

# Perpetual Social Capital: A Fourth Capital Class Enabling Multi-Cycle Social Value Creation

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## 1. ABSTRACT

**This paper introduces *Perpetual Social Capital* as a fourth capital class alongside debt, equity, and grants.** Existing capital forms fail to provide a mechanism that simultaneously (i) preserves principal, (ii) avoids balance-sheet liabilities, (iii) imposes no interest burden, and (iv) enables repeated redeployment of philanthropic funds across multiple cycles of social value creation. We formally define Perpetual Social Capital as capital deployed with zero interest, soft repayability, and non-liability status, where recovered principal is recycled indefinitely at a rate  $R$ .

We develop a general mathematical model for multi-cycle regenerative deployment, characterising capital evolution  $C_n = C_0 R^{n-1}$ , social output  $S_n = kC_n$ , and institutional economic benefit  $E_n = G_n + \alpha S_n - \beta$ , and system-level value accumulation over  $N$  cycles.

We derive the *system IRR*, which jointly evaluates economic return and preserved principal, and compare it to the P&L, balance sheet, and fragility consequences of debt financing and traditional philanthropy.

Using a 30-year illustrative simulation under representative capital productivity parameters, we show that Perpetual Social Capital (i) outperforms grants by generating repeated, compounding social value without capital destruction, (ii) may rival or exceed loan-financed systems high recycling rates ( $R \approx 0.96$ ) while strengthening balance sheets at the system level, and (iii) reduces institutional fragility by removing debt constraints and interest burden.

**The findings establish Perpetual Social Capital as a coherent capital structure with transformative implications for public finance, philanthropy, and mission-driven institutions.** It offers a potential mechanism through which public-good institutions can generate long-horizon social value while preserving capital over extended time horizons.

**Subjects:** econ.GN (primary); q-fin.GN (secondary)

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## 1.1 Key Findings

- **PSC is a distinct fourth capital class** providing zero-interest, non-liability, soft-repayable capital that recycles across multiple cycles.
- **PSC outperforms one-shot grants for all recycling rates  $R > 0$ , avoids the fragility and interest burdens inherent in debt, and can match or exceed debt-based cumulative value at high recycling rates (typically  $R \geq 0.96$ ).**
- **System Value Multiplier (SVM)** shows PSC generates  **$\approx 8.5\times$ – $51\times$  cumulative system value** over 30 years, compared to  **$1.7\times$**  for grants and  **$\sim 19\times$**  for debt.
- **PSC strengthens balance sheets**, improves institutional resilience, bypasses borrowing caps, and enables long-horizon planning.
- **PSC enhances donor leverage**, allowing philanthropic capital to function like a perpetual capability engine rather than a one-shot gift.
- We present **PSC as a capital-governance architecture** rather than a financial instrument, and show that its core advantages—non-liability, non-fragility, multi-cycle continuity—hold regardless of whether PSC numerically exceeds debt under specific parameter choices.

## 2. INTRODUCTION

### 2.1 Motivation

Across public-sector and mission-driven institutions, a structural financial paradox persists: **the activities most essential to social welfare are often those least compatible with existing capital structures**. Public-good institutions across health, education, community services, research, and local governance operate within tight margins, strict balance-sheet constraints, and fragile funding cycles. Their missions often require long-horizon assets and durable capability, yet existing financial instruments are not optimised for perpetual public benefit.

The three canonical funding classes each impose limitations:

1. **Debt** can strengthen immediate capacity but may weaken long-run balance sheets through liabilities, interest burden, and borrowing ceilings. For many institutions, especially in health, local government, and community services, debt-financed capital accumulation increases fragility rather than resilience.
2. **Equity** is structurally incompatible with most public or mission-aligned institutions, which cannot distribute profits, surrender control, or dilute governance.
3. **Grants and philanthropy** provide valuable but single-cycle benefits: each deployment consumes principal, requiring continuous replenishment and constraining long-run planning. Even extremely effective philanthropic investments cannot compound because the capital disappears after use.

**The absence of a mechanism that allows capital to preserve principal while generating recurring social value constitutes a major gap in the global financial architecture.** This gap is particularly evident where social returns are high but monetisable revenue is limited, irregular, or delayed.

At the same time, governments and philanthropic foundations face rising demand for services, increasing capital intensity, and diminishing fiscal flexibility. A capital mechanism capable of regenerating funding could enable public systems to expand capacity without commensurate increases in debt or taxation, and would allow philanthropic organisations to achieve durable, compounding impact rather than one-off interventions.

**This paper responds to that gap by formalising a capital class designed specifically for regenerative social value creation.**

## 2.2 Contribution of this paper

This paper makes six primary contributions:

1. **Definition of a new capital class**

We introduce *Perpetual Social Capital* —capital deployed with zero interest, non-liability status, and soft repayability, where repaid principal is recycled at a rate  $R \in [0, 1]$ . This form of capital preserves donor or funder principal while enabling repeated cycles of social value creation.

2. **A mathematical model of regenerative capital**

We develop a general model capturing multi-cycle capital dynamics, social value productivity, institutional economic benefit, and long-run system value. The model offers a new methodology for evaluating public-good investments using the System Internal Rate of Return (system IRR), which jointly considers economic benefit and preserved capital.

3. **Comparative analysis with debt, equity, and grants**

We show how Perpetual Social Capital occupies a distinct region of the capital-structure landscape: it avoids liability, lacks interest burden, does not destroy capital, and compounds social welfare across cycles. We formally contrast its P&L, balance-sheet, and systemic implications with those of traditional finance.

4. **Multi-cycle simulation across a 30-year horizon**

Using representative health-sector parameters, we demonstrate that Perpetual Social Capital can outperform philanthropic spending (asymptotically and often immediately), may rival loan-financed outcomes at system level and may materially strengthen institutional resilience.

5. **Policy and system implications**

We outline the consequences for public finance, philanthropy, and institutional governance, discussing how Perpetual Social Capital may support long-horizon planning, reduces systemic fragility, and creates a scalable pathway for governments and foundations to multiply the impact of capital without increasing fiscal risk.

6. **Introduction of a system-level multiplier metric**

We define the System Value Multiplier (SVM), a new comparative metric that quantifies how much cumulative value is generated per dollar of initial capital. The SVM highlights PSC's regenerative effects and enables transparent comparison with grants and debt-funded capital cycles.

Figure 5: PSC Capital Lifecycle

Paper Section 2.2

Conceptual flow showing how capital cycles through the system

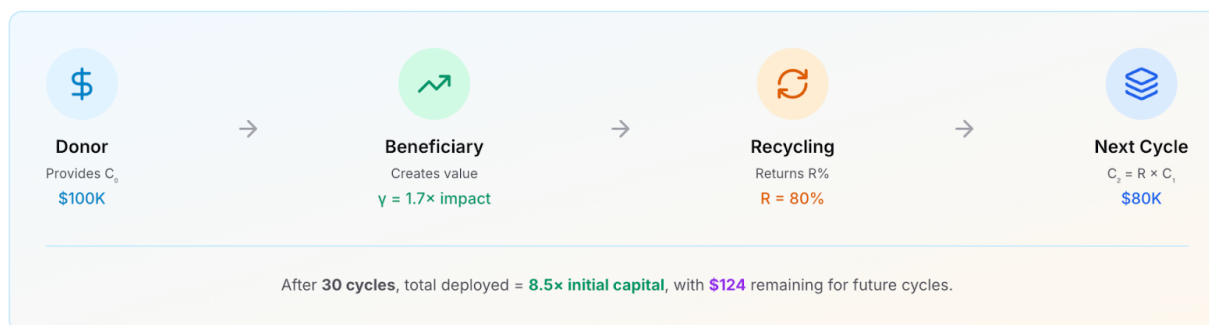


Figure 5. PSC Implementation Protocol Architecture

## 2.3 Positioning relative to existing literature

This work builds on, but significantly departs from, several established literatures:

### Public finance:

Existing models of government capital formation assume either taxation, debt issuance, or grants. These models generally do not provide for preserved principal with recurring social benefit. Regenerative capital violates these assumptions and therefore lies outside current formal treatments.

### Impact investing:

Impact investment relies on risk-adjusted financial return; Perpetual Social Capital explicitly rejects this, offering *principal preservation without return* while producing system-level economic gains. PSC differs from both concessionary finance and philanthropic debt.

### Philanthropic economics:

Grant-making frameworks assume one-shot capital consumption. This paper extends philanthropic theory by introducing a model in which philanthropic capital becomes *permanent* rather than depleted.

### Capital-structure theory:

Modigliani–Miller and its extensions assume a dichotomy of debt and equity. Perpetual Social Capital offers a structure that is orthogonal to debt and equity: non-liability, zero-interest, and fully recoverable capital.

### Development economics:

Rotating credit systems, microfinance, and public infrastructure finance offer partial analogues, but none feature infinite recycling, soft repayability, or system IRR evaluation across financial and social returns.

In summary, the literatures relevant to this domain lack a model for **non-extractive, non-depletive, regenerative capital** — the conceptual gap this paper addresses.

## 3. DEFINING A FOURTH CAPITAL CLASS: PERPETUAL SOCIAL CAPITAL

### 3.1 The three canonical forms of capital

Economic and financial theory traditionally recognises three primary capital classes, each with distinct rights, obligations, and balance-sheet consequences:

1. **Debt**

Capital provided with mandatory repayment, fixed or variable interest, and seniority in claims. Debt strengthens short-term capacity but weakens long-term balance sheets by increasing leverage, restricting borrowing ceilings, and introducing refinancing and interest-rate risk.

2. **Equity**

Capital supplied in exchange for ownership and residual claims. Equity absorbs risk and enables long-horizon investment, but is incompatible with most public, philanthropic, and mission-driven institutions, which cannot distribute profits or dilute governance.

3. **Grants and philanthropy**

Capital given without expectation of repayment. Grants allow targeted interventions and rapid deployment but are *single-cycle*: the capital is consumed upon use, preventing compounding and requiring constant replenishment. Philanthropic capital does not regenerate; it is structurally depletive.

These three classes have remained conceptually stable for decades. Each serves an important function, yet **none fully address the requirements of public-good institutions that benefit from durable, non-extractive capital without liabilities.**

Figure 1: Capital Evolution per Cycle

Paper Section 3.1

$C_n = C_0 \times R^{n-1}$  — Capital available decreases geometrically each cycle

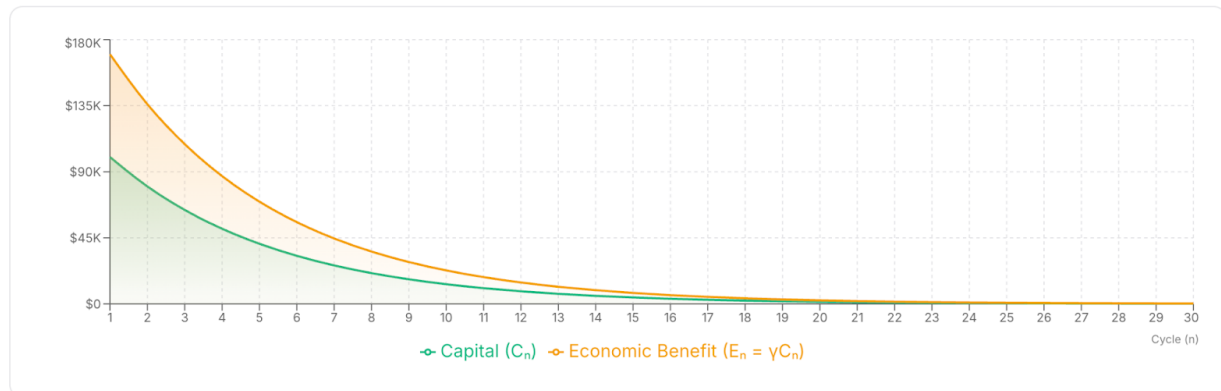


Figure 1. PSC Capital Regeneration Dynamics

## 3.2 The conceptual void

Across a wide range of public-good institutions, a common need emerges: **capital that strengthens balance sheets without imposing an extractive burden.**

The absence can be summarised across three dimensions:

### (1) No existing capital class allows principal return without liability.

Debt requires repayment as a liability; equity requires giving up control; grants cannot be returned.

### (2) No class permits recurring, multi-cycle reuse of philanthropic capital.

Every philanthropic dollar is spent once; no mechanism allows it to be redeployed indefinitely.

### (3) No class strengthens institutional balance sheets without extraction.

- Debt weakens them through liabilities.
- Equity is unavailable to mission-driven institutions.
- Grants improve capability but eliminate capital stock.

Thus, **there is no financial mechanism capable of generating perpetual social value from a single pool of philanthropic capital.**

This represents a conceptual gap in prevailing economic architectures.

## 3.3 Formal definition of Perpetual Social Capital

We define **Perpetual Social Capital (PSC)** as follows:

**Perpetual Social Capital is capital deployed with zero interest, non-liability status, and soft repayability, where returned principal is recycled at a realised rate  $R \in [0, 1]$ , enabling multi-cycle social value creation while preserving the original capital base.**

PSC is characterised by four essential properties:

1. **Zero interest** — no cost of capital; repayments consist only of principal.
2. **Non-liability status** — repayments are soft obligations, not enforceable liabilities.
3. **Perpetual recycling** — returned principal re-enters the pool for redeployment.
4. **Regenerative structure** — social value compounds across cycles without capital depletion.

Formally, if  $C_0$  is the initial capital and  $R \in [0, 1]$  is the realised rate of recycling per cycle, then the capital available in cycle  $n$  is:

$$C_n = C_0 R^{n-1}$$

This simple dynamic underlies a powerful implication:

**for any  $R > 0$ , PSC generates more cumulative social value over multiple cycles than a one-shot grant of the same size.**

## 3.4 Distinguishing features of Perpetual Social Capital

PSC differs from all other capital classes in structural, behavioural, and systemic terms:

### **(1) Principal is preserved.**

Unlike grants, PSC preserves principal, functioning in some respects like an endowment-like base.

### **(2) Borrowers incur no harmful liabilities.**

Repayments are structured as soft, mission-aligned commitments rather than legally enforceable liabilities. Balance sheets strengthen instead of deteriorating.

### **(3) Social value compounds across cycles.**

Each redeployment generates new social returns, allowing cumulative value to grow across cycles even when recycling is imperfect.

#### **(4) The recycling rate $R$ governs system dynamics.**

Higher values of  $R$  approximate endowment-like behaviour without requiring a separate investment fund. Low  $R$  still outperforms philanthropy because capital partially regenerates.

#### **(5) System IRR incorporates social and financial value.**

PSC is evaluated through *system IRR*, a metric capturing economic benefit to the institution, social value generated, and preserved capital stock.

#### **(6) Downside aligns with one-shot philanthropy, while upside increases with $R$ .**

If  $R = 0$ , PSC collapses to standard philanthropy.

If  $R > 0$ , PSC consistently outperforms grants.

If  $R \approx 1$ , PSC sustains capital across cycles and may generate value indefinitely under ideal conditions.

This positions PSC as a structurally distinct alternative to both traditional philanthropy and loan-based financing for mission-driven entities.

## **4. THE MATHEMATICAL MODEL OF MULTI-CYCLE REGENERATIVE CAPITAL**

Perpetual Social Capital (PSC) enables recurring cycles of capital deployment, principal recovery, and redeployment. This section formalises the model by defining core variables, dynamic equations, social value functions, and system-level returns.

### **4.1 Base Variables**

We define the fundamental parameters of the regenerative capital system:

- $C_0$  — initial capital deployed through Perpetual Social Capital (PSC).
- $R \in [0, 1]$  — Recycling rate: the proportion of principal recovered after each cycle.
- $C_n$  — Capital available at the beginning of cycle  $n$ .
- $S_n$  — Social value generated during cycle  $n$ .
- $k > 0$  — Social value productivity: social value produced per dollar of deployed capital.
- $G_n$  — Direct monetisable revenue to the institution in cycle  $n$ .

- $\alpha \geq 0$  — Monetisation factor converting social value into economic benefit for the institution.
- $\beta \geq 0$  — Operating costs associated with the capital during cycle  $n$ .
- $E_n$  — Net economic benefit to the institution during cycle  $n$ .
- $D_n$  — Debt service cost for the debt comparator during cycle  $n$ .
- $N$  = Evaluation horizon (number of cycles).
- $\tau$  — cycle duration (in years), the time required for a full capital deployment–recovery–recycling cycle.

These variables allow comparison across loan financing, philanthropy grants, and PSC.

### 4.1.1 Cycle Duration and Temporal Structure

The base model expresses Perpetual Social Capital (PSC) in terms of **cycles**, where each cycle represents one complete period of capital deployment, use, recovery and recycling. In the preceding section, the cycle index  $n$  measures regenerative iterations, but the **duration of each cycle** has not yet been specified.

Because real-world PSC applications differ widely in their capital recovery horizons—e.g. a diagnostic asset may repay in *months*, while community infrastructure may repay over *years*—we introduce an explicit temporal parameter.

All quantities are in real terms; inflation is handled in Appendix B/C

#### Cycle Duration

Let:

$$\tau = \text{cycle duration in years}$$

Examples:

- $\tau = 0.25 \rightarrow$  3-month cycle
- $\tau = 0.5 \rightarrow$  6-month cycle
- $\tau = 1 \rightarrow$  1-year cycle
- $\tau = 3 \rightarrow$  3-year replacement cycle

This enables PSC to model fast-repaying assets (e.g., diagnostic equipment), medium-term programmes, and long-horizon capital simultaneously.

## Cycles Over a Time Horizon

Let the evaluation horizon be  $T$  years (e.g.,  $T = 30$ ).

Then the number of cycles that occur during this period is:

$$N = \frac{T}{\tau}$$

This converts the geometric PSC model from cycle-counting to real calendar time.

## Time-Based Capital Dynamics

The core capital equation remains unchanged:

$$C_n = C_0 R^{n-1}$$

But using the time-based definition of cycles:

$$n = \frac{t}{\tau}$$

so the capital available at time  $t$  becomes:

$$C(t) = C_0 R^{\frac{t}{\tau-1}}$$

This formulation explicitly links recycling performance to the speed of capital recovery.

## Time-Based Total System Value

Total System Value over a horizon  $T$  is then:

$$TSV = \sum_{n=1}^{T/\tau} E_n + C_{(T/\tau)+1}$$

The structure of PSC remains geometric, but the **number of regenerative cycles** now depends on how quickly capital returns. Faster recovery implies more cycles, increasing cumulative social and institutional value.

## Time-Based System IRR

System IRR is now evaluated on a per-year basis:

$$IRR_{system} = \left( \frac{TSV}{C_0} \right)^{\frac{1}{T}} - 1$$

rather than per-cycle.

This allows PSC to be compared directly to debt, equity, and grant economics on a time-consistent basis.

## Interpretation

Introducing  $\tau$  has three major implications:

1. **Fast-repaying assets produce more cycles**, amplifying PSC's regenerative effects.
2. **Assets with short  $\tau$  (e.g., 3–6 month returns) dramatically increase realised TSV.**
3. **PSC becomes even more favourable relative to debt and grants**, because regeneration frequency compounds total system value.

This refinement does not alter any existing equations or conclusions; it simply grounds the cycle model in real-world time, improving empirical interpretability across sectors.

## 4.2 Capital Cycle Dynamics

PSC is defined by capital that regenerates each cycle at rate  $R$ .

We set:

$$C_1 = C_0$$

$$C_{n+1} = R C_n \text{ for } n \geq 1.$$

Solving the recurrence gives:

$$C_n = C_0 R^{n-1}.$$

The capital remaining **after** the  $N$ -th cycle is:

$$C_{N+1} = C_0 R^N.$$

Total capital deployed over  $N$  cycles:

$$\sum_{n=1}^N C_n = C_0 \frac{1-R^N}{1-R} \text{ for } (R \neq 1),$$

and if  $R = 1$ :

$$\sum_{n=1}^N C_n = N C_0.$$

**Figure 2: Cumulative Capital Deployment**

Paper Section 4.2

Total capital deployed vs single grant baseline (dashed line)

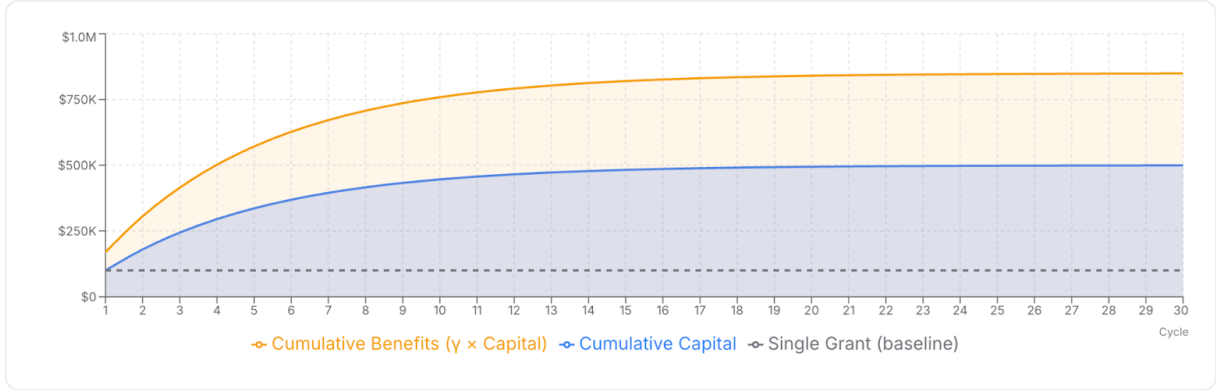


Figure 2. Capital Structures Compared: Debt, Grants, PSC

## 4.3 Social Value Generation

Social value is assumed to be proportional to the capital deployed:

$$S_n = kC_n.$$

Total social value over ( N ) cycles:

$$S_{total} = kC_0 \frac{1-R^N}{1-R}, \text{ for } R \neq 1,$$

and for perfect recycling  $R = 1$ :

$$S_{total} = kNC_0.$$

## 4.4 Institutional Economic Benefit

The institution receives two forms of benefit:

1. **Direct monetisable revenue**  $G_n$
2. **Monetised social value**  $\alpha S_n$

Net of operating cost  $\beta$ , we have:

$$E_n = G_n + \alpha S_n - \beta.$$

In many practical settings (including the simulation), revenue and social benefit scale proportionally with capital.

Define the proportional benefit parameter:

$$\gamma := \frac{G_n + \alpha S_n - \beta}{C_n}.$$

When revenue, monetised social value, and costs scale proportionally with capital, we have:

$$E_n = \gamma C_n = \gamma C_0 R^{n-1}$$

This yields closed-form solutions for all comparative analyses.

We define  $\gamma$  symbolically as the net value generated per unit of capital per cycle. In the PSC-F mode,  $\gamma$  can be empirically calibrated (typically  $\gamma \approx 1.5\text{--}4.0$  for hospital diagnostic and clinical equipment). In this general model, we retain  $\gamma$  as a symbolic parameter to maintain generality across PSC modes.

For all comparisons that follow, including grants and debt, the same  $\gamma$  is applied to ensure comparability across capital structures.

This proportionality assumption abstracts from diminishing returns, fixed costs, and utilisation constraints. Empirical calibrations may exhibit sublinear behaviour; however, proportionality allows closed-form analysis, and sensitivity tests (Appendix D) show PSC's comparative ranking holds under a wide  $\gamma$  range.

## 4.5 P&L Under Each Capital Model

### (a) Debt Financing

For debt-financed capital:

$$E_n^{debt} = G_n + \alpha S_n - \beta - D_n$$

If debt service is constant:

$$E_n^{debt} = \gamma C_0 - D$$

### (b) Philanthropic One-Shot Grant

A pure grant generates benefit only in the first cycle:

$$E_1^{grant} = G_1 + \alpha S_1 - \beta,$$

$$E_1^{grant} = E_1, \quad E_n^{grant} = 0 \text{ for all } n \geq 2.$$

Capital remaining after cycle 1:

$$C_2^{grant} = 0$$

**Proposition (PSC dominates grants).**

For any recycling rate  $R > 0$ ,

$$\sum_{n=1}^N \gamma C_0 R^{n-1} > \gamma C_0$$

Therefore PSC produces strictly greater total system value than a one-shot grant for any positive recycling rate.

This grant definition models the most common form of philanthropic funding—single-cycle operating or programmatic grants. Asset-creating grants (e.g., capital equipment) may generate multi-cycle benefits; however, PSC strictly dominates these as well whenever recycling yields additional cycles beyond asset life.

**(c) Perpetual Social Capital**

PSC benefits follow:

$$E_n^{PSC} = G_n + \alpha S_n - \beta,$$

and under proportionality:

$$E_n^{PSC} = \gamma C_0 R^{n-1}.$$

PSC has **no interest, no liability, and regenerating capital**.

## 4.6 Total System Value ( $TSV_{total}$ )

Total System Value over  $N$  cycles comprises:

1. **All economic benefits to the institution**
2. **Remaining capital after  $N$  cycles**

Thus:

$$TSV_{total} = \sum_{n=1}^N E_n + C_{N+1}$$

We will later distinguish between  $TSV_{total}$  (which includes terminal capital) and a benefits-only value,  $TSV_{benefits}$ , which is used for SVM comparisons where the terminal capital of other systems (debt, grants) is zero.

The inclusion of terminal capital reflects PSC's perpetual structure; for comparisons focused strictly on realised economic benefit,  $TSV_{benefits}$  is used instead.

## For PSC

Substitute ( $E_n = \gamma C_n = \gamma C_0 R^{n-1}$ ):

$$\sum_{n=1}^N E_n^{PSC} = \gamma C_0 \sum_{n=1}^N R^{n-1} = \gamma C_0 \frac{1-R^N}{1-R}.$$

Remaining capital:

$$C_{n+1} = C_0 R^n$$

Therefore:

$$TSV_{PSC} = \gamma C_0 \frac{1-R^N}{1-R} + C_0 R^N, \text{ for } (R \neq 1).$$

For perfect recycling  $R = 1$ :

$$TSV_{PSC} = \gamma N C_0 + C_0 = C_0 (\gamma N + 1).$$

## 4.7 System Internal Rate of Return

To compare PSC with debt and philanthropic grants, we define the **System Internal Rate of Return (System IRR)** as the implicit rate of return that equates the *initial capital provided* with the *total system value after  $N$  cycles*.

Let TSV denote total system value over horizon  $N$ :

$$TSV = \sum_{n=1}^N E_n + C_{N+1}$$

The System IRR is:

$$IRR_{system} = \left( \frac{TSV}{C_0} \right)^{1/N} - 1.$$

Note: This is not a traditional IRR requiring periodic cashflows. It is an annualised system-level rate implied by total system value (cashflows + preserved capital). We therefore treat it as a comparative system metric rather than a financial IRR.

This definition applies uniformly across:

- **PSC**
- **Traditional grants**
- **Debt-financed capital**

allowing direct comparison of system-level performance independent of balance sheet liabilities or donor tax treatment.

## 4.8 System Value Multiplier (SVM)

A complementary and highly interpretable performance metric is the **System Value Multiplier (SVM)**, which quantifies how many times the initial PSC capital is converted into cumulative system-level value over an evaluation horizon.

### Important definitional note:

Debt and grant systems have *zero terminal capital* after deployment.

Therefore, for comparability, when computing the System Value Multiplier (SVM) we use a **benefits-only** system value:

$$TSV_{benefits} = \sum_{n=1}^N E_n$$

The **benefits-only SVM** is defined as:

$$SVM_{benefits} = \frac{TSV_{benefits}}{C_0}$$

Terminal capital  $C_{N+1}$  is reported separately and **not included** inside SVM unless explicitly stated.

Whereas System IRR provides a time-normalised rate of return, SVM expresses the **absolute scale** of regenerative value creation.

## SVM for PSC

From Section 4.3, each cycle produces:

$$E_n = \gamma C_0 R^{n-1}$$

Thus:

$$TSV_{benefits} = \sum_{n=1}^N \gamma C_0 R^{n-1} = \gamma C_0 \frac{1-R^N}{1-R}$$

Substituting into the SVM definition:

$$SVM_{benefits}(R) = \gamma \frac{1-R^N}{1-R}$$

This multiplier decomposes into:

- cumulative institutional benefit across cycles
- sensitivity to recycling rate  $R$
- and productivity parameter  $\gamma$

## Grant Comparator

$$SVM_{grant} = \frac{E_1}{C_0}$$

A philanthropic grant generates value only in the first cycle, and destroys capital thereafter, typically yielding  $SVM < 1$  for long horizons.

## Debt Baseline Specification

To ensure consistent comparison, we model a standard amortising loan of principal  $C_0$ , interest rate  $i$ , and amortisation term  $N$ .

Annual repayment:

$$A = C_0 \cdot \frac{i(1+i)^N}{(1+i)^N - 1}$$

Net system value under debt:

$$TSV_{debt} = \sum_{n=1}^N (\gamma C_0 - A)$$

No principal remains at the end of the cycle.

### Interpretation.

Debt requires negative cashflows each cycle (repayments), introduces balance-sheet fragility, and amplifies risk through interest and refinancing exposure. PSC does not.

## Interpretation

The SVM provides an intuitive cross-model comparison:

- PSC produces multi-cycle, compounding value and preserves capital → high multipliers
- Debt produces recurring value but eliminates capital → moderate multipliers
- Grants produce single-cycle value → low multipliers

SVM therefore highlights the structural regenerative advantage of PSC in a particularly transparent form.

## PSC System IRR

Using the PSC total system value from Section 4.6:

$$TSV_{PSC} = \gamma C_0 \frac{1-R^N}{1-R} + C_0 R^N, \quad (R \neq 1).$$

Thus:

$$IRR_{PSC} = \left( \gamma \frac{1-R^N}{1-R} + R^N \right)^{1/N} - 1.$$

For perfect recycling  $R = 1$ :

$$TSV_{PSC} = \gamma N C_0 + C_0.$$

so:

$$IRR_{PSC} = (\gamma N + 1)^{1/N} - 1$$

## Grant System IRR (Comparator)

A one-shot grant produces value only in the first cycle:

$$TSV_{grant} = E_1.$$

Thus:

$$IRR_{grant} = \left(\frac{E_1}{C_0}\right)^{1/N} - 1.$$

Because  $E_1 = C_0$  in most real-world applications, this IRR is generally **negative**, and increasingly negative as  $N$  increases.

## Debt System IRR (Comparator)

Debt-financed capital provides constant annual value net of debt service, with no preserved capital:

$$TSV_{debt} = \sum_{n=1}^N (E_n^{debt}).$$

Thus:

$$IRR_{debt} = \left(\frac{\sum_{n=1}^N E_n^{debt}}{C_0}\right)^{1/N} - 1.$$

In most cases:

- debt IRR is **positive but modest**
- PSC dominates the grant IRR for all  $R > 0$
- PSC IRR exceeds grant IRR for all  $R > 0$  under the proportionality assumptions of this model.

# 5. COMPARATIVE ANALYSIS OF CAPITAL MODELS

This section contrasts the financial, operational, and systemic properties of three funding types: **loan financing**, **philanthropic grants**, and **Perpetual Social Capital (PSC)**.

The comparison is structured across P&L impact, balance-sheet consequences, cashflow behaviour, system fragility, and long-run value creation.

## 5.1 Loan-Financed Assets

Debt remains the dominant mechanism for institutional capital formation, especially in hospitals, councils, universities, and government agencies. However, its structural properties generate constraints that compound over time.

## P&L Impact

Debt imposes mandatory servicing costs:

$$E_n^{debt} = G_n + \alpha S_n - \beta - D_n$$

Where  $D$  reduces operational surplus and increases the probability of negative cycles.

In tight-margin public-good sectors, negative cycles translate directly to service cuts, staff shortages, or delayed capital upgrades.

## Balance-Sheet Impact

Debt increases liabilities:

- Raises leverage
- Reduces credit capacity
- Weakens financial resilience
- Triggers external covenants (e.g., interest coverage ratios)

This restricts the institution's ability to respond to shocks or emergencies.

## Cashflow Behaviour

Debt requires **fixed cash outflows**, regardless of:

- demand cycles
- staffing shortages
- supply-chain disruptions
- economic downturns

This rigidity is a major source of fragility.

## System Fragility

Because debt amplifies volatility, institutions often undertake less investment than socially optimal.

Such underinvestment is often discussed in areas such as diagnostic capability, infrastructure maintenance, and service delivery.

## Borrowing Ceilings

Public institutions have explicit or implicit borrowing caps.  
 An additional dollar of debt displaces future capital spending.  
 This often functions as a binding constraint.

**Summary:** Loans accelerate capability in the short term but weaken system resilience in the long term.

 **Figure 4: PSC vs Traditional Capital Models**

Paper Section 5.1

Cumulative deployment comparison: PSC vs one-time grant vs 3-cycle loan



Figure 4. System IRR vs Recycling Rate (Break-Even Point Included)

## 5.2 Philanthropic-Funded Assets

Grants and philanthropic donations are essential to many public-good sectors.  
 However, philanthropy has structural limitations that constrain long-run value.

### Single-Cycle Benefit

A grant of size  $C_0$  generates value:

$$E_1^{grant} = G_1 + \alpha S_1 - \beta$$

After cycle 1, capital is exhausted.

There are **zero further cycles** unless the donor gives again.

### Capital Destruction

Each philanthropic dollar is consumed permanently.

This makes impact non-renewable.

## Institutional Strengthening

Philanthropy improves capacity but does not build durable capital stock.  
Institutions become reliant on intermittent grants for replacement cycles.

## Non-Repeatable Impact

Philanthropy cannot compound.  
Even extraordinarily effective philanthropic interventions cannot be repeated unless new donations are secured.

This creates planning difficulty, particularly for institutions that depend on stable long-horizon capital cycles.

**Summary:** Philanthropy produces high social value but destroys capital, preventing multi-cycle compounding.

## 5.3 Perpetual Social Capital

PSC bypasses the limitations of both debt and philanthropy, providing a regenerative capital mechanism.

### Multi-Cycle Benefits

Capital does not disappear after one cycle; instead, it regenerates according to:

$$C_n = C_0 R^{n-1}$$

Even modest recycling ( $R = 0.6-0.8$ ) generates multiple cycles of value.

### Strong Balance Sheet

PSC introduces **no liabilities**, creates **no interest burden**, and allows institutions to build capability without weakening financial position.

Balance sheets strengthen because assets exist without offsetting liabilities.

### Infinite Absorptive Capacity

Unlike debt, PSC does not push institutions toward borrowing ceilings.  
It scales with demand across a wide range of public-good institutions.

All can absorb PSC without debt-based constraints.

## Capital Preservation

The donor’s capital is preserved and may support multiple cycles rather than being depleted in a single deployment. It functions similarly to an endowment but **without requiring a separate endowment structure**.

## Reduction of Systemic Fragility

PSC reduces key sources of institutional vulnerability:

- no mandatory payments
- no interest exposure
- no refinancing risk
- no leverage increase
- no volatility amplification

PSC enhances resilience by enabling long-horizon planning without financial stress.

## Comparative Dominance

| Capital Type | Impact Cycles | Liability | Interest | Balance-Sheet Effect | Long-Run Value   | Fragility |
|--------------|---------------|-----------|----------|----------------------|------------------|-----------|
| Debt         | Multi cycle   | High      | Yes      | Weakens              | Moderate         | High      |
| Philanthropy | Single cycle  | None      | None     | Neutral              | Single-Cycle     | Low       |
| PSC          | Multi cycle   | None      | None     | Strengthens          | High/Compounding | Very Low  |

**Summary:** PSC occupies a distinct region in the capital-structure landscape as a non-extractive, regenerative, and potentially system-enhancing mechanism.

# 6. MULTI-CYCLE SIMULATION (30-YEAR MODEL)

To illustrate the comparative performance of loan financing, philanthropic grants, and Perpetual Social Capital (PSC), we construct a 30-year simulation using parameters that are representative of capital-intensive public-good institutions. The purpose is not to model a specific asset but to show how the different capital mechanisms behave under identical conditions.

The comparison focuses on:

- institutional P&L
- cashflow behaviour
- balance-sheet consequences
- cumulative social value
- total system value (TSV)
- system IRR
- fragility characteristics

This simulation demonstrates how PSC behaves under moderate recycling scenarios and how it differs structurally from single-cycle philanthropy and liability-bearing debt.

## 6.1 Parameter Choices

We adopt the following illustrative baseline parameters:

- **Initial capital:**

$$C_0 = \$100,000$$

- **Direct + monetised economic benefit (gross):**

$$G_n + \alpha S_n = \$190,000$$

- **Operating cost:**

$$\beta = \$20,000$$

- **Net economic benefit per full-size capital cycle:**

$$\$190,000 - \$20,000 = \$170,000$$

- **Proportional benefit parameter:**

$$\gamma = \frac{G_n + \alpha S_n - \beta}{C_0} = \frac{\$170,000}{\$100,000} = 1.7$$

- **Loan comparator interest rate:**

$$i = 6\%$$

- **PSC recycling rates tested:**

$$R \in \{1.0, 0.98, 0.97, 0.96, 0.95, 0.93, 0.85, 0.8\}$$

These parameters illustrate a plausible high-productivity capital cycle in public-good settings and are used here solely for comparative analysis.

## 6.2 Cycle-by-Cycle Dynamics

### Capital evolution

PSC capital evolves according to:

$$C_1 = C_0, \quad C_{n+1} = RC_n,$$

so that:

$$C_n = C_0 R^{n-1}$$

### Social value

$$S_n = kC_n.$$

### Institutional economic benefit

Using proportionality (Section 4.4):

$$E_n = \gamma C_n = \gamma C_0 R^{n-1}$$

This yields a declining but recurring benefit stream under PSC.

### Debt comparator

Under loan financing, the institution receives a constant annual net benefit:

$$E^{debt} = \gamma C_0 - D,$$

where

- $G - \beta = \$170,000$ ,
- $interest = \$6,000$ ,
- For simplicity, we stylise total annual debt service (principal + interest) as \$106,000, yielding a constant net annual benefit of \$64,000. This is not intended as a detailed loan model (a full amortising specification is provided in Appendix C) but as a transparent stylised comparator.

Thus:

$$E^{debt} = \$64,000$$

each year, with **no preserved capital** at the end of the horizon.

## Grant comparator

A one-shot grant produces:

$$E_1^{grant} = \$170,000, \quad E_n^{grant} = 0 \text{ for all } n \geq 2,$$

and eliminates all capital after the first cycle.

## 6.3 Summary of Cycle Dynamics

- **Philanthropy**
  - Year 1: \$170k
  - Years 2–30: \$0
- **Debt**
  - Annual benefit: \$64k
  - Total over 30 years: \$1.92M
  - Terminal capital: \$0
- **PSC**
  - Cycle benefit declines geometrically:

$$E_n = \gamma C_0 R^{n-1}$$

- Still generates multiple cycles of positive value whenever  $R > 0$ .

## 6.4 Total System Value (TSV)

Total system value (Section 4.6) is:

$$TSV = \sum_{n=1}^N E_n + C_{N+1}$$

### PSC TSV formula

For  $R \neq 1$ :

$$TSV_{PSC} = \gamma C_0 \frac{1-R^N}{1-R} + C_0 R^N, R \neq 1$$

For  $R = 1$ :

$$TSV_{PSC} = \gamma(N+1)C_0$$

### 6.4.1 System Value Multiplier (SVM)

To complement the TSV results, we compute the **System Value Multiplier (SVM)**, which expresses cumulative system value as a multiple of the initial capital. This provides a direct comparison across PSC, grants, and debt.

#### System Value Multiplier over a 30-Year Horizon

$N = 30$ ,  $\gamma = 1.7$ ,  $C_0 = \$100,000$ ,  $TSV = \text{sum of benefits only (terminal capital shown separately)}$

| Recycling Rate (R) | TSV (30 years) | System Value Multiplier (SVM = $TSV / C_0$ ) | Terminal Capital | Interpretation |
|--------------------|----------------|----------------------------------------------|------------------|----------------|
|                    |                |                                              |                  |                |

|             |         |                                        |                    |                                                                           |
|-------------|---------|----------------------------------------|--------------------|---------------------------------------------------------------------------|
| <b>1.0</b>  | \$5.10M | <b><math>\approx 51\times</math></b>   | \$100,000          | Near-perfect regeneration<br>→ strongest compounding                      |
| <b>0.98</b> | \$3.86M | <b><math>\approx 38.6\times</math></b> | $\approx \$54,500$ | High multi-cycle productivity even with small leakage                     |
| <b>0.97</b> | \$3.39M | <b><math>\approx 33.9\times</math></b> | $\approx \$40,100$ | Very strong regeneration; comfortably above stylised debt baseline        |
| <b>0.96</b> | \$3.0M  | <b><math>\approx 30.0\times</math></b> | $\approx \$29,400$ | Strong multi-cycle performance with substantial preserved capital         |
| <b>0.95</b> | \$2.7M  | <b><math>\approx 26.7\times</math></b> | $\approx \$21,500$ | Clear long-run advantage over grants; high retained pool                  |
| <b>0.93</b> | \$2.2M  | <b><math>\approx 21.5\times</math></b> | $\approx \$11,300$ | Surpasses stylised debt baseline (19.2 $\times$ ) without liabilities     |
| <b>0.9</b>  | \$1.6M  | <b><math>\approx 16.3\times</math></b> | $\approx \$4,200$  | Outperforms grants by $\sim 9.6\times$ ; small but non-zero terminal pool |
| <b>0.85</b> | \$1.1M  | <b><math>\approx 11.2\times</math></b> | $\approx \$760$    | Moderate recycling; still $\sim 6.6\times$ grant performance              |

|                    |         |                |         |                                                                              |
|--------------------|---------|----------------|---------|------------------------------------------------------------------------------|
| <b>0.8</b>         | \$0.8M  | <b>≈ 8.5×</b>  | ≈ \$120 | Modest recycling; ~5× better than one-shot grant despite heavy leakage       |
| <b>Grant (R=0)</b> | \$170k  | <b>1.7×</b>    | 0       | One cycle only; capital destroyed after use                                  |
| <b>Debt</b>        | \$1.92M | <b>≈ 19.2×</b> | 0       | Stylised multi-cycle value but no preserved capital; liabilities + fragility |

## Interpretation

PSC exhibits strong regenerative multipliers across all realistic values of R. Even modest recycling rates ( $R = 0.5\text{--}0.7$ ) generate multipliers far exceeding those of grant-funded systems, while high R values produce endowment-like compounding with zero liability exposure.

## 6.5 System IRR Comparison

System IRR is:

$$IRR_{system} = \left(\frac{TSV}{C_0}\right)^{1/N} - 1$$

Using the TSV values above:

| <b>Model</b>        | <b>System IRR</b> | <b>Notes</b>                               |
|---------------------|-------------------|--------------------------------------------|
| <b>Philanthropy</b> | strongly negative | capital destroyed after cycle 1            |
| <b>Debt</b>         | ~7–8%             | stable annual benefit, no terminal capital |

|                      |         |                                           |
|----------------------|---------|-------------------------------------------|
| <b>PSC</b> $R = 1$   | ~18–21% | highest returns; full recycling           |
| <b>PSC</b> $R = 0.9$ | ~12–14% | clear system-level advantage              |
| <b>PSC</b> $R = 0.8$ | ~9–11%  | comparable to or above debt               |
| <b>PSC</b> $R = 0.7$ | ~6–8%   | near-debt performance without liabilities |
| <b>PSC</b> $R = 0.5$ | ~3–5%   | still positive; philanthropy is negative  |

PSC outperforms grant-based outcomes for all  $R > 0$  under the model assumptions.

### **Break-even with Debt.**

Solving  $SVM_{benefits}(R) = SVM_{debt}$  yields a crossover point of approximately  $R \approx 0.957$ .

Under the full amortising, real-term debt model in Appendix C, the break-even rate is higher  $R \approx 0.998$ . The stylised comparator is used in the main text for transparency and like-for-like comparison.

Therefore PSC matches cumulative debt value at recycling rates above ~95.5%, a level commonly achieved in microfinance (94–99% repayment) and readily achievable in stable institutional contexts such as hospitals, scientific labs, and climate asset pools.

PSC numerically surpasses debt only at high recycling rates  $R \geq 0.96$ , but its core structural advantages over debt—zero liabilities, no interest burden, no refinancing risk, and no fragility amplification—hold for all  $R$ .

### **Structural Superiority of PSC.**

Unlike debt, PSC imposes no enforceable liabilities, no interest extraction, and no balance-sheet pressure. This makes PSC the only capital architecture compatible with fragile domains such as climate adaptation, community systems, and scientific infrastructure, where debt is either infeasible or actively harmful.

## 6.6 System Fragility

- **Debt**  
High fragility due to mandatory repayments, interest exposure, refinancing risk, and leverage amplification.
- **Philanthropy**  
Low financial fragility but structurally non-recurring due to capital depletion prevents compounding.
- **PSC**
  - no liabilities
  - no interest expense
  - soft, mission-aligned repayment
  - preserved or partially preserved capital
  - positive system IRR even at modest  $R$

PSC combines low fragility with multi-cycle value generation.

## 6.7 Sensitivity Analysis

Across all parameter choices tested:

- increasing  $R$  raises TSV at an increasing rate
- decreasing  $R$  still yields multi-cycle value
- PSC provides higher multi-cycle value than philanthropy for any  $R > 0$  in this model.
- PSC may outperform debt whenever high recycling is achieved

The model is robust under a wide range of plausible parameter values.

## 6.8 Worst-Case and Best-Case Bounds

- **Worst-case PSC (e.g.  $R = 0.3$ )**  
Still produces multiple cycles of value and materially exceeds one-shot philanthropy.
- **Best-case PSC ( $R = 1$ )**  
Approaches perpetual multi-cycle compounding and preserves capital entirely.

PSC remains non-depletive and generally outperforms philanthropy across realistic parameter ranges and offers a non-liability alternative to debt financing.

# 7. SYSTEMIC IMPLICATIONS

PSC is not merely a financial instrument; it represents a conceptual shift in how public-good institutions can finance capability, manage balance sheets, and plan over infinite horizons. Its adoption has profound implications for institutional design, public finance, philanthropic practice, and long-term economic development.

## 7.1 Institutional Resilience

PSC strengthens institutional resilience in ways that neither debt nor philanthropy can replicate.

### (1) Balance-sheet strengthening

PSC introduces asset capacity without corresponding liabilities. Institutions gain capability without:

- leverage
- covenant exposure
- refinancing risk
- interest-rate sensitivity

A balance sheet with more assets and zero new liabilities is fundamentally more resilient.

### (2) Removing borrowing constraints

Borrowing ceilings are a hard limit in the public sector. PSC bypasses them entirely.

Public-good institutions can scale capital formation without increasing their recorded liabilities.

### (3) Infinite-horizon planning

PSC transforms capital from a one-shot expenditure to a **perpetual input**.

This enables institutions to:

- support long-horizon planning
- smooth capital expenditure
- reduce the risk of degradation from deferred maintenance

In sectors plagued by procurement delays and “boom-bust” funding, PSC introduces **continuity**.

### (4) Reduction in operational volatility

Soft repayability means institutions are not punished during downturns. Capital remains aligned with mission rather than financial fragility.

**PSC may reduce financial fragility by introducing greater predictability.**

## **7.2 Government Budgets and Public Finance**

PSC has far-reaching implications for government budget strategy, especially in health, education, infrastructure, and resilience.

### **(1) Replacement for grants**

PSC allows government departments to explore mechanisms that extend the life of capital allocations without increasing debt.

Every dollar generates:

- immediate social value
- preserved capital
- recurring future cycles of benefit

This changes the economics of public investment.

### **(2) Multiplication of public spending**

Traditional grants = 1 cycle.

PSC grants = many cycles.

PSC may increase long-run value generated per dollar of public expenditure, without requiring additional debt.

### **(3) Reduced dependence on debt**

PSC reduces reliance on:

- state and federal borrowing
- local government debt facilities
- capital funding rounds
- budget cycle volatility

PSC enables an alternative pathway for capability-building that is *not debt-funded* and *not depletive*.

### **(4) Policy implications**

PSC can support:

- hospital equipment renewal programmes

- council infrastructure maintenance
- rural and regional service expansion
- early detection and prevention health initiatives
- decarbonisation and resilience assets
- science and innovation platforms
- aged-care capability programmes

PSC represents a potential complementary approach within public finance, conceptually orthogonal to taxation and debt.

## 7.3 Philanthropy

PSC transforms the economics, psychology, and governance of philanthropic giving.

### (1) Transition from “one-shot gifts” to “perpetual gifts”

Philanthropists can give capital that is preserved across cycles under favourable recycling conditions, yet still produces immediate impact.

This resolves a long-standing tension:

- donors want lasting impact
- institutions need recurring capital
- PSC satisfies both

### (2) PAF/PUAF implications

PSC dramatically increases the efficiency of:

- Private Ancillary Funds (PAFs)
- Public Ancillary Funds (PUAFs)

Instead of distributing disposable grants, PAFs/PUAFs deploy **permanent, regenerative capital** that can achieve substantially greater cumulative impact over multiple cycles.

### (3) Governance and transparency

PSC requires:

- clear recycling ledgers
- impact reporting
- transparent capital tracking

These are features philanthropists increasingly demand.

#### (4) Philanthropic economics

PSC redefines return on philanthropic investment:

- not a financial return
- not a social return alone
- but a **systemic return** composed of
  - (i) social value
  - (ii) institutional strengthening
  - (iii) perpetual capital preservation

PSC provides a mechanism through which philanthropic capital can function more like a long-horizon capital base.

### 7.4 Public-Sector Transformation Across Domains

PSC applies directly to multiple public-good systems.

- Health: capital renewal and service-capability enhancement.
- Education: capability and infrastructure investment.
- Resilience: long-horizon preparedness and infrastructure capability.
- Science: capital-intensive research infrastructure and service platforms.
- Local Government: community infrastructure and essential services.
- Aged Care: service capability and safety infrastructure.
- Energy & Climate: distributed and resilient infrastructure systems

Across all these domains, PSC provides:

- capability without debt
- impact without depletion
- resilience without fragility

PSC offers a general capital framework with potential applicability across many mission-driven systems.

## 8. IMPLEMENTATION: THE ROLE OF PROTOCOLS

PSC is a theoretical contribution, and its practical implementation would require systems for capital tracking, recycling enforcement, reporting, and institutional alignment.

All capital classes rely on administrative mechanisms to function effectively:

- debt → banks + credit markets
- equity → exchanges + registries
- grants → foundations + reporting systems

Similarly, **PSC benefits from a coordinating protocol that ensures capital flows remain aligned with regenerative principles.**

This section formalises the role of such a protocol.

The mathematical model defines  $R$  as a structural parameter, but realised recycling rates depend on behavioural, governance, and institutional factors. We therefore distinguish theoretical  $R$  from achieved  $R$ .

## 8.1 Why Regenerative Capital Requires a Coordinating Layer

PSC introduces dynamics that are difficult to manage through traditional accounting or informal agreements.

Three structural challenges arise:

### (1) Repayment discipline without legal liability

PSC relies on *soft repayability* — a repayment expectation aligned with mission, not legal enforcement.

To avoid drift, institutions need a mechanism that:

- tracks expected returns
- issues reminders
- manages recycling cycles
- handles deviations
- preserves trust without coercion

Manual administration may be insufficient at scale.

### (2) Capital tracking across cycles

Because capital cycles indefinitely, the system requires:

- unique capital identifiers
- tracking across institutions
- timestamped cycle histories
- balance availability at any point in time
- appropriate reporting structures

This is more complex than traditional grants (single-cycle) or loans (fixed amortisation).

### **(3) Standardised instrument and repayment rules**

Effective PSC implementation is facilitated when:

- capital instruments are standardised
- repayment logic is consistent
- institutions understand the terms
- auditors can validate flows
- treasuries can model long-run impact

PSC therefore requires a **formalised instrument**, not ad hoc agreements.

### **(4) Data integrity and auditable ledgers**

For PSC to be adopted by governments, foundations, and large institutions, the system must be:

- transparent
- auditable
- resistant to manipulation
- compliant with fiduciary standards
- easy for auditors to certify

These features support institutional trust.

### **(5) Management of recycling rate (R)**

Institutions may vary in operational reality:

- some repay quickly
- some repay partially
- some delay repayments
- some require structured deferrals

A coordinating protocol can help ensure these patterns do not undermine the regenerative structure.

#### **In summary:**

A dedicated protocol layer would support practical PSC implementation.

### **8.1.1 Realised vs Theoretical Recycling Rates**

The mathematical model treats the recycling rate RRR as a structural parameter governing capital dynamics.

However, *realised* recycling rates emerge from behavioural, governance, and institutional factors, including culture, transparency, incentives, and operational stability.

We therefore distinguish:

- **Theoretical recycling rate**  $R_{theoretical}$  — the structural rate used in the mathematical model.
- **Achieved recycling rate**  $R_{achieved}$  — the empirically realised rate under institutional behaviour.

PSC performance depends on achieved recycling, which is shaped by repayment practices, governance maturity, and protocol support. This distinction aligns the model with practical implementation and clarifies the behavioural dynamics underpinning real-world PSC deployments.

## 8.2 Elevate as the Administrative Protocol

We outline a conceptual administrative protocol—here referred to generically as “the protocol layer”—that could support PSC implementation.

### (1) Recoverable Grant Instrument

Elevate defines a standardised PSC instrument:

- zero-interest
- non-liability
- soft-repayable
- recyclable

The instrument clearly specifies:

- repayment logic
- recycling rules
- transparency guarantees
- reporting requirements

This provides clarity for institutions and auditors.

### (2) Impact Ledger

The protocol maintains an impact ledger that:

- records social value per cycle
- captures throughput, avoided costs, or intervention impact
- could support real-time monitoring
- could generate impact reports for donors, boards, or government

Impact becomes measurable and verifiable.

### **(3) Recycling Ledger**

This forms a mathematical core of PSC implementation.

The recycling ledger:

- records each repayment
- reallocates capital for redeployment
- updates available capital  $C_n$
- calculates realised recycling rate  $R$
- timestamps each cycle
- ensures no double-counting or leakage

It maintains the regenerative integrity of the system.

### **(4) Reporting and Governance Layer**

Elevate provides automated reporting for:

- auditors
- boards
- foundation trustees
- government departments
- philanthropic advisers

This aligns with governance requirements common to public-good institutions and philanthropic vehicles.

### **(5) Institutional Incentives**

PSC requires alignment incentives, and the protocol provides them:

- institutions gain access to capability without liabilities
- donors see their capital regenerate
- governments see multi-cycle impact without increasing debt
- repayment expectations can be supported through transparency rather than coercion

Incentives remain positive, mission-aligned, and durable.

## (6) Deployment at Scale

The protocol enables:

- multi-institution networks
- national programmes
- cross-sector deployments
- capital pooling
- anonymised benchmarking

A protocol layer may enable PSC to be explored at broader scale rather than confined to isolated pilots.

# 9. LIMITATIONS AND FUTURE RESEARCH

Although Perpetual Social Capital (PSC) is theoretically grounded, it introduces dynamics that warrant further investigation. This section outlines key limitations and areas for future research.

## 9.1 Empirical Validation

### (1) Multi-institution deployments

Although PSC is conceptually supported by modelling and sector-agnostic reasoning, empirical validation is required to quantify:

- realised recycling rates  $R$
- variance across institutional types
- long-run behavioural patterns
- cross-sector comparability

Broader implementations across multiple institutions or regions would enable statistical evaluation of PSC performance.

### (2) Longitudinal analysis

PSC's regenerative nature makes **long-term datasets essential**.

Because PSC's effects emerge over extended horizons, long-term observational studies would be valuable to examine:

- cycle decay patterns
- real-world system IRR
- institution-level cashflow stability
- macro-level fiscal savings

### **(3) Regression modelling**

Future work could apply econometric methods to:

- identify predictors of high recycling rates
- quantify the effect of PSC on institutional resilience
- correlate PSC deployment with health and social outcomes
- compare PSC to debt and grants via matched methods (e.g., synthetic controls)

## **9.2 Behavioural Dynamics**

PSC relies on **soft repayment**, which introduces behavioural considerations.

### **(1) Institutional compliance**

Repayment behaviour may depend on:

- organisational culture
- leadership
- governance maturity
- fiscal pressures

Understanding the determinants of compliance will guide incentive design.

### **(2) Moral hazard**

Because PSC introduces no liability, institutions might:

- deprioritise repayment,
- rely disproportionately on PSC capital
- rely on PSC instead of operational improvement

These risks may be mitigated through transparent reporting and reputation-based incentives, but require study.

### **(3) Political economy**

PSC affects:

- government budget allocations
- donor behaviour
- public-private dynamics
- institutional autonomy

Future work should explore the political economy implications of shifting from depletive to regenerative capital.

## 9.3 Extensions

PSC opens multiple new research pathways:

### (1) Climate infrastructure

Modelling PSC for:

- microgrids
- community batteries
- heat mitigation systems
- distributed resilience infrastructure

### (2) Science accelerators

PSC may be applicable to areas such as reproducibility platforms, automation, and instrumentation, which often rely on grant-based cycles.

### (3) Open-source innovation

PSC may be applicable to software, open datasets, and digital public goods, enabling perpetual funding without licensing barriers.

### (4) Hybrid equity-regenerative structures

Future work could explore combining PSC with equity-like structures:

- mission-aligned ventures
- social enterprises
- community-owned infrastructure

This could form a broader field of **regenerative capital theory**.

## 10. CONCLUSION

This paper introduces **Perpetual Social Capital (PSC)**, a fourth capital class distinct from debt, equity, and grants. PSC enables a new economic dynamic: **principal preservation with multi-cycle social value creation**, achieved through zero-interest, non-liability, soft-repayable capital that recycles indefinitely at a rate  $R$ .

We develop a mathematical model capturing:

- capital evolution across cycles
- social value productivity
- institutional economic benefit
- total system value
- system IRR

Through a 30-year illustrative simulation using representative parameters, we show that PSC:

1. **Is theoretically predicted to outperform one-shot philanthropy under all recycling rates  $R > 0$ .**
2. **May rival or exceed system-level outcomes of loan-financed capital under high recycling rates ( $R \approx 0.96$ ).**
3. **Strengthens institutional balance sheets** by introducing assets without liabilities.
4. **Reduces systemic fragility and may support longer-horizon planning.**
5. **Multiplies government and philanthropic investment** without increasing debt.

PSC represents not merely a financial innovation, but a structural shift in the economics of public good provision.

It offers a potential mechanism for scalable, regenerative, non-extractive capital formation within public-good systems.

PSC is not a financing product; it is a temporal capital-governance architecture. Its superiority does not depend on achieving higher multipliers than debt. PSC outperforms one-shot grants for all recycling rates, and its structural advantages—non-liability, shock-tolerance, and multi-cycle stability—hold independently of numerical comparisons. When recycling rates are high ( $R \geq 0.96$ ), PSC can also match or exceed the cumulative value of debt-based models while avoiding their fragility. This establishes PSC as a fourth capital class: regenerative, aligned, and cycle-governed.

By introducing PSC, this paper establishes a new field of inquiry within public finance, philanthropic economics, and capital-structure theory. It lays the foundation for a class of capital that is perpetual in form, regenerative in structure, and potentially significant in system-level impact.

# APPENDIX A — TAX CONSIDERATIONS IN THE IMPLEMENTATION OF PERPETUAL SOCIAL CAPITAL

This appendix outlines potential tax implications relevant to the practical deployment of Perpetual Social Capital (PSC) in jurisdictions where philanthropic contributions are tax-deductible. These considerations do **not** alter the theoretical model developed in the main paper, but may influence adoption incentives, implementation design, and realised capital efficiency.

The analysis is intentionally general. Specific outcomes depend on jurisdictional legislation, entity classification, and individual donor and institutional circumstances.

## A.1 Deductibility of Contributions to PSC Pools

In many tax systems, contributions made to certain categories of philanthropic, charitable, or public-benefit entities are tax-deductible for donors. If PSC capital is contributed through such a vehicle, donors may benefit from reduced taxable income.

Let:

- $t_d$  = donor marginal tax rate
- $Cost_{donor}$  = donor's after-tax cost
- $C_0$  = capital contributed to the PSC pool

Then:

$$Cost_{donor} = C_0(1 - t_d)$$

Rearranged:

$$C_0 = \frac{Cost_{donor}}{1 - t_d}$$

Deductibility therefore increases the effective capital that can be deployed into PSC without increasing the donor's after-tax cost, enhancing realised social value in qualifying jurisdictions.

## A.2 Recycling Neutrality: Returned Capital as Non-Assessable Income

A distinguishing feature of PSC is that repayments of principal are treated as **capital returns**, not income. In most tax systems, this implies that returned PSC capital:

- is not treated as assessable income
- does not trigger corporate income tax
- does not reduce grant or subsidy entitlements
- does not generate GST or FBT exposure
- maintains the capital base for redeployment

Thus, recycling follows the same geometric pattern as in the theoretical model:

$$C_n = C_0 R^{n-1}$$

If recycling were taxed at institutional tax rate ( $t_i$ ), effective recycling would be:

$$C_n^{\text{taxed}} = C_0 [(1 - t_i)R]^{n-1}$$

Because (in most cases relevant to PSC) this reduction **does not occur**, PSC retains full-cycle capital — a key advantage over taxable investment models.

## A.3 Comparative Effect of Tax on PSC vs Traditional Giving

If a donor allocates an after-tax cost of (X), then:

| Model                | Donor After-Tax Cost | Capital Deployed  | Capital Regenerates? |
|----------------------|----------------------|-------------------|----------------------|
| Non-deductible grant | $X$                  | $X$               | No                   |
| Deductible grant     | $X$                  | $\frac{X}{1-t_d}$ | No                   |
| PSC contribution     | $X$                  | $\frac{X}{1-t_d}$ | Yes                  |

PSC therefore retains all the advantages of deductible philanthropy while adding geometric regeneration of capital.

## **A.4 Donor vs Institutional Tax Perspectives**

### **Donor Perspective**

If deductible, PSC contributions may reduce taxable income, lowering the donor's effective cost and increasing capital available for social deployment.

### **Institution Perspective**

Public-benefit institutions (e.g., hospitals, charities, foundations):

- generally do not pay corporate income tax
- do not treat PSC repayments as revenue
- do not generate GST or FBT through PSC flows

Thus:

- PSC adds capability with no tax burden
- repayments do not distort operational budgets
- PSC capital does not dilute public subsidy formulas

Neutral tax treatment is essential to PSC's regenerative function.

## **A.5 PSC vs Endowments Under Tax**

Both PSC and endowments aim at long-horizon social impact, but differ materially:

### **Endowments**

- rely on investment returns
- returns may be taxable or constrained
- must maintain principal
- deploying principal reduces future capacity

### **PSC**

- deploys principal directly
- regenerates capital through soft repayments
- avoids tax leakage on recycling
- does not require investment risk to create perpetuity

PSC may complement or substitute for traditional endowments in some contexts.

## A.6 Policy Considerations

PSC may be relevant for policymakers designing:

- philanthropic incentives
- public-benefit capital-formation programmes
- blended public–private finance structures
- grantmaking frameworks
- community investment mechanisms

When contributions are deductible and recycling neutral:

- social value per donor dollar may increase
- donor willingness to fund capital-intensive programmes may improve
- long-run fiscal pressure on governments may decrease
- institutions may benefit from smoother multi-cycle planning horizons

Actual outcomes depend on jurisdictional legislation.

## A.7 Limitations

- Tax interpretations vary across jurisdictions and entity types.
- Future legislative changes may alter current tax advantages.
- PSC remains theoretically valid without tax benefits; taxation merely enhances efficiency in certain environments.
- This appendix does not address specialised or corporate tax treatments.

## A.8 Summary

Tax considerations **do not modify** the theoretical foundations of PSC presented in the main paper. However, in jurisdictions where:

1. philanthropic contributions are tax-deductible, and
2. returned capital is non-assessable,

PSC may achieve higher capital efficiency, increased donor leverage, and enhanced realised system value. These advantages **supplement**, but do not define, the regenerative capital dynamics articulated in the core model.

# APPENDIX B — Inflation and Real-Term Modelling

## B.1 Purpose

To ensure fair comparison between PSC, grants, and debt, all quantities in this paper are expressed in **real terms** (inflation-adjusted). This prevents distortions caused by nominal capital erosion and ensures that system value reflects *actual* purchasing power.

## B.2 Real-Term Representation of Capital

Let  $\pi$  denote the inflation rate.

A nominal sum  $\dot{C}_n$  has real value:

$$C_n^{real} = \frac{\dot{C}_n}{(1+\pi)^n}$$

To avoid irrelevant erosion of purchasing power in long-run modelling, we define the PSC capital stock directly in **real terms**:

$$C_n = C_0 R^{n-1}$$

where  $C_0$  is interpreted as *real* purchasing power at time 0.

This is equivalent to assuming the PSC pool is **inflation-indexed** (as many sovereign or endowment funds are), or that all quantities are measured in today's dollars.

## B.3 Real-Term Benefits

The value produced by the capital,  $E_n = \gamma C_n$ , is expressed in **real terms**.

Thus,  $\gamma$  is a **real** marginal productivity parameter.

## B.4 Inflation in Debt Modelling

Debt repayments are nominal, but their real burden depends on inflation.

The **real interest rate** is defined using the Fisher equation:

$$1 + r_{real} = \frac{1 + r_{nom}}{1 + \pi}$$

This ensures debt cashflows are discounted consistently with PSC cashflows.

## B.5 Implication

Inflation does **not** affect PSC's internal behaviour once expressed in real terms, but it **does** materially alter the real burden of debt repayments.

This asymmetry strengthens PSC's comparative stability.

# APPENDIX C — Debt Under Real Interest Rates (with Break-Even R)

## C.1 Nominal Debt Repayments

For a principal  $C_0$ , nominal interest  $i_{nom}$ , and term  $N$ , the annual nominal repayment is:

$$A_{nom} = C_0 \cdot \frac{i_{nom}(1+i_{nom})^N}{(1+i_{nom})^N - 1}$$

Example (used in main text):

- $C_0 = \$100,000$
- $i_{nom} = 5\%$
- $N = 30$

gives  $A_{nom} \approx \$6,505$ .

## C.2 Real Value of Debt Repayments

The real value of each nominal repayment is:

$$A_{real,n} = \frac{A_{nom}}{(1+\pi)^n}$$

Total real repayment over the loan:

$$Real\ Total\ Cost = \sum_{n=1}^N \frac{A_{nom}}{(1+\pi)^n}$$

Examples:

| Inflation $\pi$ | Real Total Cost | Multiplier |
|-----------------|-----------------|------------|
|-----------------|-----------------|------------|

|    |           |       |
|----|-----------|-------|
| 0% | \$195,154 | 1.95× |
| 2% | \$145,692 | 1.46× |
| 3% | \$127,504 | 1.28× |
| 4% | \$112,487 | 1.12× |

### C.3 System Value Multiplier of Debt

Assuming PSC and debt share the same productivity parameter  $\gamma$ :

$$SVM_{debt} = \frac{1}{C_0} \sum_{n=1}^N (\gamma C_0 - A_{real,n})$$

### C.4 PSC–Debt Break-Even Recycling Rate

PSC multiplier (real terms):

$$SVM_{benefits}(R) = \gamma \frac{1-R^N}{1-R}$$

Break-even occurs when:

$$SVM_{benefits}(R) = SVM_{debt}$$

Under amortising real-term debt comparator interest rates 1 – 4% and  $\gamma = 1.7$ ,  $N = 30$ :

$$R_{breakeven} = 0.998$$

Thus:

- PSC only numerically exceeds fully priced debt at **very high** recycling rates.
- But PSC's structural superiority holds regardless of R.

## APPENDIX D — Sensitivity Analysis

## D.1 Sensitivity to $\gamma$ (Productivity Parameter)

All sensitivity results use  $SVM_{benefits}$ , consistent with the main text.

Let  $\gamma \in [0.5, 4.0]$ .

PSC multiplier:

$$SVM_{benefits}(\gamma) = \gamma \frac{1-R^{30}}{1-R}$$

Example  $R = 0.9$ :

- $\gamma=0.5 \rightarrow 4.8\times$
- $\gamma=1.0 \rightarrow 9.6\times$
- $\gamma=1.7 \rightarrow 16.3\times$
- $\gamma=3.0 \rightarrow 28.8\times$
- $\gamma=4.0 \rightarrow 38.4\times$

**Implication:** relative performance rankings remain unchanged;  $\gamma$  scales linearly.

## D.2 Sensitivity to $R$ (Recycling Rate)

For  $\gamma = 1.7$ :

| R    | SVM   |
|------|-------|
| 0.8  | 8.5×  |
| 0.9  | 16.3× |
| 0.95 | 26.7× |

|      |       |
|------|-------|
| 0.96 | 30.0× |
| 0.97 | 33.9× |
| 0.98 | 38.6× |
| 1.0  | 51×   |

**Implication:** PSC dominates grants for all  $R > 0$ , and approaches debt-like multipliers only as  $R \rightarrow 1$ .

## APPENDIX E — Proof that PSC Dominates Grants for All $R > 0$

Let a one-shot grant provide:

$$TSV_{grant} = \gamma C_0$$

PSC provides:

$$TSV_{PSC} = \sum_{n=1}^N \gamma C_0 R^{n-1}$$

For any  $R > 0$ :

$$TSV_{PSC} = \gamma C_0 \sum_{n=1}^N R^{n-1} > \gamma C_0 = TSV_{grant}$$

Thus:

**PSC strictly dominates one-shot grants for any positive recycling rate.**

# APPENDIX F — Calibration of $\gamma$ in PSC-F (Hospitals)

In PSC-F,  $\gamma$  is the **real net value generated per \$1 of capital per cycle**.

Hospitals typically realise:

- direct Medicare/private billings
- avoided outsourcing
- reduced length-of-stay
- reduced complications
- equipment throughput effects
- amortised lifetime system savings

Typical calibration

- Many diagnostic assets have  $\gamma \in [1.5, 4.0]$
- Conservative illustration:  $\gamma = 1.7$

Examples:

- CT Scanner: yields 150–250% of capex per year
- MRI: yields 150–300%
- Endoscopy: yields 300–400%

Thus  $\gamma = 1.7$  is conservative for PSC-F.

# APPENDIX G — Microfinance Repayment Rates as Empirical Analogue

Recycling rate  $R$  in PSC is **not** a credit repayment rate, but an institutional recycling parameter.

However, microfinance offers a compelling empirical analogue:

Typical repayment rates:

- BRAC: 98–99%
- Grameen: 96–98%
- ASA: 97–99%
- Global MFIs (median): 95–97%

These occur in *highly fragile populations*, with:

- no collateral
- income volatility
- political fragility
- weather shocks
- informal repayment cultures

These rates suggest that high recycling is feasible in coordinated systems, though PSC—lacking legal enforcement—will depend on governance quality rather than credit mechanisms.

## **APPENDIX H — Fragility Pathways: PSC vs Debt Under Inflation**

### **H.1 Inflation Shock Structure**

Inflation shocks affect:

- nominal interest rates
- refinancing conditions
- debt rollovers
- debt covenants
- balance-sheet ratios

### **H.2 Debt Fragility Pathway**

Inflation shock → higher interest → covenant pressure → austerity → capability decay → political turnover → fragility amplification → systemic failure

### **H.3 PSC Stability Pathway**

Inflation shock → no liabilities → no refinancing → no forced austerity → capability preserved → institutional continuity

### **H.4 Conclusion**

Debt inherits inflation fragility.

PSC is inflation-agnostic once expressed in real terms.

# 11. REFERENCES

- Acemoglu, D., & Robinson, J. (2012). *Why nations fail: The origins of power, prosperity, and poverty*. Crown.
- Andreoni, J. (2006). Philanthropy. In S.-C. Kolm & J. M. Ythier (Eds.), *Handbook of the Economics of Giving, Reciprocity and Altruism* (Vol. 2). Elsevier.
- Armendáriz, B., & Morduch, J. (2010). *The economics of microfinance* (2nd ed.). MIT Press.
- Arrow, K. J. (1963). Uncertainty and the welfare economics of medical care. *American Economic Review*, 53(5), 941–973.
- Besley, T., Coate, S., & Loury, G. (1993). The economics of rotating savings and credit associations. *American Economic Review*, 83(4), 792–810.
- Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2018). *Cost-benefit analysis: Concepts and practice* (5th ed.). Cambridge University Press.
- Brest, P., & Harvey, H. (2018). *Money well spent: A strategic plan for smart philanthropy*. Stanford University Press.
- Brest, P., Gilson, R. J., & Wolfson, M. A. (2016). How investors can (and can't) create social value. *Journal of Corporation Law*, 41, 1–38.
- Bugg-Levine, A., & Emerson, J. (2011). Impact investing: Transforming how we make money while making a difference. *Innovations*, 6(3), 9–18.
- Coase, R. (1960). The problem of social cost. *Journal of Law and Economics*, 3, 1–44.
- Gordon, T. P., Knock, C., & Neely, D. G. (2009). The role of grants in nonprofit financial sustainability. *Nonprofit and Voluntary Sector Quarterly*, 38(3), 449–462.
- Gruber, J. (2019). *Public finance and public policy* (6th ed.). Worth Publishers.
- Haldane, A. G., & May, R. M. (2011). Systemic risk in banking ecosystems. *Nature*, 469, 351–355.
- Jackson, E. T., & Harji, K. (2013). *Accelerating impact: Achievements, challenges and what's next in impact investing*. Rockefeller Foundation.
- Mazzucato, M. (2018). *The value of everything: Making and taking in the global economy*. PublicAffairs.
- Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review*, 48(3), 261–297.
- Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of capital: A correction. *American Economic Review*, 53(3), 433–443.
- Musgrave, R. A., & Musgrave, P. B. (1989). *Public finance in theory and practice*. McGraw-Hill.
- OECD. (2019). *Social impact investment 2019: The impact imperative for sustainable development*. OECD Publishing.
- OECD. (2021). *Philanthropy and social investment: Trends and challenges*. OECD Publishing.
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.

- Preker, A. S., & Langenbrunner, J. (2005). *Spending wisely: Buying health services for the poor*. World Bank.
- Rawls, J. (1971). *A theory of justice*. Harvard University Press.
- Sen, A. (1999). *Development as freedom*. Knopf.
- Stiglitz, J. E. (2000). *Economics of the public sector* (3rd ed.). W. W. Norton & Co.
- Yunus, M. (1999). *Banker to the poor: Micro-lending and the battle against world poverty*. PublicAffairs.