

# The Calçotada Protocol: Equity Peg Tokens for Decentralized Venture Capital

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**Abstract**—This paper presents the Calçotada Protocol, a blockchain-based framework for democratizing early-stage venture capital through tokenized convertible notes designed to track startup valuations. The protocol implements a dual-token architecture combining ERC721 NFTs for governance participation with ERC20 RMSC tokens for economic exposure. Built on Polygon with Chainlink oracle integration, the system features sophisticated bonding curve pricing, automated treasury management, and transparent on-chain fundraising mechanics. While the current implementation provides core token infrastructure, future development will add on-chain accountancy, automated buyback mechanisms, and full DAO governance to create a complete decentralized venture capital platform accessible to retail investors.

**Index Terms**—Blockchain, Venture Capital, Decentralized Finance, Tokenization, Equity Peg Token, DAO

## I. INTRODUCTION: UNLOCKING FOUNDATIONAL CAPITAL FOR EVERYONE

Venture capital (VC) acts simultaneously as the engine and gatekeeper of innovation, deciding which startups receive funding and consequently determining who shapes the products and services of tomorrow. This concentration of influence leads to what Acemoglu and Johnson describe as a “tunnel vision” in their seminal work *Power and Progress* (2023), wherein the future is shaped not by societal necessities or disruptive innovations, but by trends favored by large capital holders. This cycle perpetuates itself: venture capital firms backed by substantial resources dictate innovation agendas, consolidating wealth and reinforcing their dominance over technological and economic progress.

This entrenched model of early-stage investing not only restricts innovation to predefined agendas but exacerbates inequality by excluding smaller investors from the highest-return investment opportunities—namely, seed-stage equity rounds. Consequently, retail investors resort to speculative assets such as memecoins, seeking the kinds of outsized returns historically realized in early-stage VC funding, but without genuine exposure to underlying innovation or governance rights.

Blockchain technology offers a foundational shift in this dynamic by enabling decentralized autonomous organizations (DAOs) and token-based governance models to democratize access to venture-stage capital and decision-making processes.

The Calçotada Protocol is our practical response to this systemic imbalance. It provides a structured, transparent on-chain mechanism that directly links token ownership to startup

valuations and governance rights. Through tokenized convertible notes, the protocol allows individual investors—not just large institutions—to meaningfully participate in both the financial and governance aspects of promising startups at their earliest stages.

This protocol was specifically developed to meet the funding requirements of The Calçotada Company, a food-tech startup with a disruptive and validated business model. The innovative nature of this company has inspired the development of Equity Peg Tokens as a foundational mechanism for exploring Decentralized Autonomous Venture Capital (DAVC). Moreover, the protocol aims explicitly to bridge the gap between traditional, non-crypto startups and blockchain-based funding mechanisms, thus enabling broader, more inclusive access to early-stage venture capital opportunities.

## II. PRIOR ART AND RELATED WORK

Blockchain technology has significantly altered the landscape of startup financing, leading to an emergence of novel funding mechanisms primarily through Initial Coin Offerings (ICOs) and token sales. Guangye Cao (2023), in his seminal paper “*Startup Financing: Token vs Equity*”, highlights that blockchain-based startups commonly prefer token issuance over traditional equity due to enhanced liquidity and lower return expectations from investors, driven by early liquidity rather than intrinsic valuation [1]. However, this financing model predominantly targets crypto-native startups building decentralized applications (dApps) or blockchain protocols. Thus, these tokens typically derive value from speculative market dynamics rather than a measurable relationship to company success or valuation milestones [2], [3].

Several foundational studies underline these market dynamics. Howell et al. (2020) find that token success in ICOs correlates closely with disclosure practices and speculative expectations rather than fundamental valuation metrics tied explicitly to a startup’s success [2]. Similarly, Chod and Lyandres (2021) point out that token financing frequently introduces agency problems, as entrepreneurs are incentivized to underproduce since their revenues are not strictly pegged to token values or vice versa [4]. Cong et al. (2021) also note the prevalence of speculative pricing, driven largely by investor expectations about future platform popularity rather than underlying business fundamentals [5].

The literature further emphasizes a structural shortcoming in current token funding models, specifically their inherent inability to effectively bridge token valuation to real-world company performance and equity milestones. For example, the widely-used Simple Agreement for Future Tokens (SAFT), while attempting to integrate traditional funding elements, still ultimately relies on future speculative market conditions rather than measurable startup outcomes [6]. Meanwhile, token-warrant structures and automated convertible notes introduced by ConsenSys and others attempt to blend equity and token economics but do not provide explicit pegging mechanisms between token value and company valuation, leaving substantial room for market speculation and volatility [7].

In this context, token financing as historically implemented has primarily appealed to blockchain-focused ventures, offering limited utility to traditional non-crypto enterprises seeking structured and valuation-based early-stage financing mechanisms. Despite clear liquidity advantages outlined by Cao (2023) and others, the absence of a stable and measurable peg to equity valuation remains a critical gap in current blockchain funding structures.

Addressing precisely this gap, the Calçotada Protocol proposes an innovative framework: a *Tokenized Convertible Note (TCN)* explicitly pegged to company valuation. By bridging traditional valuation-linked financial instruments with blockchain-enabled liquidity, the protocol uniquely positions itself as a solution capable of transcending speculative market dynamics and offering structured equity participation and governance rights to retail investors.

### III. EXTENDED ANALYSIS OF DUAL-TOKEN MODELS

#### A. Dual-Asset Token Models

A growing class of decentralized finance and DAO systems use a dual-token model, combining:

- A non-fungible or governance token for voting/access
- A fungible token for utility or financial participation

Examples include:

**Charged Particles** offers a framework allowing NFTs to hold fungible tokens—creating hybrid assets, but not necessarily valuation-pegged economic instruments [8].

**Tensor DAO** issues a governance token (TNSR) alongside protocol usage tokens—holders vote and receive revenue-share—but tokens are not directly pegged to outside company valuations [9].

**Origyn Protocol** uses OGY as a fungible utility/governance token alongside provenance NFTs—though again, without a peg to company performance [10].

Academic work on NFT authentication and hybrid structures exists (e.g. Talgar & Banach [11], Avrilionis & Hardjono [12]), but these focus on access control or metadata consistency—not on funding mechanics or value-redemption.

#### B. Research Gap

While dual-token models are gaining traction in DeFi and NFT ecosystems, none explicitly link the fungible token's value to company performance or guarantee redemption

pegged to valuation. Existing models focus on speculative pricing, membership perks, or governance, not on treating tokens as digital equity with built-in mechanisms to ensure economic alignment.

#### C. Contribution of the Calçotada Protocol

The Calçotada Protocol bridges these gaps by:

- Issuing **Founder NFTs** for governance and access;
- Issuing **RMSC fungible tokens** with a strict, externally validated PEG to company valuation;
- Enforcing buyback commitments on-chain via transparent smart contracts and external oracles;
- Combining liquidity, governance, and valuation parity in a single dual-token financial architecture.

### IV. FUNDAMENTAL KEY ASSETS AND ON-CHAIN ACCOUNTANCY

A primary innovation of the Calçotada Protocol is the incorporation of on-chain accountancy as a transparent foundation for venture valuations, investor returns, and protocol trust. This section reviews the strategic assets necessary for protocol integrity and public confidence, highlighting how on-chain financial tracking directly informs estimated valuations and buyback commitments.

#### A. On-Chain Accountancy

Unlike traditional venture frameworks—where assessment of company value and investor ROI rely on opaque, often delayed financial reporting—the Calçotada Protocol mandates continuous, verifiable financial accounting on-chain. All critical financial flows (revenue, costs, operational reserves, distributions) are recorded in transparent smart contracts.

This enables:

- **Real-time, tamper-proof valuation:** Investors and protocol governors can view up-to-date figures at any point, reducing ambiguity or information asymmetry.
- **Reliable ROI estimates:** Using industry-standard financial metrics (see next subsection), the protocol can project and periodically update company valuations and potential ROI for token holders.
- **Algorithmic buyback triggers:** Token buyback amounts and conditions are derived from on-chain accounting data, automating investor returns and aligning incentives.

#### B. Valuation Methodology and Financial Modeling

To ensure that buybacks reflect fundamentally justified valuations, the protocol leverages conventional startup valuation techniques. The accompanying `Tokenomics RMSC.ods` model calculates buyback scenarios and expected valuations based on revenue multiples, discounted cash flows, or other startup-typical factors. These methods are encoded in oracles or contract formulas, supporting automated, auditable financial flows without need for off-chain negotiations.

This structure allows retail and institutional investors to benefit from return estimates and exit strategies anchored in both blockchain transparency and accepted financial practice—even before actual company liquidity events.

### C. Additional Key Assets

- **Smart Contracts:** All protocol commitments (NFTs, RMSC tokenomics, buybacks, treasury reserve) are transparently on-chain.
- **External Oracles:** For validation of off-chain revenue or event triggers as needed.
- **Decentralized Governance:** Founder NFTs enable participatory protocol upgrades and control structures.

## V. PROTOCOL ARCHITECTURE

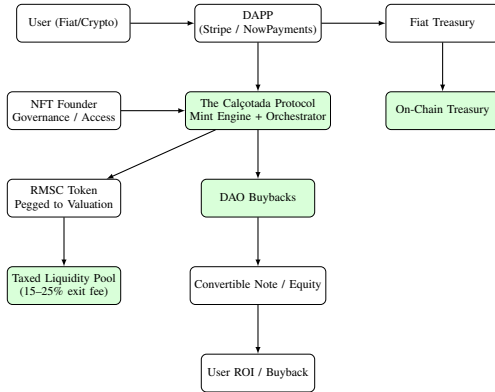


Fig. 1. Simplified architecture of the Calçotada Protocol: dual-token issuance and treasury-integrated valuation peg.

The Calçotada Protocol implements a sophisticated two-asset system deployed on the Polygon blockchain to facilitate decentralized venture funding. The architecture consists of four core smart contracts that work in concert: CalcotCoin (NFT), Romesco (RMSC token), Calçotada (orchestrator), and NormalizeToEuro (oracle integration). This system combines governance through non-fungible tokens (NFTs) with economic participation via fungible tokens (RMSC) that are designed to track company valuation.

### A. CalcotCoin NFT: Governance and Foundational Access

The *CalcotCoin* (CEBA) contract implements an ERC721 NFT system designed to recognize early supporters and provide governance rights. The current implementation features:

#### Technical Specifications:

- Fixed supply of 333 NFTs (CEBA Genesis edition)
- 33 tokens reserved for treasury (10% allocation)
- Linear pricing mechanism from 222.22 to 200 RMSC per NFT
- Base price of 100 EUR per NFT with dynamic RMSC conversion

**Minting Mechanism:** The CalcotCoin contract implements a sophisticated dual-minting system where NFT purchases trigger a 2x RMSC mint. When purchasing an NFT:

- 1) The buyer receives 2x the NFT price in newly minted RMSC
- 2) Half of the RMSC is automatically transferred to the treasury as payment
- 3) The buyer retains the other half as a bonus incentive

- 4) The NFT is minted to the buyer's address

#### Planned Governance Features:

- One vote per wallet (implementation pending)
- Participation in valuation recognition and capital allocation decisions
- Access to exclusive founder communications

Note: The whitepaper originally specified 6 batches totaling 5,888 NFTs. The current implementation focuses on the initial 333-unit genesis collection, with future batches to be deployed based on protocol evolution and community feedback.

### B. RMSC Token: Equity-Pegged Financial Instrument

The *Romesco Token (RMSC)* is the core financial instrument of the protocol, implemented as an ERC20 token with ERC1363 and ERC20Permit extensions for enhanced functionality.

#### Technical Implementation:

- Fixed maximum supply of 5,000,000 RMSC (hard cap enforced in contract)
- Initial pre-mint of 200,000 RMSC for liquidity and operational needs
- Pausable functionality for emergency situations
- Permit functionality for gasless approvals
- ERC1363 support for single-transaction transfers and callbacks

#### Economic Design:

- Minting controlled by the orchestrator contract only
- No burn functionality for regular users (maintains supply integrity)
- Designed for future buyback mechanism at €1.5–€3.0 per RMSC
- Starting valuation implies approximately €0.40–€0.60 per RMSC

**Integration Features:** The RMSC token is designed for composability with DeFi protocols:

- ERC20Permit enables gasless transactions and meta-transactions
- ERC1363 allows for advanced payment flows and automated callbacks
- Standard ERC20 interface ensures compatibility with all major DEXs and lending protocols

Note: The buyback mechanism mentioned in the economic design is planned for future implementation through a separate contract that will interact with the on-chain accountancy system.

### C. Calçotada Orchestrator: Protocol Coordination

The *Calçotada* contract serves as the central orchestrator, coordinating interactions between all protocol components:

#### Core Functions:

- Manages the dual-minting mechanism for NFT purchases
- Controls RMSC minting according to bonding curve pricing
- Handles both public and private sale mechanisms

- Integrates with NormalizeToEuro for multi-currency support

**Bonding Curve Implementation:** The orchestrator implements a sophisticated normalized bonding curve using:

- Q16.16 fixed-point arithmetic for precision
- Configurable sigmoid curve shape for optimal price discovery
- Integration with trapezoidal rule for accurate pricing
- Starting price: €0.40 per RMSC, ending price: €0.60 per RMSC

**Transaction Fee Structure:**

- NFT purchases: €4.50 transaction fee
- RMSC purchases: €2.50 transaction fee
- Fees collected in POL and forwarded to treasury

*D. Price Oracle Integration*

The *NormalizeToEuro* contract provides real-time price conversion using Chainlink oracles:

**Oracle Feeds:**

- ETH/USD, EUR/USD, and POL/USD price feeds
- Automatic conversion between EUR pricing and POL payments
- 18-decimal precision for all calculations

*E. PEG Enforcement and Future Development*

While the current implementation provides the foundation for equity-pegged tokens, the full PEG mechanism awaits implementation:

**Current State:**

- Token supply and pricing mechanisms are fully implemented
- Oracle integration provides real-time price conversion
- Treasury accumulation occurs automatically

**Planned Enhancements:**

- On-chain accountancy module for transparent financial tracking
- Automated buyback contracts triggered by valuation milestones
- Governance voting mechanisms for NFT holders
- Integration with external valuation attestation services

*F. Initial Supply and Distribution*

The initial supply of RMSC tokens is allocated in a controlled and transparent manner to recognize pre-protocol contributions and prepare for public issuance. No tokens are minted speculatively or granted without capital justification.

1) *Angel Investor Allocation:* Prior to the protocol's launch, a group of early angel investors provided capital to The Calçotada Company under a convertible loan agreement. These early backers are entitled to receive RMSC tokens at the protocol's base issuance price, plus an interest premium to account for the time value of their risk.

- **Base Price Conversion:** Angel investments are converted into RMSC at the same base price offered during the initial public issuance phase.

- **Interest Adjustment:** A fixed 7% interest rate is applied to the original invested amount, and this adjusted total determines the corresponding RMSC allocation.
- **Non-inflationary Grant:** These tokens are accounted for as part of the protocol's total capped supply and are not created in excess of the 5 million RMSC ceiling.

2) *Pre-Mint Reserve:* In addition to angel investor conversion, a total of 200,000 RMSC tokens are pre-minted and held in the protocol treasury for operational, liquidity, and market stabilization purposes. This reserve will be used judiciously to support exchange listings, liquidity pool seeding, and strategic partnerships.

3) *Public Issuance:* All remaining RMSC tokens are made available through direct, capital-backed purchase via the protocol interface. Tokens are minted on-demand as described in the Minting Scheme, with no pre-sale, airdrop, or speculative allocation.

This initial supply model ensures that token distribution is fully aligned with the company's real financial history and avoids the common pitfalls of over-allocation, unbacked inflation, or opaque private rounds.

*G. Initial Distribution and Structured Pricing*

The protocol implements a sophisticated pricing mechanism that balances early adopter incentives with sustainable fundraising:

1) *Current Implementation: Genesis Collection:* The deployed contracts focus on the initial CalcotCoin Genesis collection:

- 333 total NFTs with 33 reserved for treasury
- Linear RMSC pricing from 222.22 to 200 RMSC per NFT
- Fixed EUR price of €100 per NFT
- Dual-minting mechanism providing 2x RMSC to NFT buyers

2) *Future Batch Structure:* The protocol design accommodates future expansion through additional NFT collections:

TABLE I  
NFT BATCHES AND ASSOCIATED RMSC MINTING

Batch	NFTs	NFT €	RMSC €	MINT kRMSC
Calçot Coins	333	100	0.40	66
FounderPass 1	555	125	0.50	139
FounderPass 2	1111	250	0.525	529
FounderPass 3	1111	375	0.55	757
FounderPass 4	1111	500	0.575	966
FounderPass 5	1111	625	0.60	1,157
Total: 5,332 NFTs				
2,047,025 € raised, 1,807,796 RMSC minted				

Half of the RMSC minted for each NFT is transferred to the protocol treasury, while the remaining half is consumed by the NFT minting contract. This ensures that treasury-backed liquidity grows proportionally with capital raised.

3) *Public RMSC Issuance via Bonding Curve:* The Calçotada orchestrator implements a sophisticated bonding curve mechanism for public RMSC sales:

### Technical Implementation:

- Normalized sigmoid curve stored as Q16.16 fixed-point values
- Configurable curve shape via uploadable parameters
- 16-step trapezoidal integration for accurate pricing
- Real-time POL/EUR conversion via Chainlink oracles

### Pricing Parameters:

- Starting price: €0.40 per RMSC
- Ending price: €0.60 per RMSC
- Available supply: Up to 4.6M RMSC (after pre-mint and NFT allocations)
- Transaction fee: €2.50 per purchase

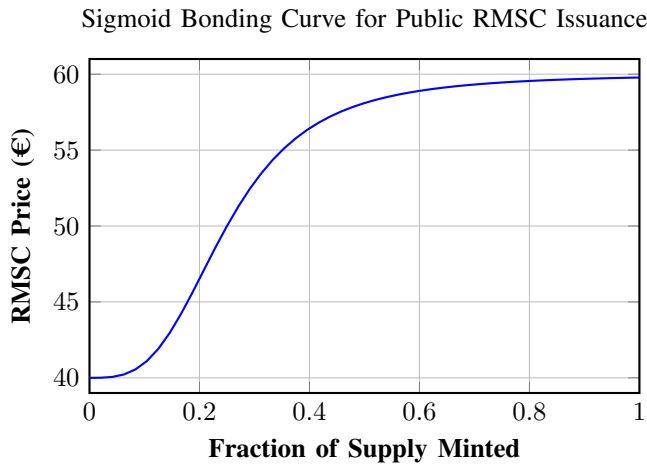


Fig. 2. Sigmoid bonding curve used for public RMSC issuance pricing.

This curve allows the protocol to capture higher marginal funding value while maintaining a predictable and fair pricing structure. Early public buyers enjoy lower prices, and late-stage buyers pay a premium as the available supply nears exhaustion.

4) *Liquidity and Secondary Market Strategy*: The protocol's liquidity strategy leverages standard DeFi infrastructure:

### Current Implementation:

- RMSC is a standard ERC20 token, compatible with all major DEXs
- Treasury accumulates POL and RMSC for future liquidity provision
- No transfer restrictions or vesting schedules

### Planned Liquidity Features:

- DEX liquidity pools on QuickSwap or Uniswap V3
- Treasury-funded initial liquidity provision
- Potential liquidity mining incentives for early providers
- Integration with lending protocols for RMSC collateralization

Note: The Taxed Liquidity Pool (TLP) mentioned in the original design is deferred to future protocol upgrades, allowing for simpler initial deployment and community-driven liquidity solutions.

### H. Network Deployment

Polygon is selected as the base network for its:

- Low transaction fees and fast confirmation times,
- Proven security track record via Ethereum finality,
- Established ecosystem of NFT and DeFi projects.

Deploying on Polygon enables frictionless user participation while ensuring composability with future liquidity protocols and DAO tools.

## VI. TECHNICAL IMPLEMENTATION

### A. Smart Contract Architecture

The Calçotada Protocol consists of four core smart contracts deployed on Polygon:

#### 1. CalcotCoin.sol (ERC721):

- Manages NFT issuance and ownership
- Implements linear pricing mechanism
- Handles treasury pre-allocation
- Integrates with orchestrator for minting

#### 2. Romesco.sol (ERC20):

- Implements capped token supply (5M RMSC)
- Provides ERC1363 and Permit extensions
- Controlled minting via orchestrator only
- Pausable for emergency situations

#### 3. Calcotada.sol (Orchestrator):

- Coordinates all protocol interactions
- Implements bonding curve pricing
- Manages dual-minting mechanism
- Handles fee collection and treasury forwarding

#### 4. NormalizeToEuro.sol (Oracle):

- Integrates Chainlink price feeds
- Provides EUR/POL/ETH conversions
- Ensures accurate multi-currency pricing

### B. Security Considerations

#### Access Control:

- Owner-controlled administrative functions
- Orchestrator pattern for inter-contract calls
- No external minting access on token contracts

#### Safety Features:

- ReentrancyGuard on all payment functions
- Pausable functionality for emergency response
- Overflow protection via Solidity 0.8.28
- Battle-tested OpenZeppelin libraries

### C. Gas Optimization

- Batch minting reduces per-NFT gas costs
- Q16.16 arithmetic minimizes computational overhead
- Efficient storage patterns in bonding curve
- Optimized loops with unchecked arithmetic where safe

## VII. CONCLUSION AND FUTURE WORK

The Calçotada Protocol represents a significant step toward democratizing venture capital through blockchain technology. By implementing tokenized convertible notes with clear valuation pegs, the protocol creates a bridge between traditional startup funding and decentralized finance.

### A. Current Achievements

The deployed implementation successfully demonstrates:

- Functional dual-token architecture with NFT governance rights and RMSC economic participation
- Sophisticated bonding curve pricing with real-time oracle integration
- Transparent, on-chain fundraising mechanics
- Gas-efficient smart contract design suitable for retail investors

### B. Future Development Roadmap

The protocol's evolution will focus on implementing the complete vision:

#### Phase 1 - On-Chain Accountancy (Q2 2024):

- Deploy transparent financial tracking contracts
- Integrate with company accounting systems
- Implement automated valuation calculations

#### Phase 2 - Buyback Mechanism (Q3 2024):

- Develop profit-sharing smart contracts
- Create automated buyback triggers
- Implement redemption queuing system

#### Phase 3 - Governance Implementation (Q4 2024):

- Deploy DAO voting contracts
- Implement proposal and execution systems
- Enable community-driven protocol upgrades

#### Phase 4 - Ecosystem Expansion (2025):

- Launch additional NFT collections
- Integrate with major DeFi protocols
- Expand to support multiple portfolio companies

### C. Research Directions

Future research will explore:

- Optimal bonding curve parameters for different funding stages
- Integration of zero-knowledge proofs for private financial data
- Cross-chain implementations for broader accessibility
- Regulatory compliance frameworks for security token standards

The Calçotada Protocol demonstrates that blockchain technology can create more equitable access to venture capital opportunities while maintaining the rigor and transparency required for institutional participation. As the protocol evolves, it aims to become a standard framework for tokenized venture funding, enabling a new generation of investors to participate in the innovation economy.

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