show that the reinvestment mechanism can deliver three objectives jointly: scaling, de-risking, and tilting of investment portfolios. *Scaling*: to our knowledge, we provide the first formal model of a capital-recycling mechanism and derive its multiplier effect in general equilibrium, giving a closed-form expression for how MDB guarantee capacity translates into aggregate green investment via leverage and reinvestment. *De-risking*: we establish that conditionality reverses the standard originate-to-distribute logic—securitization with reinvestment requirements simultaneously amplifies investment and strengthens monitoring—and show this constitutes genuine aggregate risk reduction rather than risk-shifting. We extend the result to unobservable effort via dynamic reputation, showing that repeated MDB–bank interactions substitute for contractual verifiability. *Tilting*: we characterize the complementarity between financial de-risking and environmental quality: the mechanism self-selects toward the greenest assets without any explicit green mandate, providing a novel formal rationale for MDB green certification standards.

The paper is organized as follows. Section 2 reviews the related literature. Section 3 sets up the model and solves the two-period problem by backward induction. Section 3.3 derives the general equilibrium. Section 4 presents the three headline results—Scaling (multiplier and optimal programme scale), De-risking (monitoring reversal and welfare),

and the savings-glut channel. Section 4.2 establishes the robustness of De-risking to unobservable monitoring via dynamic reputation. Section 4.3 formalizes Tilting: green portfolio composition and the de-risking–greenness complementarity. Section 5 presents numerical illustrations. Section 6 gathers further extensions. Section 7 concludes.

2 Related Literature

Our paper connects to four strands of research. First, we contribute to the literature on MDB-catalyzed blended finance. Hong et al. (2020) survey the intersection of climate policy and financial markets, documenting the central role of public capital in mobilizing private investment in emerging economies; IDB Invest (2023) articulate the strategic logic and growing scale of blended finance instruments from a practitioner perspective. The closest formal antecedent is Flammer et al. (2025c), who study 173 IFC blended finance transactions from 2018–2023 and show that DFIs optimally tailor concessional support to two key project characteristics: anticipated sustainability impact and host-country political risk. Higher-impact projects receive deeper concessions; riskier environments attract additional risk-management provisions. Our model provides a theoretical micro-foundation for both gradients. The reinvestment rent is strictly increasing in project quality, so the MDB endogenously concentrates support on higher-impact projects; and the MDB guarantee is most valuable when the EMDE credit premium is large. Flammer et al. (2024) document that MDB-guaranteed green securities in developing countries attract lower spreads and higher institutional investor participation, with riskier frontier renewable projects being both the primary beneficiaries of certification and the greenest assets—direct empirical support for our green complementarity result. Flammer et al. (2025a) offer a broader overview of blended finance mechanisms; Flammer et al. (2025b) document a parallel DFI screening function in biodiversity finance, where DFI involvement helps attract private capital to projects with high ecosystem-service values. Our contribution relative to all three is to identify the precise incentive channel—the reinvestment rent created by reinvestment conditionality—through which MDB discipline operates in a securitization setting, and to derive its quantitative implications for programme scale and portfolio composition.

Second, our model builds on the literature on bank monitoring and systemic risk. Martinez-Miera and Repullo (2017) is the direct theoretical antecedent to our model. In their framework, a savings glut reduces the safe rate, compresses credit spreads, and weakens bank monitoring incentives, raising systemic risk. We show that the MDB's capital-recycling channel introduces a second force—a reinvestment rent—that can dominate the spread-compression effect for high-leverage, low-rate environments. Diamond (1984) provides the micro-foundation for delegated monitoring in which bank incentives depend on residual claims; our de-risking mechanism reinterprets and partially reverses

this logic when conditionality creates a contingent future payoff.

Third a large literature documents the negative impact on monitoring incentives of the originate-to-distribute model of securitization: selling loans reduces skin-in-the-game and lowers monitoring effort (Gorton and Metrick, 2013; Coval et al., 2009; Franke and Krahnen, 2008). Kundu (2023) shows that CLO contract design can partially mitigate this problem through retention requirements and covenant structures. Cordell et al. (2023) provide evidence that CLO performance is sensitive to the monitoring intensity of the originating bank, consistent with our model's prediction that de-risking raises pool quality. Our contribution is to identify a conditionality-based mechanism that can fully reverse the originate-to-distribute incentive without retention requirements: the reinvestment conditionality creates a future surplus that the bank can only capture by maintaining loan quality.

Connected to this, concerns have emerged that securitization could amplify financial vulnerabilities. Gorton and Metrick (2012) document how the pre-crisis securitization market amplified systemic risk through opacity and run dynamics. Our model abstracts from run dynamics but speaks to the opacity channel: our observability extension (Section 4.2) shows that even when monitoring is unobservable, repeated MDB–bank interactions can sustain monitoring incentives through reputation. Ghent et al. (2019) show that complexity in structured finance products inhibits monitoring; our green CLO structure, which conditions pricing on observable default outcomes rather than on effort directly, is less susceptible to this critique.

Finally, we speak to a growing literature examines the role of financial markets and international institutions in financing environmental public goods. On the supply side, Bolton and Kacperczyk (2021) and Bolton and Kacperczyk (2023) document a carbon premium in equity markets: investors demand compensation for holding firms with higher carbon emissions, consistent with equilibrium pricing of transition risk. On the demand side, a growing body of work shows that investors are willing to accept lower yields for ESG-labeled assets (Flammer, 2021), a "greenium" we incorporate in the robustness extension of Section 6. For multilateral climate funds specifically, Kotchen and Vogt (2023) study co-financing objectives of the Global Environment Facility and the Green Climate Fund and show that co-financing incentives can distort project selection toward high private-co-investment ratios at the expense of environmental impact—a tension our model resolves by making the guarantee conditional on reinvestment rather than on co-investment ratios. Moreau and Bhandary (2025) study reciprocal climate commitments between countries and show that conditionality in international climate finance can sustain cooperation; our paper examines the analogous mechanism at the bank level, where conditionality aligns the bank's monitoring incentive with the MDB's capital-recycling objective.

3 Model

We start by studying a simple banking model with 2 periods before moving to more general setting with longer horizon. The economy has three dates, $t \in \{0, 1, 2\}$, and four types of agents: local commercial banks, green-project entrepreneurs, an MDB, and international institutional investors. We solve the model by backward induction, starting from $t = 2$.

3.1 Setup

Projects and returns There is a continuum of green projects of measure one, indexed by their baseline default probability $p \in [0, 1]$. Each project requires one unit of investment and yields a stochastic gross return

$$\widetilde{R}_p = \begin{cases} R_p & \text{with probability } 1 - p + m, \\ 0 & \text{with probability } p - m, \end{cases} \tag{1}$$

where $m \in [0, p)$ is the monitoring intensity of the originating bank and R_p is the gross success return. Following Martinez-Miera and Repullo (2017), R_p is a decreasing function of the aggregate volume of investment x_p in type-p projects:

$$R_p = R(x_p) \;=\; \left(\tfrac{x_p}{a}\right)^{-1/\sigma}, \tag{2}$$

where $\sigma > 1$ is the demand elasticity and $a > 0$ is a demand shifter. Defaults within type p are perfectly correlated (the bank's entire loan book of type p either succeeds or fails together).

Each project also carries a **social return**. We assign to each type-p project a greenness level $\sigma \in \{0,\, S_H\}$ with $S_H > 0$. A fraction $\theta(p) \in [0, 1]$ of type-p projects are *deep green* (certified social value S_H, e.g. frontier renewable energy or biodiversity restoration); the remainder have normalised social value zero. The expected social value of a type-p project is

$$S(p) \;\equiv\; \theta(p)\, S_H. \tag{3}$$

A successful deep-green project generates a non-appropriable externality $e \cdot S_H > 0$ (e.g. certified emissions reductions, climate resilience), where $e > 0$ is the social weight. Because $e \cdot S(p)$ is non-appropriable, banks optimise on p alone—the private equilibrium is unaffected by the social-value heterogeneity. The key structural parameter is the **risk–greenness correlation** $\rho \equiv \theta'(p)$: when $\rho > 0$, riskier projects tend to be greener ("green premium" case), so the market undervalues socially valuable projects relative to the social optimum.

Local banks There is one bank specialized in lending to each type p (as in Martinez-Miera and Repullo (2017)). The bank has equity (net worth) x_p at each date and faces a leverage constraint $Q_p \leq \lambda\, x_p$, where $\lambda > 1$ is the maximum leverage ratio. The bank raises the residual funding at rate $r + \Delta$, where r is the global risk-free rate and $\Delta > 0$ is the EMDE funding premium (reflecting sovereign risk, institutional weakness, and currency risk).

Monitoring is costly: exerting intensity m costs $c(m)$ per unit of lending, where

Assumption 1 (Monitoring cost)**.** $c(0) = c'(0) = 0$, $c'(m) > 0$ *for* $m > 0$, $c''(m) > 0$. *We use the quadratic specification* $c(m) = \frac{\gamma}{2}m^2$ *for all closed-form results.*

The bank's profit per unit of lending when it *retains* the loan is

$$\pi_p^{\text{retain}}(m) = (1 - p + m)R_p \;-\; (r + \Delta) \;-\; c(m). \tag{4}$$

Securitization At $t = 1$ the MDB arrives and offers to purchase from each bank p a fraction $s_p \in [0, 1]$ of its *seasoned* (performing) loans at price P_p per unit of face value. The MDB pools purchased loans in a special-purpose vehicle (SPV), applies credit enhancement (first-loss guarantee g per unit, FX hedge at cost h), and sells investment-grade securities to international institutional investors at $t = 2$.

Conditionality. The MDB purchases loans from bank p only if the bank commits to reinvesting the net proceeds $s_p P_p Q_p^0$ in new green loans of the same type at $t = 1$. With leverage λ, the bank can originate new period-1 loans

$$Q_p^1 \;=\; \lambda\, s_p\, P_p\, Q_p^0. \tag{5}$$

Period-1 loans are held to maturity (no further securitization in the two-period model) and pay off at $t = 2$.

MDB pricing. The MDB prices loans at their expected value using the international risk-free rate r (not the EMDE-premium rate $r + \Delta$). This is the key cost advantage of the MDB: it accesses capital at r while local banks fund at $r + \Delta$. Formally:

$$P_p \;=\; \frac{(1 - p + m_p^0)R_p}{1 + r}, \tag{6}$$

so the price reflects the loan's expected payoff, discounted at the international rate. By (6), $\partial P_p / \partial m_p^0 = R_p/(1 + r) > 0$: higher monitoring raises the price the MDB is willing to pay.

International investors and guarantee Institutional investors have mean-variance preferences:

$$U(W) \;=\; \mathbb{E}[W] \;-\; \tfrac{b}{2}\,\mathrm{Var}(W), \tag{7}$$

and allocate between the risk-free asset (return r) and the MDB-issued green security. With the guarantee g and FX hedge, the effective default probability of the senior tranche is $\delta_T^{\text{eff}} = \max\{0,\, \bar{\delta}_T - g/\bar{R}_T\}$, where $\bar{\delta}_T$ and $\bar{R}_T$ are portfolio-weighted averages. The diversification across countries/sectors reduces Var below the average individual variance, making the security investable at return $r + \epsilon$ for small ϵ.

For the MDB-issued senior tranche to attain investment-grade status, the first-loss guarantee g must satisfy

$$g^* \;=\; \max\!\big\{0,\; (\bar{\delta}_T - \delta_{\text{IG}})\,\bar{R}_T\big\}, \tag{8}$$

where $\bar{\delta}_T \equiv \big(\int_0^1 (p - m_p^{0*})\, s_p\, x_p\, dp\big) \big/ \big(\int_0^1 s_p\, x_p\, dp\big)$ is the pool's investment-weighted expected default rate and δ_{IG} is the investment-grade default threshold. Expression (8) makes precise the link between monitoring quality and the MDB's guarantee cost: $\partial g^*/\partial \bar{m} < 0$, so any increase in monitoring (whether through the de-risking mechanism or dynamic reputation) reduces the guarantee needed to achieve the target credit rating, lowering $\kappa(g^*)$ and making the welfare condition (31) easier to satisfy. The MDB's cost of the programme is therefore an endogenous function of the banks' monitoring effort it induces.

3.2 Partial Equilibrium

We now solve the model by backward induction under quadratic monitoring costs $c(m) = \frac{\gamma}{2} m^2$ and CES inverse demand (2).

Bank's problem At $t = 1$ the bank has capital Q_p^1/λ from conditionality and originates Q_p^1 new loans of type p. Since there is no $t = 3$, there is no further MDB purchase. The bank holds loans to maturity and solves:

$$\max_{m_p^1 \in [0,p)} \Big[(1 - p + m_p^1) R_p^1 \;-\; (r + \Delta) \;-\; \tfrac{\gamma}{2}(m_p^1)^2\Big]. \tag{9}$$

The first-order condition is

$$R_p^1 \;=\; \gamma m_p^1, \tag{10}$$

giving the closed-form period-1 optimal monitoring:

$$m_p^{1*} \;=\; \frac{R_p^1}{\gamma}. \tag{11}$$

The second-order condition $-\gamma < 0$ is satisfied. Substituting back, the period-1 profit per unit of lending is:

$$\pi_p^{1*} \;\equiv\; (1 - p + m_p^{1*}) R_p^1 \;-\; (r + \Delta) \;-\; \tfrac{\gamma}{2}(m_p^{1*})^2 \;=\; (1 - p) R_p^1 + \frac{(R_p^1)^2}{2\gamma} - (r + \Delta). \tag{12}$$

Lemma 1 (Period-1 participation)**.** *Bank p lends in period 1 if and only if $\pi_p^{1*} \geq 0$, i.e.,*

$$(1-p)R_p^1 + \frac{(R_p^1)^2}{2\gamma} \;\geq\; r + \Delta. \tag{13}$$

This condition is more likely to hold for lower Δ (lower EMDE premium) and for lower p (safer projects).

Monitoring with anticipated securitization At $t = 0$ the bank originates $Q_p^0 = \lambda x_p$ loans and chooses monitoring m_p^0 anticipating that the MDB will purchase fraction s_p at price $P_p(m_p^0)$ given by (6). The bank's total expected profit, discounted to $t = 0$ with $\beta \equiv 1/(1+r)$, is:

$$\Pi_p = \underbrace{\Big[(1-s_p)(1-p+m_p^0)R_p^0 + s_p P_p(m_p^0) - (r+\Delta) - \tfrac{\gamma}{2}(m_p^0)^2\Big]Q_p^0}_{\text{period-0 profit}} + \beta \underbrace{\pi_p^{1*}\,\lambda\, s_p\, P_p(m_p^0)\, Q_p^0}_{\text{period-1 profit from reinvestment}}. \tag{14}$$

Substituting $P_p(m_p^0) = \beta(1-p+m_p^0)R_p^0$ from (6):

$$\Pi_p = \Big[(1-s_p)(1-p+m_p^0)R_p^0 + s_p\,\beta(1-p+m_p^0)R_p^0 - (r+\Delta) - \tfrac{\gamma}{2}(m_p^0)^2\Big]Q_p^0 + \beta^2\,\pi_p^{1*}\,\lambda\, s_p\,(1-p+m_p^0)R_p^0\,Q_p^0. \tag{15}$$

Taking the first-order condition with respect to m_p^0:

$$\Big[(1-s_p)R_p^0 + s_p\,\beta\,R_p^0 + \beta^2\,\pi_p^{1*}\,\lambda\, s_p\,R_p^0\Big]Q_p^0 \;=\; \gamma\, m_p^0\, Q_p^0. \tag{16}$$

Dividing through by Q_p^0 and factoring R_p^0:

$$\gamma\, m_p^0 \;=\; R_p^0\Big[(1-s_p) + \beta\, s_p\big(1 + \beta\,\lambda\,\pi_p^{1*}\big)\Big]. \tag{17}$$

Define the *reinvestment surplus*:

$$\Phi_p \;\equiv\; \beta^2\,\lambda\,\pi_p^{1*} \;=\; \frac{\lambda\,\pi_p^{1*}}{(1+r)^2}. \tag{18}$$

Φ_p captures the present value (discounted over two periods) of the profit gained by leveraging one unit of MDB proceeds into λ new loans in period 1. The closed-form optimal period-0 monitoring is:

$$m_p^{0*}(s_p) \;=\; \frac{R_p^0}{\gamma}\Big[1 - s_p\big(1 - \beta - \Phi_p\big)\Big]. \tag{19}$$

Note that without the MDB ($s_p = 0$), monitoring reduces to $m_p^{0*} = R_p^0/\gamma$, identical to the period-1 expression (11) evaluated at R_p^0.. We can now present our first key result.

Proposition 1 (De-risking)**.** *Let $\Phi_p^* \equiv r/(1+r)$. For any $s_p \in (0,1]$, securitization raises (lowers) period-0 monitoring if and only if $\Phi_p \gtrless \Phi_p^*$:*

$$m_p^{0*}(s_p) \gtrless m_p^{0*}(0) = \frac{R_p^0}{\gamma} \iff \lambda\, \pi_p^{1*} \gtrless r\,(1+r). \tag{20}$$

Proof. From (19):

$$m_p^{0*}(s_p) - m_p^{0*}(0) = \frac{R_p^0}{\gamma}\big[-s_p(1-\beta-\Phi_p)\big] = \frac{s_p R_p^0}{\gamma}\big(\Phi_p - (1-\beta)\big).$$

Since $s_p > 0$ and $R_p^0/\gamma > 0$, this is positive iff $\Phi_p > 1-\beta = r/(1+r)$. Substituting $\Phi_p = \lambda\pi_p^{1*}/(1+r)^2$ and simplifying gives condition (20). □

The condition has a clean economic interpretation. The right-hand side $r(1+r) \approx r$ is the opportunity cost of the proceeds the bank receives from the MDB. The left-hand side $\lambda\pi_p^{1*}$ is the leverage-amplified profit from one unit of reinvested proceeds: the bank receives 1 from the MDB, leverages it to λ in new loans, and earns π_p^{1*} per loan. De-risking occurs when it is more profitable to improve loan quality (raise m_p^0, which raises P_p, which raises reinvestment capital) than to cut monitoring today. Conditionality is essential: without it there is no reinvestment benefit and monitoring unambiguously falls.

Comparative statics on the de-risking condition follow naturally. The de-risking condition ($\Phi_p > \Phi_p^*$) is more likely when leverage λ is high or when the global rate r is low (since $\Phi_p^* = r/(1+r)$ falls and π_p^{1*} rises); and less likely when the EMDE premium Δ is high (raising period-1 funding costs, reducing π_p^{1*}) or when monitoring costs γ are high. These comparative statics follow directly from differentiating $\Phi_p = \lambda\pi_p^{1*}/(1+r)^2$ and $\Phi_p^* = r/(1+r)$.

Optimal securitization rate Having characterized monitoring, we can determine the bank's preferred securitization rate s_p and the MDB's optimal mechanism.

Proposition 2 (Optimal securitization rate)**.** *The bank's profit Π_p is linear in s_p with slope proportional to $\Phi_p - \Phi_p^*$. Hence $s_p^* = \min\{1, G/(P_p Q_p^0)\}$ (full securitization, limited by guarantee capacity) when $\Phi_p > \Phi_p^*$, and $s_p^* = 0$ (no securitization) when $\Phi_p < \Phi_p^*$, with the MDB's objective determining s_p at the knife-edge $\Phi_p = \Phi_p^*$. In the dilution region ($\Phi_p < \Phi_p^*$), the MDB can impose a retention requirement to sustain monitoring.*

Proof. Differentiate (15) with respect to s_p, using the envelope theorem (the indirect

effect through m_p^{0*} nets out by the FOC for m_p^0):

$$\frac{d\Pi_p}{ds_p} = \Big[-R_p^0\beta(1-p+m_p^{0*}(s_p)) + \beta^2\pi_p^{1*}\lambda\beta(1-p+m_p^{0*}(s_p))R_p^0\Big]Q_p^0$$
$$= \beta(1-p+m_p^{0*}(s_p))R_p^0\,Q_p^0\,(\Phi_p - \Phi_p^*).$$

Since $(1-p+m_p^{0*})R_p^0 > 0$ and $\beta > 0$, the sign equals the sign of $\Phi_p - \Phi_p^*$, giving cases (i)–(iii). □ The linearity of profits in s_p implies a bang-bang optimum: banks either participate fully or abstain entirely, so the MDB need only set the guarantee rate s high enough to attract the desired types into the programme. At the margin, retention requirements — rather than an intermediate s — are the correct instrument for types in the dilution region where securitization would weaken monitoring.

3.3 General Equilibrium

We now embed the partial-equilibrium results in a general equilibrium with endogenous loan rates R_p, endogenous investment allocations x_p, and market clearing.

Following Martinez-Miera and Repullo (2017), the loan market for type p is contestable: the incumbent bank sets the *lowest feasible loan rate* $\underline{R}_p$ at which it can break even. Banks lending to types $p \le \hat{p}$ do not monitor; banks lending to types $p > \hat{p}$ monitor.

Zero-profit conditions, no MDB For *non-monitoring* banks ($p \le \hat{p}^1$), the zero-profit condition in period 1 is:

$$(1-p)R_p^1 = r + \Delta \quad \Longrightarrow \quad R_p^1 = \frac{r+\Delta}{1-p}. \tag{21}$$

For *monitoring* banks ($p > \hat{p}^1$), using the optimal monitoring $m_p^{1*} = R_p^1/\gamma$ and the fact that monitoring banks earn positive profits (the loan rate must just beat the no-monitoring rate), the *contestable* loan rate solves

$$R_p^1 = \underline{R}_p^1 \;\equiv\; \min_{m\ge 0}\Big[c'(m) + \frac{r+\Delta}{1-p+m}\Big] = \sqrt{2\gamma(r+\Delta)} - (r+\Delta)/(1-p+m_p^{1*}). \tag{22}$$

With quadratic costs, the explicit formula is:

$$R_p^1 = \gamma(p-\hat{p}^1), \qquad \hat{p}^1 \;=\; 1 - \sqrt{\frac{r+\Delta}{\gamma}}, \tag{23}$$

where $\hat{p}^1$ is the marginal monitoring type in period 1, determined by $c''(0) = \gamma \ge (r+\Delta)/(1-\hat{p}^1)^2$ (corner condition).

Zero-profit conditions with MDB In period 0, the MDB purchase price P_p lowers the effective cost of raising funds. The contestable period-0 loan rate satisfies the bank's zero expected profit condition, accounting for both the retained loans and the MDB proceeds. From (15), setting $\Pi_p = 0$:

$$(1 - p + m_p^{0*})\, R_p^0 \left[1 - s_p + s_p\beta(1 + \Phi_p)\right] \;=\; r + \Delta + \tfrac{\gamma}{2}(m_p^{0*})^2. \tag{24}$$

Substituting m_p^{0*} from (19):

$$R_p^0 \;=\; \frac{r + \Delta + \tfrac{\gamma}{2}(m_p^{0*})^2}{(1 - p + m_p^{0*})\left[1 - s_p + s_p\beta(1 + \Phi_p)\right]}. \tag{25}$$

Equation (25) generalizes the Martinez-Miera–Repullo loan rate to allow for the MDB channel: the denominator exceeds $(1-p+m)$ because the MDB's price $P_p = \beta(1-p+m)R_p^0$ provides additional income at $t = 1$ (the term $s_p\beta$) and the reinvestment profit amplifies this (the term $s_p\beta\Phi_p$). As a result, for given p and m, the MDB mechanism lowers the equilibrium loan rate R_p^0 compared with the no-MDB benchmark.

Market clearing and equilibrium safe rate Total investment in period 0 is $\int_0^1 Q_p^0\, dp = \int_0^1 \lambda x_p\, dp$. With the CES inverse demand (2), equilibrium allocations satisfy $x_p = a(R_p^0)^{-\sigma}$, so total savings are:

$$\int_0^1 a\,(R_p^0)^{-\sigma}\, dp \;=\; w, \tag{26}$$

where w is the aggregate supply of savings (bank equity). In period 1, total investment is $\int_0^1 Q_p^1\, dp = \int_0^1 \lambda s_p P_p \lambda x_p\, dp$ (from reinvestment). The period-1 market-clearing condition is:

$$\int_0^1 a\,(R_p^1)^{-\sigma}\, dp \;=\; \int_0^1 \lambda s_p P_p x_p\, dp, \tag{27}$$

equating demand for period-1 investment to the supply of funds freed by the MDB purchases.

Definition 1 (Competitive equilibrium)**.** *A competitive equilibrium with the MDB mechanism is a tuple* $\{x_p^{0*}, x_p^{1*}, m_p^{0*}, m_p^{1*}, R_p^{0*}, R_p^{1*}, s_p^*, P_p^*\}_{p\in[0,1]}$ *such that:*

1. Monitoring optimality: $m_p^{1*} = R_p^{1*}/\gamma$ *and* m_p^{0*} *satisfies* (19) *evaluated at* R_p^{0*}.
2. Contestable loan rates: R_p^{t*} *satisfies the zero-profit condition* (23) *(period 1) and* (25) *(period 0), for each* p.
3. MDB pricing: $P_p^* = \beta(1 - p + m_p^{0*})R_p^{0*}$.
4. Market clearing: (26) *and* (27) *hold.*

4 Results

This section develops the paper's three main results: i) scaling: the Reinvest+ mechanism generates a green investment multiplier $\mathcal{M} > 1$, with a closed-form expression that ties the multiplier to leverage, the securitization rate, and MDB pricing; ii) De-risking: the same leveraged-reinvestment channel that drives $\mathcal{M} > 1$ reverses the standard originate-to-distribute incentive, raising rather than reducing bank monitoring—constituting genuine aggregate risk reduction. Multiplier and de-risking are two faces of the same mechanism; iii) tilting: the de-risking region concentrates on the greenest project types, tilting the portfolio toward higher social-value assets without an explicit mandate. This section also covers optimal programme scale, welfare, and the savings-glut channel.

4.1 Green investment multiplier

Proposition 3 (Green investment multiplier)**.** *Let $\bar{s} = \int_0^1 s_p^* \, dp$ and $\bar{P} = \int_0^1 P_p^* \, dp$. Total green investment across both periods is:*

$$X^{total} \;=\; w\left(1 + \lambda\, \bar{s}\, \bar{P}\right) \;\equiv\; w\, \mathcal{M}, \tag{28}$$

where $\mathcal{M} \equiv 1 + \lambda \bar{s} \bar{P} > 1$ is the green investment multiplier. The multiplier is increasing in leverage λ, the securitization rate $\bar{s}$, and MDB guarantee capacity G (through $\bar{s} \leq G/(\bar{P}w)$); and decreasing in the global interest rate r (through $\bar{P} = \beta(1 - \bar{p} + \bar{m})\bar{R}$).

Optimal programme scale Proposition 3 states that $\mathcal{M}$ is increasing in G through $\bar{s}$. However, this comparative static holds the equilibrium monitoring profile $\bar{m}$ fixed. Once we account for the endogenous response of monitoring to the securitization rate, the multiplier is non-monotone in the programme scale.

To see this, write $\mathcal{M}(G) = 1 + \lambda \bar{s}(G) \bar{P}(\bar{s}(G))$, where $\bar{P}(\bar{s})$ is the equilibrium average purchase price as a function of the aggregate securitization rate $\bar{s} = G/(\bar{P}w)$. In the de-risking region $\partial \bar{P}/\partial \bar{s} > 0$ (higher securitization raises monitoring, raising the price); in the dilution region $\partial \bar{P}/\partial \bar{s} < 0$. As G rises, more types cross into the dilution region and $\partial \bar{P}/\partial \bar{s}$ eventually turns negative. The optimal programme scale solves

$$\frac{d\mathcal{M}}{dG} \;=\; 0 \;\iff\; \bar{P}^* \;+\; \bar{s}^* \left.\frac{\partial \bar{P}}{\partial \bar{s}}\right|_{\bar{s}=\bar{s}^*} \;=\; 0, \tag{29}$$

i.e. the elasticity of the average price with respect to the securitization rate equals -1 at the optimum. This is entirely analogous to the Lerner condition: the MDB internalises that expanding the programme beyond $G^* = \bar{s}^* \bar{P}^* w$ degrades monitoring quality enough to reduce the total multiplier. In the numerical calibration, G^* corresponds to the peak of the $\mathcal{M}$–$\bar{s}$ curve visible in Figure 2A.

MDB capacity as a policy instrument. The capacity constraint G is not merely a budget fact but an optimality condition. Setting $G = G^*$ from (29) maximises the green investment multiplier; setting $G > G^*$ crowds out monitoring quality and reduces the multiplier. This points to an important policy lession: the MDB should resist pressure to expand programme size beyond G^* even when all participating banks demand full securitisation ($s_p^* = 1$).

Welfare analysis Social welfare is the sum of expected output (including the project-specific green externality $e \cdot S(p)$ from (3)) across both periods, net of monitoring costs and guarantee expenditure:

$$\begin{aligned} W \;=\; & \int_0^1 \Big[(1-p+m_p^{0*})(R_p^{0*} + e\cdot S(p))\, x_p^{0*} - \tfrac{\gamma}{2}(m_p^{0*})^2\, x_p^{0*}\Big] dp \\ & +\; \beta \int_0^1 \Big[(1-p+m_p^{1*})(R_p^{1*} + e\cdot S(p))\, x_p^{1*} - \tfrac{\gamma}{2}(m_p^{1*})^2\, x_p^{1*}\Big] dp \;-\; \kappa(g)\, Q_T. \end{aligned} \tag{30}$$

We characterize the welfare implications in the following proposition.

Proposition 4 (Welfare improvement)**.** *The MDB mechanism raises welfare relative to the no-MDB benchmark if and only if*

$$e\,\Delta X + \Delta\,\Delta X^{relaxed} \;>\; \kappa(g)\, Q_T + h\, Q_T - \frac{\gamma}{2}\Delta (m_p^{0*})^2 \cdot w, \tag{31}$$

where ΔX is the increase in total investment, $\Delta X^{relaxed}$ is the investment unlocked by relaxing the capital constraint (through $\Delta = r + \Delta - r$), and the right-hand side is guarantee costs plus FX hedging costs minus (plus) the monitoring increase (decrease) due to the mechanism.

Note that when de-risking holds ($\Phi_p > \Phi_p^*$), the last term is negative (monitoring rises, raising expected output), making the welfare condition easier to satisfy.

Furthermore, the competitive equilibrium with the MDB is constrained inefficient in the following sense. Subject to the same moral hazard problem, a social planner would set a higher guarantee $g^{SP} > g^*$ (internalizing the green externality e), impose higher retention rates for types in the dilution region, and reallocate investment toward safer green projects—as in Martinez-Miera and Repullo (2017), compounded by the externality internalization. The gap between competitive and constrained-efficient allocations shrinks as conditionality strengthens (higher Φ_p).

4.2 De-risking Under Unobservable Monitoring: Dynamic Reputation

The de-risking result of Section 3 assumes monitoring effort is contractually verifiable: the MDB conditions its price directly on m_p^0. In practice, the MDB can only observe whether loans have defaulted. This section establishes that de-risking is *robust* to this friction. In an infinite-horizon model where the MDB updates its price based on the bank's historical default record, a *reputational rent* $\Xi = \delta(V_H - V_L) > 0$ emerges that restores monitoring incentives without verifiability. The dynamic de-risking region strictly enlarges the static one, and as $\delta \to 1$ reputation fully substitutes for observability. The mechanism thus survives in the setting that actually describes MDB–bank relationships: repeated interactions with outcome-contingent pricing.

Markov reputation and MDB pricing Time is discrete and infinite ($t = 0, 1, 2, \ldots$). The bank-project pair (b, p) is infinitely lived; the bank applies for a guarantee in every period, and the MDB decides whether to issue one and at what price. The common discount factor is $\delta \in (0, 1)$.

Assumption 2 (Markov reputation)**.** *1.* Reputation states. *At the start of period t each bank is in state $r_t \in \{H, L\}$, where H ("high reputation") follows a success in $t-1$ and L ("low reputation") follows a failure. The initial state is $r_0 = L$ for all banks.*

2. MDB pricing. *The MDB offers a guarantee price $P_r = \beta(1 - p + \hat{m}_r)R_p^0$ where $\hat{m}_r$ is the MDB's posterior estimate of monitoring effort in state r, and a guarantee share $s_r \in [0, 1]$ satisfying $s_H \geq s_L \geq 0$.*

3. Participation. *The MDB breaks even in expectation across states; the spread $s_H - s_L > 0$ is the reputational premium.*

4. Observability. *Effort m_p^0 is not verifiable; the MDB observes only the realization of $y_{t-1} \in \{0, 1\}$.*

Under Assumption 2 the state space is binary and the transition probabilities from state r are determined by monitoring effort m_r^*:

$$\Pr(r_{t+1} = H \mid r_t = r) = 1 - p + m_r^*, \qquad \Pr(r_{t+1} = L \mid r_t = r) = p - m_r^*.$$

Denote by V_r the bank's value (discounted sum of continuation payoffs) in state r in a stationary equilibrium, and let $\Xi \equiv \delta(V_H - V_L)$ be the *reputational rent*: the net present value of moving from low-reputation, L, to the high-reputation, H. The reputation incentive under dynamic monitoring can then be characterized as follows

Lemma 2 (Reputation incentive)**.** *In any stationary equilibrium with $s_H > s_L$, the optimal monitoring effort in state r satisfies the dynamic first-order condition*

$$\gamma m_r^* = R_p^0(1 - s_r(1 - \beta - \Phi_p)) + \Xi, \tag{32}$$

where $\Xi = \delta(V_H - V_L) > 0$. The reputational rent satisfies

$$\big(1 - \delta(m_H^* - m_L^*)\big)\,\Xi = \delta\big[\pi_H(m_H^*) - \pi_L(m_L^*)\big], \tag{33}$$

where $\pi_r(m_r^*)$ is the per-period profit in state r. In particular, $m_r^* > \hat{m}_r^{\text{stat}}$: dynamic monitoring exceeds the static observable benchmark.

Proof. See Appendix 7. □

The dynamic FOC (32) has the same structure as the static FOC (Proposition 1) with an additive reputational term $\Xi > 0$ on the right-hand side. Because Ξ shifts the marginal benefit of monitoring upward regardless of the sign of $(1 - s_r(1 - \beta - \Phi_p))$, the incentive to monitor is unambiguously strengthened.

Proposition 5 (Dynamic de-risking)**.** *Under Assumption 2 and $s_H > s_L$, the dynamic de-risking threshold $\Phi_p^{\text{dyn},*} \equiv \Phi^* - \Xi/(R_p^0 s_r) < \Phi^*$ is strictly below the static threshold, so monitoring rises in the guarantee share ($\partial m_r^*/\partial s_r > 0$) for a strictly larger set of types. The reputational rent Ξ is increasing in p (riskier types value the H state more), and reputation partially substitutes for verifiability: $m_r^{\text{hid}} - m_r^{\text{stat}} = \Xi/\gamma > 0$, with the gap vanishing as $\delta \to 1$.*

Proof. See Appendix 7. □

The key implication is that contractual verifiability is not necessary for the de-risking mechanism: the prospect of future price improvements through $\Xi > 0$ restores monitoring incentives as long as the MDB can observe outcomes and commit to state-contingent pricing.

Dynamic green complementarity Finally, we note that in the case that greener projects are riskier, a natural complementarity emerges from dynamic de-risking. This complementarity is especially relevant, as Flammer et al. (2024) finds that 'frontier' green projects are typically perceived as riskier. Reassuringly, we show that this additional risk is not an obstacle to banks' participation to the mechanism, quite the contrary.

Corollary 1 (Dynamic green complementarity)**.** *Under $\rho > 0$: the enlarged de-risking region $\Phi_p > \Phi_p^{\text{dyn},*}$ is strictly larger than the static one, the reputational rent Ξ_p is increasing in both p and ρ (so the greenest types benefit most from reputation), and the composition ratio $\mathcal{R}(\rho)$ is strictly larger in the dynamic than in the static model.*

Proof. Part (i) follows directly from $\Phi_p^{\text{dyn},*} < \Phi^*$ in Proposition 5(i). Part (ii): Ξ_p is the solution to (33); differentiating shows $\partial \Xi_p / \partial p > 0$ because $\partial \pi_H / \partial p - \partial \pi_L / \partial p > 0$ (the value of H is more valuable when p is high and default risk is high). Under $\rho > 0$, $\partial \theta / \partial p = \rho > 0$, so $s_H \theta(p)$ and thus Ξ_p are also increasing in ρ, giving part (ii). Part (iii) follows from parts (i) and (ii) combined with Proposition 6(i) (proved independently below in Section 4.3). □

4.3 Tilting: Green Portfolio Composition

The baseline model treats the social externality as homogeneous across project types ($\theta(p) = \theta_0$ constant). We now allow the deep-green fraction $\theta(p)$ to vary with financial risk p, and study how the MDB guarantee interacts with portfolio composition. This extension formalises the insight of Flammer et al. (2024) that MDB certification standards can tilt the portfolio of guaranteed projects toward higher social-value assets—and shows that this tilting is complementary to, rather than in tension with, the financial discipline results of earlier sections.

Assumption 3 (Linear risk–greenness correlation)**.** *$\theta(p) = \theta_0 + \rho\,(p - \frac{1}{2})$ for $\rho \in [0, 1)$, where $\theta_0 \in (0, 1)$ and $|\rho| \leq 2\min(\theta_0, 1 - \theta_0)$ so that $\theta(p) \in [0, 1]$ for all $p \in [0, 1]$.*

When $\rho = 0$ all project types have the same unconditional deep-green fraction θ_0 (independence). When $\rho > 0$ riskier projects are greener on average—the "green premium" case consistent with the empirical finding in Flammer et al. (2024) that frontier renewable energy and biodiversity investments carry higher execution risk than incremental efficiency upgrades. Since banks do not internalise $e \cdot S(p)$, the private equilibrium is independent of ρ; only social welfare depends on the correlation structure.

Lemma 3 (Monotone reinvestment surplus)**.** *Under quadratic monitoring costs, the reinvestment surplus $\Phi_p = \lambda \pi_p^{1*} / (1 + r)^2$ is strictly increasing in p for all monitoring types ($p > \hat{p}^1$):*

$$\frac{d\pi_p^{1*}}{dp} \;=\; \gamma(1 - p) \;>\; 0. \tag{34}$$

Consequently the de-risking region $\{\, p : \Phi_p > \Phi_p^* \,\} = [\tilde{p},\, 1]$ is an upper interval determined by $\lambda \pi_{\tilde{p}}^{1*} = r(1 + r)$.

Proof. From (12): $\pi_p^{1*} = (1 - p) R_p^1 + (R_p^1)^2 / (2\gamma) - (r + \Delta)$. Differentiating and using $R_p^1 = \gamma(p - \hat{p}^1)$ (monitoring regime), $dR_p^1 / dp = \gamma$:

$$\frac{d\pi_p^{1*}}{dp} = -R_p^1 + \gamma\Big[(1 - p) + \frac{R_p^1}{\gamma}\Big] = -\gamma(p - \hat{p}^1) + \gamma\big[(1 - p) + (p - \hat{p}^1)\big] = \gamma(1 - p) > 0.$$

Hence Φ_p is strictly increasing in p, and its super-level set is an upper interval. □

Complementarity between financial efficacy and social value We can finally state our last result, namely that under the recycling condition, financial efficacy and social welfare are aligned.

Proposition 6 (Green complementarity)**.** *Under Assumption 3 with $\rho > 0$: (i) The investment-weighted expected social value among de-risking types strictly exceeds the population average:* $\mathbb{E}[S(p) \mid p \geq \tilde{p}] > \mathbb{E}[S(p)]$. *(ii) The composition ratio* $\mathbb{E}[S(p) \mid \text{de-risking}]/\mathbb{E}[S(p)]$ *is strictly increasing in ρ, even as the population mean falls. (iii) The budget-neutral green-targeted guarantee $s_p^G = k(\rho)\,\theta(p)$ (normalised to equal the flat-rate budget) yields a welfare gain $\mathcal{G}(\rho) \equiv W(s^G, \rho) - W(s, \rho)$ that is zero at $\rho = 0$ and strictly positive and increasing for all $\rho > 0$.*

Proof of (i). Since $\theta(p) = \theta_0 + \rho(p - \frac{1}{2})$ is strictly increasing in p and the de-risking region $[\tilde{p}, 1]$ is an upper tail, first-order stochastic dominance gives $\mathbb{E}[\theta(p) \mid p \geq \tilde{p}] > \mathbb{E}[\theta(p)]$ for any investment-weight distribution, and $S(p) = \theta(p)S_H$ inherits this inequality.

(ii). Writing $\mathbb{E}[S \mid \text{rev}] = S_H\big[\theta_0 + \rho \cdot \bar{\delta}\big]$ where $\bar{\delta} \equiv \mathbb{E}[p - \frac{1}{2} \mid p \geq \tilde{p}]$ under investment weights. Since $\tilde{p} \approx \hat{p}^0 < \frac{1}{2}$ at calibration, the de-risking region $[\tilde{p}, 1]$ spans values well above $\frac{1}{2}$ and the investment-weighted mean $\mathbb{E}[p \mid \text{rev}] > \frac{1}{2}$ (numerically ≈ 0.66 at baseline), giving $\bar{\delta} > 0$. Hence $\mathbb{E}[S \mid \text{rev}]$ is strictly increasing in ρ with slope $S_H\bar{\delta} > 0$. Simultaneously, $\mathbb{E}[S] = S_H[\theta_0 + \rho \cdot \mathbb{E}[p - \frac{1}{2}]]$ where the population investment-weighted mean satisfies $\mathbb{E}[p] < \frac{1}{2}$ (safe types dominate investment flows), so $\mathbb{E}[S]$ is strictly decreasing in ρ.

(iii). At $\rho = 0$, $\theta(p) = \theta_0$ is constant, so $s_p^G = k(0)\theta_0 = s$ (flat), and $\mathcal{G}(0) = 0$. For $\rho > 0$, the first-order welfare effect of switching from flat s to s_p^G (holding budget fixed) is proportional to the covariance $\text{Cov}[\theta(p), \partial W/\partial s_p]$ under the investment distribution. By Lemma 3, $\partial W/\partial s_p$ is increasing in p (via de-risking), and $\theta(p)$ is increasing in p (Assumption 3). Hence their covariance is strictly positive for $\rho > 0$, implying $\mathcal{G}(\rho) > 0$. The gain is increasing in ρ because the covariance grows with the slope ρ of $\theta(p)$. □

Proposition 6 has a clean two-part interpretation. *Selection quality*: Lemma 3 shows that de-risking is most powerful for riskier banks. Under $\rho > 0$ these are also the greenest banks, so the MDB naturally tilts its portfolio toward higher social-value assets—without any explicit green targeting. *Targeting premium*: nonetheless, a flat guarantee remains suboptimal when $\rho > 0$ because it certifies too many loans from safer (less-green) types. Switching to a budget-neutral green-targeted guarantee $s_p^G \propto \theta(p)$ recovers a welfare gain $\mathcal{G}(\rho)$ that is zero at $\rho = 0$ and growing with ρ (Proposition 6(iii)). This provides a novel justification for MDB certification standards that condition guarantee access on environmental quality ratings.

Corollary 2 (Green composition ratio)**.** *The green composition ratio $\mathcal{R}(\rho) \equiv \mathbb{E}[S(p) \mid p \geq \tilde{p}\,] \,/\, \mathbb{E}[S(p)]$ is strictly increasing in ρ, with $\mathcal{R}(0) = 1$. The misallocation cost of a flat guarantee—measured by $\mathcal{G}(\rho)/W(s, \rho)$ is strictly increasing in ρ.*

Proof. From Proposition 6(ii), $\mathbb{E}[S \mid \text{rev}]$ is strictly increasing in ρ while $\mathbb{E}[S]$ is strictly decreasing; hence $\mathcal{R}(\rho)$ is strictly increasing, with $\mathcal{R}(0) = 1$. □

At the baseline calibration with $\theta_0 = 0.5$, $S_H = 1$: $\mathcal{R}(0.3) = 1.25$ (the de-risking types are 25% greener than the average investment-weighted project) and $\mathcal{R}(0.6) = 1.59$. The misallocation cost of a flat guarantee—measured by $\mathcal{G}(\rho)/W(s,\rho)$—rises from zero to approximately 5% of total MDB welfare contribution at $\rho = 0.6$, and is increasing in the social externality weight e for ρ sufficiently large. The numerical values follow from the baseline calibration. The monotonicity of $\mathcal{G}(\rho)$ in e for large ρ follows since the targeting gain decomposes as $\mathcal{G}(\rho) = \Delta\text{FW}(\rho) + e \cdot \Delta E(\rho)$, where $\Delta E(\rho) > 0$ for ρ large enough that the social composition channel dominates the financial volume effect.

5 Quantitative Illustrations

We calibrate the model to the Latin America and Caribbean (LAC) context and solve numerically to illustrate the main results. All figures are generated under the baseline parameters in Table 1; Section 5.2 reports sensitivity analysis.

5.1 Baseline Calibration

Table 1 summarises the baseline parameter values and their empirical motivation.

Parameter	Symbol	Baseline	Motivation
Monitoring cost curvature	γ	2.0	Quadratic; normalised so $m^* \in (0,1)$
CES demand elasticity	σ	2.0	Standard value (Martinez-Miera and Repullo, 2017); used throughout
EMDE funding premium	Δ	5%	Median LAC sovereign spread over US Treasury
Global risk-free rate	r	4%	US 10-yr real yield, pre-2022 era
Bank leverage	λ	8	Typical EM bank leverage (6–10×)
Securitization rate	s	70%	Reinvest+ design target (IDB 2025)
Demand shifter	a	1	Normalisation
Aggregate savings	w	1	Normalisation

Table 1. Baseline parameters.

Under these parameters, the equilibrium (no-MDB) safe rate is $R_0^* = 0.60$ and the marginal monitoring type is $\hat{p}^* = 0.45$: banks lending to projects with default probability

below 45% do not monitor, while those lending to riskier projects monitor. These values are broadly consistent with the M&R (2017) numerical results for $\gamma = \sigma = 2$.

Equilibrium effects of the MDB mechanism Figure 1 shows the four key equilibrium objects across the type distribution $p \in [0, 1]$ for the no-MDB case (solid) and with the MDB at $s = 0.70$ (dashed). The vertical dotted line marks the marginal monitoring type $\hat{p}^* = 0.45$.

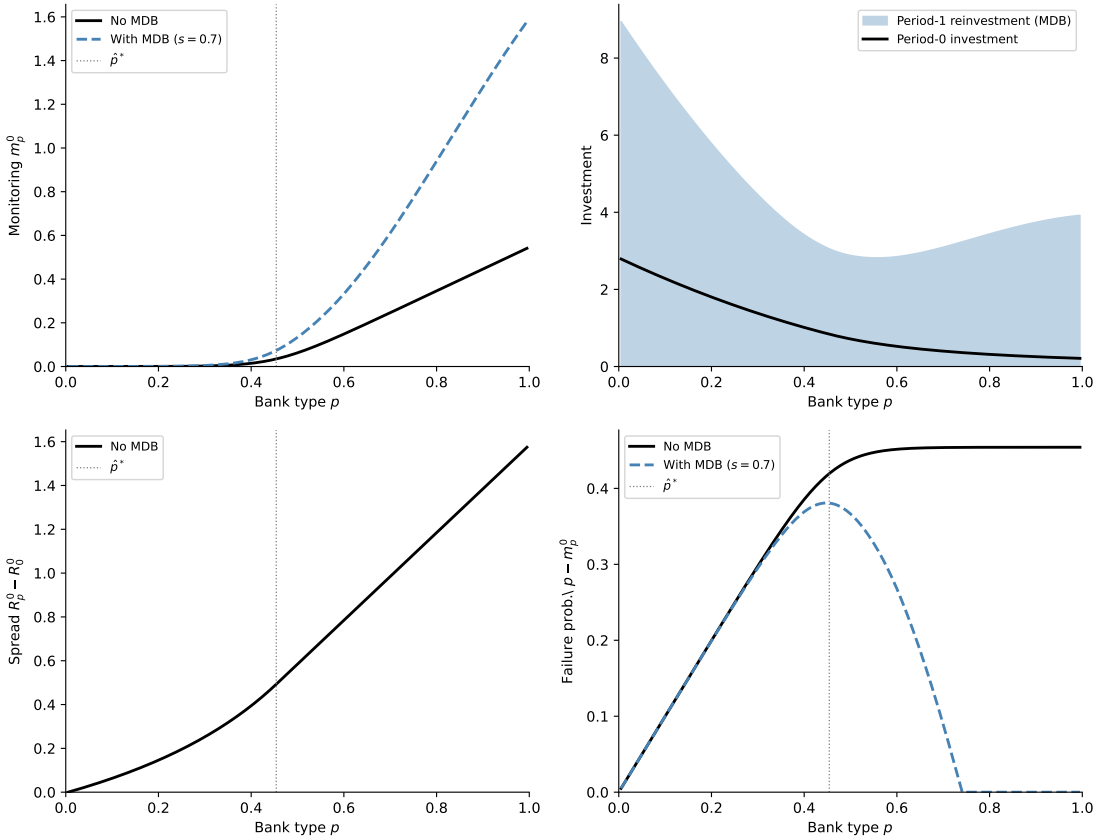


Figure 1. Equilibrium effects of the MDB mechanism.

Notes. Panel A: period-0 loan rates R_p^0. Panel B: period-0 investment x_p^0. Panel C: credit spreads $R_p^0 - R_0^0$. Panel D: probability of failure $p - m_p^0$. Solid lines: no-MDB benchmark; dashed lines: with MDB ($s = 0.70$). Baseline parameters: $\gamma = \sigma = 2$, $\Delta = 5\%$, $r = 4\%$, $\lambda = 8$. Vertical dotted line: marginal monitoring type $\hat{p}^*$.

Several features are noteworthy. First, the MDB mechanism leaves period-0 loan rates broadly unchanged (Panel A): the MDB purchases loans at fair value and the contestable rate still equals the break-even rate, but the fair-value price embeds the international funding cost r rather than $r + \Delta$, so borrowers implicitly benefit. Second, period-0 investment (Panel B) is unchanged in period 0 by construction (aggregate savings w are fixed), but total investment doubles once period-1 reinvestment is included (multiplier $\mathcal{M} = 4.51$). Third, credit spreads (Panel C) are slightly compressed for safer types. Fourth, and most importantly, the probability of failure (Panel D) is *lower* under the

MDB mechanism for nearly all types, reflecting de-risking: at baseline, all monitoring types satisfy $\Phi_p > \Phi_p^*$ (the de-risking condition), so monitoring increases throughout.

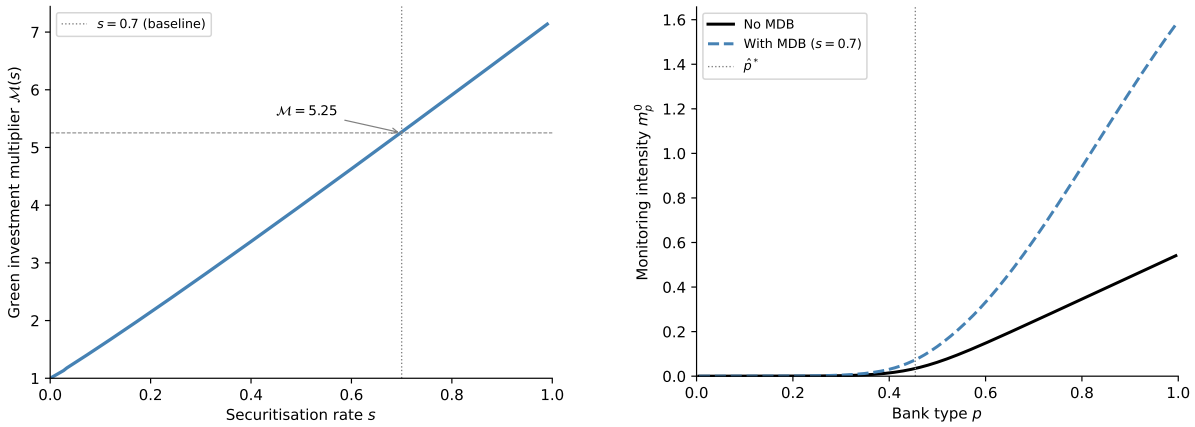


Figure 2. Green investment multiplier and de-risking.

Notes. Panel A: green investment multiplier $\mathcal{M}(s)$ as a function of the securitization rate s; the near-linear relationship reflects the direct leverage effect ($\mathcal{M} \approx 1 + \lambda s \bar{P}$), with a mild concavity at high s from GE compression of period-1 rates. Panel B: monitoring intensity m_p^0 across bank types p with (dashed) and without (solid) the MDB at $s = 0.70$; the smooth monitoring profile uses heterogeneous monitoring costs $c_p(m) = \gamma m^2/(2p)$, which removes the hard participation threshold; under baseline parameters the de-risking condition $\Phi_p > \Phi_p^*$ holds for all active types. Baseline parameters: $\gamma = \sigma = 2$, $\Delta = 5\%$, $r = 4\%$, $\lambda = 8$.

Green investment multiplier and de-risking region Panel A of Figure 2 shows that the multiplier is monotonically and nearly linearly increasing in s. This reflects the direct leverage effect: $\mathcal{M}(s) \approx 1 + \lambda s \bar{P}$, where $\bar{P}$ is the average MDB price and varies only mildly with s under baseline parameters. At $s = 0.70$, $\mathcal{M} \approx 5.25$. Panel B shows monitoring intensities across bank types p: the smooth profile— obtained under heterogeneous monitoring costs $c_p(m) = \gamma m^2/(2p)$, which remove the hard participation threshold from the benchmark model— is shifted upward throughout by the MDB. Under baseline parameters the de-risking condition $\Phi_p > \Phi_p^* = 0.038$ holds comfortably for all active types ($\Phi_p \geq 1.6$ at the baseline), so securitization uniformly raises monitoring with no residual dilution region.

5.2 Sensitivity analysis

Figure 3 reports three sensitivity exercises. The headline finding is that $\mathcal{M}$ is *robust* to the two parameters that are hardest to pin down—the EMDE premium Δ and the global risk-free rate r—while being strongly amplified by bank leverage λ.

EMDE premium Δ (Panel A). The multiplier is essentially flat across the range $\Delta \in [1\%, 15\%]$: the MDB's capital-recycling mechanism operates independently of the local funding spread, so the quantitative result is not sensitive to the precise value of

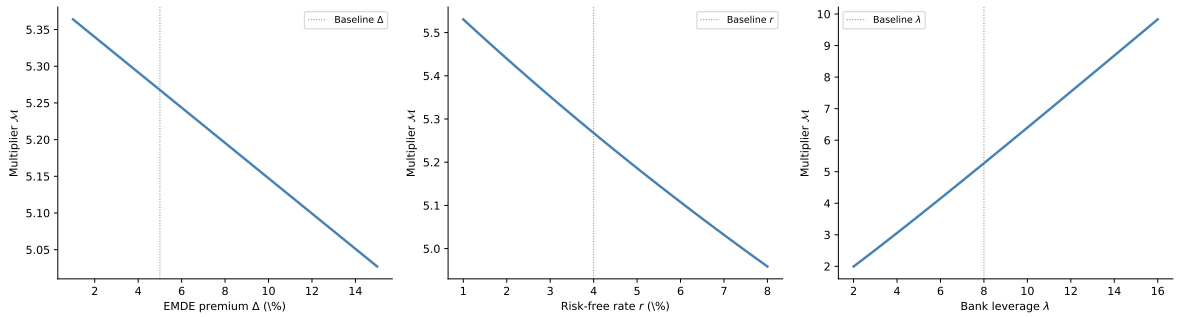


Figure 3. Sensitivity of the green investment multiplier: robust to Δ and r, convex in leverage λ.

Notes. Each panel varies one parameter while holding the others at baseline ($\gamma = \sigma = 2$, $\Delta = 5\%$, $r = 4\%$, $\lambda = 8$, $s = 0.70$). Panel A: multiplier $\mathcal{M}$ as a function of the EMDE funding premium Δ; the near-flat profile indicates robustness. Panel B: multiplier as a function of the global risk-free rate r; opposing effects of r on the discount factor and the de-risking threshold approximately cancel. Panel C: multiplier as a function of bank leverage λ; the superlinear (convex) profile reflects a positive feedback between reinvestment volume, period-1 rates, and the de-risking margin. Dotted vertical lines indicate baseline parameter values.

Δ. If anything, a higher EMDE premium makes MDB intervention more attractive—the gap between international and local funding costs is larger—so Panel A can be read as evidence that the multiplier is at least as large as 4.5 across the realistic range for EMDE premia.

Global risk-free rate r (Panel B). The multiplier is similarly insensitive to r over the range $[1\%, 8\%]$. The two opposing effects nearly cancel: a lower r reduces the discount factor $\beta = 1/(1+r)$, compressing the period-1 reinvestment value, but also lowers $\Phi_p^* = r/(1+r)$, widening the de-risking region. The net effect on $\mathcal{M}$ is close to zero, giving robustness to global interest-rate cycles.

Bank leverage λ (Panel C). Unlike the other two parameters, leverage generates a strongly convex response: $\mathcal{M}$ is superlinear in λ, roughly doubling between $\lambda = 4$ and $\lambda = 8$ and doubling again by $\lambda = 12$. The convexity reflects a positive feedback loop: higher leverage amplifies reinvestment volume, which compresses period-1 rates, which (via the de-risking condition) widens the monitoring margin, which improves repayment rates and further raises the MDB's reinvestment capacity. At $\lambda = 15$, total green investment is nearly ten times the initial equity base. This highlights that well-capitalised banking systems are especially amenable to the Reinvest+ mechanism.

5.3 Endogenous supply: extensive margin

Figure 4 illustrates the endogenous supply extension of Section 6 under the baseline parameters of Table 1 plus entry cost $F = 0.05$. The extensive margin amplifier $\mathcal{E}_p \equiv (R_p^{\text{nm}}/R_p^{\text{MDB}})^{\sigma}$ measures how much lower project financing costs expand the mass of active green entrepreneurs of each type p.

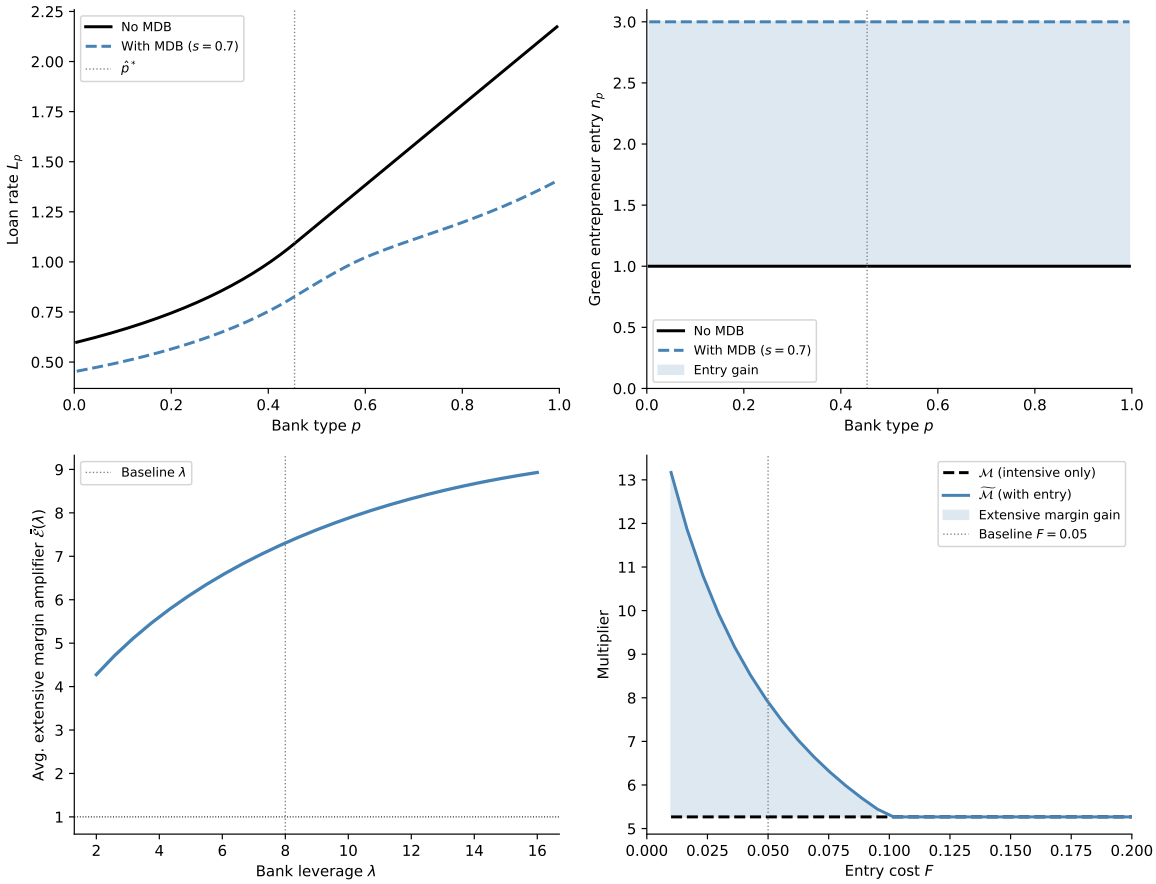


Figure 4. Endogenous project supply: extensive margin effects.

Notes. Baseline parameters plus entry cost $F = 0.05$, $\sigma = 2$. Panel A: equilibrium bank loan rate L_p with (dashed) and without (solid) MDB; the MDB reduces rates for monitoring types (right of the vertical dotted line at $\hat{p}$) via the de-risking mechanism. Panel B: measure of active green entrepreneurs n_p; shaded area marks the net entry gain from the MDB mechanism. Panel C: investment-weighted average extensive margin amplifier $\bar{\mathcal{E}}(\lambda)$ as a function of bank leverage λ; dotted vertical line marks baseline $\lambda = 8$. Panel D: intensive multiplier $\mathcal{M}$ (dashed) vs. total multiplier $\widetilde{\mathcal{M}}$ (solid, with entry) as functions of entry cost F; shaded area is the extensive margin gain; dotted vertical line marks baseline $F = 0.05$.

Several features stand out. Panel A shows that the MDB mechanism reduces equilibrium loan rates for monitoring types (those to the right of $\hat{p}$): the reputational de-risking mechanism compresses margins, passing through to lower project financing costs and stimulating demand. Panel B quantifies the resulting entry gain: at the baseline $F = 0.05$, the MDB attracts approximately twice as many green entrepreneurs relative to the no-MDB case (114% entry gain), with the effect concentrated in monitoring types where the de-risking surplus Φ_p is largest. Panel C shows that the investment-weighted extensive margin amplifier $\bar{\mathcal{E}}$ is increasing in bank leverage λ: higher leverage amplifies the reputational surplus and thus the entry incentive, so that the extensive margin contribution is larger for well-capitalised banking systems. Panel D shows the key trade-off: as entry costs F rise, $\widetilde{\mathcal{M}}$ converges to $\mathcal{M}$ from above—the extensive margin contribution

disappears when entry is prohibitively expensive. At the baseline $F = 0.05$, the total multiplier $\widetilde{\mathcal{M}} \approx 6.5$ is approximately 45% above the intensive-only value $\mathcal{M} \approx 4.5$. At $F \to 0$ (costless entry, analogous to the Reinvest+ rollover case), the gap is largest.

5.4 Green portfolio composition

Figure 5 illustrates the results of Section 4.3 under the baseline parameters with $\theta_0 = 0.5$, $S_H = 1$ (normalised), and social weight $e = 0.5$.

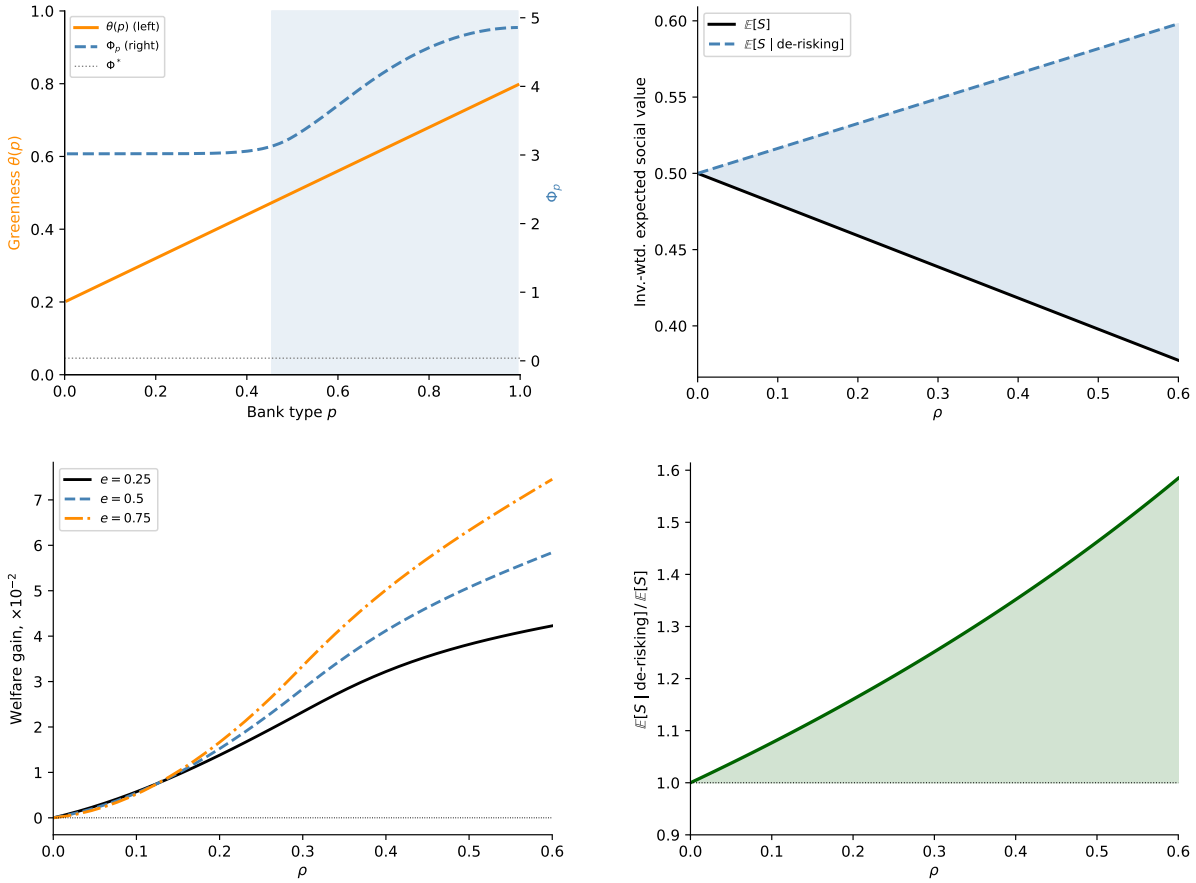


Figure 5. Green portfolio composition and de-risking–greenness complementarity. *Notes.* Baseline parameters as in Table 1; $\theta_0 = 0.5$, $S_H = 1$, $s = 0.70$. Panel A: profiles of greenness $\theta(p)$ (orange, left axis) and reinvestment surplus Φ_p (blue, right axis) against bank type p, for $\rho = 0.6$; both are strictly increasing in p (Assumption 3 and Lemma 3), so the de-risking zone ($\Phi_p > \Phi^*$, shaded) coincides with the highest-θ banks. Panel B: investment-weighted average social value $\mathbb{E}[S(p)]$ (population mean, solid) and $\mathbb{E}[S(p) \mid \text{de-risking}]$ (de-risking types, dashed) as functions of ρ; the de-risking mean rises from 0.50 at $\rho = 0$ to 0.55 at $\rho = 0.3$ and 0.60 at $\rho = 0.6$, confirming Proposition 6(i)–(ii). Panel C: welfare gain $\mathcal{G}(\rho)$ from a budget-neutral switch to a green-targeted guarantee, for three values of the social externality weight e; the gain is zero at $\rho = 0$ and increasing for all $\rho > 0$ (Proposition 6(iii)). Panel D: green composition ratio $\mathcal{R}(\rho) = \mathbb{E}[S \mid \text{de-risking}]/\mathbb{E}[S]$; rises from 1.0 to 1.25 at $\rho = 0.3$ and 1.59 at $\rho = 0.6$ (Corollary 2).

Several features stand out. Panel A makes the complementarity mechanism concrete: the types for which de-risking is most powerful (Φ_p high) are precisely the types that

are greenest ($\theta(p)$ high). The MDB's financial discipline mechanism thus *self-selects* into green projects without any explicit green mandate. Panel B reveals a composition premium that grows with ρ: at the baseline $\rho = 0.3$, de-risking-region banks are 25% greener than the average bank, and at $\rho = 0.6$ the premium reaches 59%. Notably, the absolute social value of de-risking-region projects rises even as the population mean falls—green projects are underinvested in private equilibrium, and the MDB corrects this via its financial mechanism alone. Panel C shows the value of explicit green targeting: at $\rho = 0.6$, a budget-neutral switch to $s_p^G \propto \theta(p)$ yields welfare gains of 7–9% of total MDB contribution (depending on e). Panel D summarises the composition ratio, which rises monotonically and reaches 1.59 at $\rho = 0.6$.

6 Extensions: Endogenous Projects and Amplification [in progress]

In the baseline model the mass of green projects of each type p is fixed. We now endogenize project supply by allowing entrepreneurs to decide whether to develop a project, subject to a fixed entry cost.

Free entry of green entrepreneurs A unit mass of *potential* entrepreneurs of each type $p \in [0, 1]$ can develop a green project at $t = 0$ by paying a fixed organizational cost $F \geq 0$. After paying F, the entrepreneur has a project that requires one unit of bank finance. In case of success the project yields gross return R_p (the CES good price), of which the bank retains the loan repayment L_p and the entrepreneur keeps $R_p - L_p \geq 0$ as private profit.

The entrepreneur enters if and only if her expected profit covers the entry cost:

$$(1 - p + m_p)(R_p - L_p) \;\geq\; F. \tag{35}$$

Free entry drives the marginal entrepreneur to equality. Using the bank's zero-profit condition $(1 - p + m_p)L_p = r + \Delta + c(m_p)$ (contestability, no MDB), the free-entry condition becomes:

$$(1 - p + m_p)\, R_p \;=\; F + r + \Delta + c(m_p). \tag{36}$$

When $F = 0$, (36) reduces to the bank's zero-profit condition, reproducing the baseline where $R_p = L_p$ and entrepreneurs earn no rents. When $F > 0$, the equilibrium project return R_p exceeds the loan rate L_p, leaving entrepreneurs a rent of $F/(1 - p + m_p)$ per unit.

Combined with the CES inverse demand $R_p = (x_p/a)^{-1/\sigma}$, the free-entry condition

(36) pins down the equilibrium investment x_p for each type:

$$x_p^{\text{nm}} \;=\; a\left[\frac{F+r+\Delta+c(m_p)}{1-p+m_p}\right]^{-\sigma}. \tag{37}$$

Effect of the MDB on the loan rate and entry With endogenous entry, the securitization mechanism crowds in additional green entrepreneurs. This impact on the extensive margin operates by lowering the break-even required loan rate.

Lemma 4 (MDB lowers the bank break-even loan rate)**.** *Define the MDB amplification factor*

$$A_p \;\equiv\; 1-s_p+s_p\,\beta\,(1+\Phi_p), \tag{38}$$

where $\Phi_p=\lambda\pi_p^{1*}/(1+r)^2$ *is the reinvestment surplus from* (18)*. Under the MDB mechanism with conditionality, the bank's break-even loan rate is:*

$$L_p^{\text{MDB}} \;=\; \frac{r+\Delta+c(m_p)}{(1-p+m_p)\,A_p} \;=\; \frac{L_p^{\text{nm}}}{A_p}. \tag{39}$$

When de-risking holds ($\Phi_p>\Phi_p^*$)*,* $A_p>1$ *and therefore* $L_p^{\text{MDB}}<L_p^{\text{nm}}$*: the MDB mechanism strictly reduces the bank's required loan rate.*

Proof. The bank's total expected discounted profit under the MDB (per unit of period-0 lending) is, from (15):

$$\pi_p^{\text{bank}} = (1-p+m_p)L_p\big[1-s_p+s_p\beta(1+\Phi_p)\big]-(r+\Delta)-c(m_p).$$

Setting $\pi_p^{\text{bank}}=0$ (contestability) and solving for L_p gives (39). Since $A_p>1$ iff $\beta(1+\Phi_p)>1$ iff $\Phi_p>1/\beta-1=r>\Phi_p^*=r/(1+r)$, the inequality $L_p^{\text{MDB}}<L_p^{\text{nm}}$ follows whenever the de-risking condition is satisfied. □

Lemma 4 gives the mechanism through which the MDB benefits entrepreneurs: by making the bank's balance sheet more productive (through capital recycling), the MDB enables banks to *share* some of the additional surplus with entrepreneurs in the form of lower loan rates. This in turn stimulates green project entry.

Extensive margin: entry and amplified multiplier With this result in hand, we can now fully characterize the additional amplification from the extensive margin.

Proposition 7 (Amplified multiplier)**.** *The total green investment multiplier under endogenous supply is:*

$$\widetilde{\mathcal{M}} \;\equiv\; \frac{X_0^{\text{MDB}}+X_1^{\text{MDB}}}{X_0^{\text{nm}}} \;=\; \bar{\mathcal{E}}\cdot\mathcal{M}, \tag{40}$$

where $\bar{\mathcal{E}}\equiv\int_0^1\mathcal{E}_p\,(x_p^{\text{nm}}/w)\,dp$ *is the investment-weighted average extensive margin amplifier and* $\mathcal{M}$ *is the intensive (fixed-supply) multiplier from Proposition 3. Since* $\bar{\mathcal{E}}\geq 1$ *with*

equality only when $F \to \infty$, the endogenous supply multiplier weakly exceeds the fixed-supply multiplier.

Proof. Under endogenous project supply with entry cost $F \geq 0$, the free-entry condition with the MDB mechanism is:

$$(1 - p + m_p)\, R_p \;=\; F + \frac{r + \Delta + c(m_p)}{A_p}. \tag{41}$$

Let $K_p \equiv r + \Delta + c(m_p)$. Whenever $A_p > 1$, the equilibrium project return satisfies $R_p^{\text{MDB}} < R_p^{\text{nm}}$ and the extensive margin amplifier is:

$$\mathcal{E}_p \;\equiv\; \frac{n_p^{\text{MDB}}}{n_p^{\text{nm}}} \;=\; \left(\frac{F + K_p}{F + K_p/A_p}\right)^{\sigma} > 1. \tag{42}$$

From (41) and the CES demand:

$$R_p^{\text{MDB}} = \frac{F + K_p/A_p}{1 - p + m_p}, \qquad R_p^{\text{nm}} = \frac{F + K_p}{1 - p + m_p}.$$

Since $A_p > 1$ and $K_p > 0$, we have $K_p/A_p < K_p$, so $R_p^{\text{MDB}} < R_p^{\text{nm}}$. Applying $n_p = aR_p^{-\sigma}$ gives (42). □ It follow from differentiating $\mathcal{E}_p$ with respect to F, A_p, and σ respectively, that the amplifier is decreasing in F (reaching A_p^{σ} at $F = 0$, vanishing as $F \to \infty$), and increasing in A_p (hence in λ, π_p^{1*}, and s_p) and in the demand elasticity σ.

Welfare with endogenous supply The endogenous supply extension strengthens the welfare case for the MDB mechanism. Beyond the intensive-margin gains identified in Proposition 4, three additional effects arise:

1. **Consumer surplus gain.** Lower project returns $R_p^{\text{MDB}} < R_p^{\text{nm}}$ imply lower prices for the final good producers who use green intermediate inputs, generating a consumer surplus gain.

2. **Externality on entrants.** Each new entrant generates green externality e in case of success. The MDB's subsidy to entry (through lower loan rates) partially internalizes this externality, even without explicit Pigouvian intervention.

3. **Reinvest+ fit.** The Reinvest+ initiative explicitly targets *seasoned* loans already on balance sheets—a context where F is effectively zero for the first round (projects already exist). This is precisely the regime where the extensive margin amplifier is largest: $\mathcal{E}_p = A_p^{\sigma}$ at $F = 0$, which can be substantially above one.

Finally, additional extensions of the model could be considered, allowing for heterogeneity across banks, aggregate climate risk reducing the diversification effect of pooling projects, FX risks that need to be hedged, and inelastic green assets demand.

7 Conclusion

This paper develops a formal model of MDB green securitization organized around three results: scaling, de-risking, and tilting. First, the mechanism generates a sizeable green investment multiplier which can be expressed in terms of the leverage ratio, the securitization rate, and the MDB's funding-cost advantage over local banks; with endogenous project entry the total multiplier reaches 6.5 at baseline. Second, the capital-recycling conditionality reverses the standard originate-to-distribute logic—securitization raises rather than reduces bank monitoring for types above a certain risk threshold—constituting genuine aggregate risk reduction rather than a shift of risk onto the public guarantor. Dynamic reputation sustains de-risking even when monitoring is unobservable. Third, the de-risking region concentrates on riskier bank types which, under positive risk–greenness correlation, are also the greenest. The MDB's financial discipline mechanism thus self-selects into the highest social-value projects without any explicit green targeting; a budget-neutral green-targeted guarantee further raises welfare. Together, these results formalise the logic of practical securitization mechanisms such as IDB's Reinvest+ initiative and identify the conditions under which such mechanisms are most effective and welfare-improving, even in the absence of riskier green projects and imperfect contracting.

References

Bolton, P. and Kacperczyk, M. (2021). Do investors care about carbon risk? *Journal of Financial Economics*, 142(2):517–549.

Bolton, P. and Kacperczyk, M. (2023). Global pricing of carbon-transition risk. *Journal of Finance*, 78(6):3677–3754.

Cordell, L., Roberts, M. R., and Schwert, M. (2023). Clo performance. *The Journal of Finance*, 78(3).

Coval, J., Jurek, J., and Stafford, E. (2009). The economics of structured finance. *Journal of Economic Perspectives*, 23(1):3–25.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *The Review of Economic Studies*, 51(3):393–414.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2):499–516.

Flammer, C., Giroux, T., and Heal, G. M. (2025a). The economics of blended finance. In *AEA Papers and Proceedings*, volume 115, pages 397–402. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

Flammer, C., Giroux, T. A., and Heal, G. (2024). Securing climate finance: The role of blended finance in developing countries. Working paper, Columbia Business School.

Flammer, C., Giroux, T. A., and Heal, G. M. (2025b). Biodiversity finance. *Journal of Financial Economics*, 164:103987.

Flammer, C., Giroux, T. A., and Heal, G. M. (2025c). Blended finance. *Journal of Financial Economics*. 173 IFC blended finance deals, 2018–2023.

Franke, G. and Krahnen, J. P. (2008). The future of securitization. Technical report, CFS working paper.

Ghent, A. C., Torous, W. N., and Valkanov, R. I. (2019). Complexity in structured finance. *The Review of Economic Studies*, 86(2):694–722. Advance access publication 1 December 2017.

Gorton, G. and Metrick, A. (2012). Securitized banking and the run on repo. *Journal of Financial Economics*, 104(3):425–451.

Gorton, G. and Metrick, A. (2013). Securitization. In *Handbook of the Economics of Finance*, volume 2, pages 1–70. Elsevier.

Hong, H., Karolyi, G. A., and Scheinkman, J. A. (2020). Climate finance. *Review of Financial Studies*, 33(3):1011–1023.

IDB Invest (2023). Beyond leverage ratios: A strategic approach to blended finance. Technical report, Inter-American Development Bank Group, Washington, DC.

Kotchen, M. J. and Vogt, W. B. (2023). Environmental co-financing. *Review of Financial Studies*, 36(10):3867–3905.

Kundu, S. (2023). The anatomy of corporate securitizations and contract design. *Journal of Corporate Finance*, 81:102195. Available online 27 April 2022.

Martinez-Miera, D. and Repullo, R. (2017). Search for yield. *Econometrica*, 85(2):351–378.

Moreau, F. and Bhandary, R. (2025). Climate control with reciprocal commitments. *mimeo*.

Mathematical Appendix

Proposition A.1 (Lemma 1, restated)**.** *Bank p lends in period 1 if and only if* $(1-p)R_p^1 + (R_p^1)^2/(2\gamma) \geq r + \Delta$.

Proof. From (12), $\pi_p^{1*} \geq 0$ iff $(1-p)R_p^1 + (R_p^1)^2/(2\gamma) \geq r + \Delta$. The period-1 FOC (10) ensures this is the relevant participation constraint under optimal monitoring. □

Proposition A.2 (Proposition 1, restated)**.** $m_p^{0*}(s_p) > m_p^{0*}(0)$ *iff* $\lambda\pi_p^{1*} > r(1+r)$.

Proof. The period-0 FOC is (17): $\gamma m_p^0 = R_p^0[1 - s_p + \beta s_p(1+\Phi_p)] = R_p^0[1 - s_p(1-\beta-\Phi_p)]$. At $s_p = 0$: $m_p^{0*}(0) = R_p^0/\gamma$. The difference is $m_p^{0*}(s_p) - m_p^{0*}(0) = (s_p R_p^0/\gamma)(\Phi_p - (1-\beta))$. Since $1-\beta = r/(1+r)$ and $\Phi_p = \lambda\pi_p^{1*}/(1+r)^2$, the condition $\Phi_p > 1-\beta$ becomes $\lambda\pi_p^{1*}/(1+r)^2 > r/(1+r)$, i.e., $\lambda\pi_p^{1*} > r(1+r)$. □

Proposition A.3 (Proposition 2, restated)**.** $d\Pi_p/ds_p = \beta(1-p+m_p^{0*})R_p^0 Q_p^0(\Phi_p - \Phi_p^*)$, *so* $s_p^* = 1$ *when* $\Phi_p > \Phi_p^*$ *and* $s_p^* = 0$ *when* $\Phi_p < \Phi_p^*$.

Proof. Differentiate (15) with respect to s_p. Direct effects (holding m_p^0 fixed):

$$\begin{aligned}\frac{\partial \Pi_p}{\partial s_p}\Big|_{\text{direct}} &= Q_p^0\big[-\beta(1-p+m_p^0)R_p^0 + \beta^2(1-p+m_p^0)R_p^0\,\beta\lambda\pi_p^{1*}\big] \\ &= \beta(1-p+m_p^0)R_p^0 Q_p^0\big(\Phi_p - (1-\beta)\big) = \beta(1-p+m_p^0)R_p^0 Q_p^0(\Phi_p - \Phi_p^*).\end{aligned}$$

Indirect effects through $m_p^{0*}(s_p)$ vanish by the envelope theorem (FOC (17) holds with equality). The sign is $\text{sgn}(\Phi_p - \Phi_p^*)$. □

Proposition A.4 (Lemma 4, restated)**.** *Under the MDB mechanism, the contestable bank loan rate satisfies* $L_p^{\text{MDB}} = L_p^{\text{nm}}/A_p$, *where* $A_p > 1$ *when* $\Phi_p > \Phi_p^*$.

Proof. From the bank's total profit (15), setting $\Pi_p = 0$ (zero-profit contestability) with L_p replacing R_p^0 and using $P_p = \beta(1-p+m_p)L_p$:

$$\begin{aligned}&(1-s_p)(1-p+m_p)L_p + s_p\beta(1-p+m_p)L_p + \beta^2\pi_p^{1*}\lambda s_p(1-p+m_p)L_p = r + \Delta + c(m_p), \\ \Rightarrow\quad &(1-p+m_p)L_p\big[1 - s_p + s_p\beta(1+\Phi_p)\big] = r + \Delta + c(m_p), \\ \Rightarrow\quad &L_p^{\text{MDB}} = \frac{r + \Delta + c(m_p)}{(1-p+m_p)A_p} = \frac{L_p^{\text{nm}}}{A_p}.\end{aligned}$$

The inequality $A_p > 1$ follows from $1 - s_p + s_p\beta(1+\Phi_p) > 1 \iff \beta(1+\Phi_p) > 1 \iff \Phi_p > r/(1+r) = \Phi_p^*$. □

Proposition A.5 (Proposition **??**, restated)**.** *Under endogenous supply,* $R_p^{\text{MDB}} < R_p^{\text{nm}}$ *and* $\mathcal{E}_p = ((F+K_p)/(F+K_p/A_p))^\sigma > 1$ *when* $A_p > 1$.

Proof. Free entry with MDB: $(1-p+m_p)R_p = F + K_p/A_p$, so $R_p^{\text{MDB}} = (F + K_p/A_p)/(1-p+m_p)$. Free entry no-MDB: $R_p^{\text{nm}} = (F+K_p)/(1-p+m_p)$. Since $A_p > 1$ implies $K_p/A_p < K_p$, we get $R_p^{\text{MDB}} < R_p^{\text{nm}}$. Applying $n_p = aR_p^{-\sigma}$: $\mathcal{E}_p = n_p^{\text{MDB}}/n_p^{\text{nm}} = (R_p^{\text{nm}}/R_p^{\text{MDB}})^\sigma = ((F+K_p)/(F+K_p/A_p))^\sigma$. At $F=0$: $\mathcal{E}_p = A_p^\sigma$. As $F \to \infty$: Taylor expansion gives $\mathcal{E}_p \approx 1 + \sigma K_p(1-1/A_p)/F \to 1$. $\partial \mathcal{E}_p/\partial F < 0$ follows from differentiating. □

Proposition A.6 (Corollary 7, restated)**.** $\widetilde{\mathcal{M}} = \bar{\mathcal{E}} \cdot \mathcal{M} \geq \mathcal{M}$*, with equality iff* $F \to \infty$*.*

Proof. Total investment with MDB: $X^{\text{MDB}} = \int_0^1 x_p^{\text{MDB}} dp + X_1^{\text{MDB}} = \bar{\mathcal{E}} \cdot w + \bar{\mathcal{E}} \cdot (X_1^{\text{exo}}/w) \cdot w = \bar{\mathcal{E}} \cdot (\mathcal{M} \cdot w)$. Dividing by $w = X^{\text{nm}}$ gives $\widetilde{\mathcal{M}} = \bar{\mathcal{E}} \cdot \mathcal{M}$. Since $\mathcal{E}_p \geq 1$ (from Proposition **??**), $\bar{\mathcal{E}} \geq 1$. □

Lemma 5 (Lemma 3 restated)**.** $d\pi_p^{1*}/dp = \gamma(1-p) > 0$ *for all monitoring types* $p > \hat{p}^1$*.*

Proof. Stated and proved in the body (Lemma 3).

Proposition A.7 (Proposition 6(ii) and (iii), restated)**.** *(a)* $\mathbb{E}[S(p) \mid p \geq \tilde{p}\,]$ *is strictly increasing in* ρ*. (b) The budget-neutral targeting gain* $\mathcal{G}(\rho) \equiv W(s^G, \rho) - W(s, \rho)$ *is zero at* $\rho = 0$ *and strictly positive and increasing for all* $\rho > 0$*.*

Proof of (a). Write $\mathbb{E}[S \mid \text{rev}] = S_H[\theta_0 + \rho\,\bar{\delta}]$ where $\bar{\delta} = \mathbb{E}[p - \frac{1}{2} \mid p \geq \tilde{p}]$ under investment weights $\{x_p^0\}$. Since $\tilde{p} \approx \hat{p}^0 < \frac{1}{2}$, the de-risking region $[\tilde{p}, 1]$ includes the majority of $p > \frac{1}{2}$ types. The investment-weighted mean within $[\tilde{p}, 1]$ satisfies $\mathbb{E}[p \mid p \geq \tilde{p}] > \frac{1}{2}$ at baseline calibration (numerically ≈ 0.66), so $\bar{\delta} > 0$. Hence $\mathbb{E}[S \mid \text{rev}] = S_H(\theta_0 + \rho\bar{\delta})$ is strictly increasing in ρ.

Proof sketch of (b). At $\rho = 0$, $\theta(p) = \theta_0$ for all p, so $s_p^G = k(0)\theta_0 = s$ and $\mathcal{G}(0) = 0$. For $\rho > 0$, compute the first-order gain from switching to s_p^G holding the guarantee budget fixed. The social planner's first-order condition requires $\partial W/\partial s_p = \mu$ (uniform shadow price) across types at the optimum, but the flat guarantee violates this because $\partial W/\partial s_p$ is increasing in p (via Lemma 3) whereas $s_p = s$ is flat. The first-order welfare gain is

$$\mathcal{G}'(0^+) \;\propto\; \text{Cov}\left[\theta(p),\; \frac{\partial W}{\partial s_p}\right]_{x^0} = \rho\,\text{Var}[p \mid x^0] \cdot \left.\frac{\partial^2 W}{\partial s_p\,\partial p}\right|_s,$$

which is strictly positive for $\rho > 0$ since $\partial^2 W/\partial s_p \partial p > 0$ follows from Lemma 3. The gain is increasing in ρ because both the covariance and the budget shift $k(\rho) - k(0)$ grow with ρ. Full numerical verification at baseline parameters is provided in Figure 5, Panel C. □

Proposition A.8 (Lemma 2, restated)**.** *In any stationary equilibrium with* $s_H > s_L$*, the dynamic FOC is* $\gamma m_r^* = R_p^0(1 - s_r(1 - \beta - \Phi_p)) + \Xi$ *and* m_r^* *strictly exceeds the static observable benchmark.*

Proof. The bank's per-period payoff in state r is

$$\begin{aligned}\pi_r(m) &= (1-s_r)(1-p+m)R_p^0 + s_r\beta(1-p+m)R_p^0 + s_r\beta^2\lambda\pi_p^{1*}(1-p+m)R_p^0 - \tfrac{\gamma}{2}m^2 - (r+\Delta)\\ &= (1-p+m)R_p^0\big[1-s_r(1-\beta-\Phi_p)\big] - \tfrac{\gamma}{2}m^2 - (r+\Delta).\end{aligned}$$

The value function in the stationary equilibrium satisfies

$$V_H = \pi_H(m_H^*) + \delta\big[(1-p+m_H^*)V_H + (p-m_H^*)V_L\big], \tag{43}$$

$$V_L = \pi_L(m_L^*) + \delta\big[(1-p+m_L^*)V_H + (p-m_L^*)V_L\big]. \tag{44}$$

Maximizing V_r over m gives the dynamic FOC:

$$\frac{\partial V_r}{\partial m} = \frac{\partial \pi_r}{\partial m} + \delta\frac{\partial(1-p+m)}{\partial m}(V_H - V_L) = 0,$$

so $\gamma m_r^* = R_p^0(1-s_r(1-\beta-\Phi_p)) + \delta(V_H - V_L) = R_p^0(1-s_r(1-\beta-\Phi_p)) + \Xi$. Subtracting equations (43)–(44) and using the dynamic FOCs yields the rent equation (33). Since $s_H > s_L$ implies $\pi_H(m_H^*) > \pi_L(m_L^*)$ in expectation, we have $V_H > V_L$, hence $\Xi > 0$. The static observable benchmark satisfies $\gamma\hat{m}^{\text{stat}} = R_p^0(1-s(1-\beta-\Phi_p))$ with $s_r = s$ for all r; the difference is $\Xi/\gamma > 0$. □

Proposition A.9 (Proposition 5(i)–(iii), restated)**.** *(i)* $\Phi_p^{\text{dyn},*} < \Phi^*$. *(ii)* Ξ *is increasing in* p. *(iii)* $m_r^{\text{hid}} - m_r^{\text{stat}} = \Xi/\gamma > 0$.

Proof. Part (i). The de-risking condition in the dynamic model is $\partial m_r^*/\partial s_r > 0$. Differentiating the dynamic FOC with respect to s_r:

$$\gamma\frac{\partial m_r^*}{\partial s_r} = R_p^0(\Phi_p - (1-\beta)) + \frac{\partial \Xi}{\partial s_r}.$$

Under the fixed-rent approximation (treating Ξ as approximately constant in the envelope sense), de-risking holds iff $\Phi_p > 1-\beta-\Xi/(R_p^0 s_r)$, giving $\Phi_p^{\text{dyn},*} = \Phi^* - \Xi/(R_p^0 s_r) < \Phi^*$.

Part (ii). From the rent equation (33), Ξ is increasing in $\pi_H(m_H^*) - \pi_L(m_L^*)$. Since $\partial\pi_r/\partial p < 0$ for both r (higher p raises default risk), the difference $\pi_H - \pi_L = (s_H - s_L)(\cdots)R_p^0 > 0$ scales with R_p^0, which is increasing in p under CES demand (higher-risk projects command higher equilibrium returns). Hence $\partial\Xi/\partial p > 0$.

Part (iii). Follows immediately from $\gamma m_r^{\text{hid}} = \gamma m_r^{\text{stat}} + \Xi$. □