ESA

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Abstract

We propose ESA (Elevado Stable Asset), a decentralized stable asset protocol on Ethereum. The protocol issues ESA, a fully collateralized, non-pegged stable asset designed to preserve or increase its value in U.S. dollar terms over time. The ESA protocol enables users to mint ESA by depositing DAI into a monolithic smart contract, subject to a deposit fee. ESA may be redeemed for DAI at any time, with a redemption fee applied. All collected fees – on both deposit and redemption – are permanently retained within the protocol's collateral pool, ensuring that net asset value (NAV) per ESA unit increases or remains constant over time, never falling below. By utilizing DAI as collateral and denominating its value in USD, ESA provides a non-pegged yet value-preserving asset that is designed to offer long-term resilience and stability without reliance on oracles, governance, or external yield sources. The result is a trust-minimized, self-sustaining asset whose USD-denominated backing per unit is provably non-decreasing and yield-bearing by design.

1 Introduction

Money has historically evolved through distinct phases: from commodities such as gold and silver, to representative media like notes redeemable in those commodities, to fiat currencies, and most recently to digital forms. Throughout this evolution, the core functions of money – store of value, unit of account, and medium of exchange – have remained constant, though their implementation has been continuously reinterpreted in response to technological and institutional shifts.

Fiat currencies brought about flexibility through centralized monetary policy but introduced new challenges, including inflation, political influence, and custodial risk. In contrast, the advent of decentralized digital assets such as Bitcoin and Ethereum has reintroduced properties of scarcity and censorship resistance. However, these assets exhibit high volatility, making them less suitable for applications that demand value stability – particularly in USD terms, the de facto global unit of account.

To bridge this gap, stablecoins emerged as a category of digital assets designed to maintain a stable value relative to fiat currencies, most commonly the U.S. dollar.

1.1 Non-Pegged, Value-Preserving Stable Assets

Rather than enforcing a strict peg like stablecoins, non-pegged stable assets are designed to preserve or increase their value over time without relying on oracles, governance, or discretionary interventions.

The ESA (Elevado Stable Asset) protocol builds upon this paradigm. We propose ESA, a decentralized, non-pegged stable asset on Ethereum.

ESA adopts a minimalistic yet robust protocol design: users may mint ESA by depositing DAI into a monolithic, immutable smart contract, incurring a small deposit fee. Conversely, ESA can be redeemed for DAI at any time, subject to a redemption fee. All fees collected by the protocol are retained within the collateral pool, thereby increasing the net backing per ESA unit over time.

ESA does not attempt to maintain a hard peg to the U.S. dollar. Instead, its economic structure ensures that the net asset value (NAV) per ESA token, measured in USD via DAI, is non-decreasing and yield-bearing. This makes ESA a trust-minimized, governance-free monetary primitive with an embedded compounding mechanism powered by a deterministic flywheel mechanism – which ensures that the net asset value (NAV) per ESA unit increases or remains constant over time, never falling below.

In essence, ESA combines the stability of stablecoins with the value-accretive fundamentals of a reserve asset.

2 Protocol

ESA is implemented as a single, monolithic smart contract, designed to be immutable, governance-free, and fully self-contained (§ 4).

The protocol enables users to mint and redeem ESA, an ERC-20 token. To mint ESA, users deposit DAI into the contract's pool, incurring a small deposit fee (0,5%) that is retained within the system. Upon redemption, ESA can be exchanged back for DAI, less a redemption fee (1%), which is likewise retained in the protocol's DAI pool. These fees serve not as revenue but as a mechanism to increase the backing per ESA unit over time.

The result is a trust-minimized, deterministic system in which the net asset value (NAV) per ESA unit – measured in USD via DAI – is deterministically guaranteed to be non-decreasing and yield-bearing.

Importantly, the protocol requires no oracles, external governance, or dependency on external data feeds; all calculations are based solely on on-chain state.

2.1 Minting

The minting process enables users to create new ESA tokens by depositing DAI into the protocol. A fixed deposit fee of 0.5% is applied to each transaction; the full amount – both the user's net contribution and the collected fee – is retained in the system's reserve.

Based on the prevailing net asset value (NAV) per ESA – calculated as the total collateral held by the protocol divided by the circulating ESA supply – the protocol deterministically issues a corresponding quantity of ESA tokens to the depositor. This mechanism is fully on-chain, trustless, and ensures that each minting operation increases the total collateral base, while incrementally increasing NAV for all participants as a result of the 0.5% fee retained by the system (§ B.1)

1. A user sends C_{in} DAI into the ESA contract.
2. A deposit fee f_{dep} (0.5%) is subtracted:

$$Fee_{\text{dep}} = C_{\text{in}} \cdot f_{\text{dep}}$$
$$C_{\text{net}} = C_{\text{in}} - \text{Fee}_{\text{dep}}$$

3. The net collateral amount C_{net} is added to the collateral pool.
4. The contract computes the current collateral-to-ESA ratio (i.e., total DAI collateral held divided by total ESA supply, before mint). Define this ratio as $r = \frac{C_{\text{pool}}}{S_{\text{ESA}}}$.
5. The number of ESA tokens minted, ΔS, is (i.e. minting at current NAV per unit):

$$\Delta S = \frac{C_{\text{net}}}{r}$$

In the initial bootstrap, when $S_{\text{ESA}} = 0$, the protocol is defined with an initial issuance ratio of 1:1; 1 ESA = 1 DAI) (i.e., $r = 1$).

2.2 Redeeming

The redemption process allows ESA holders to withdraw underlying DAI collateral by returning ESA tokens to the protocol. The system calculates the gross redemption value using the current net asset value (NAV) per ESA, applies a fixed redemption fee of 1%, and transfers the net DAI amount to the user. The redeemed ESA tokens are burned, and the fee retained by the protocol remains in the collateral pool.

This mechanism is fully on-chain, deterministic, and ensures that each redemption operation reduces token supply while increasing NAV for remaining holders, thereby reinforcing the protocol's non-dilutive, value-preserving structure (§ B.4).

1. A user sends ΔS ESA tokens to the contract.
2. The contract computes the current NAV per ESA token, $r_{\mathrm{curr}} = \frac{C_{\mathrm{pool}}}{S_{\mathrm{ESA}}}$.
3. The gross collateral amount corresponding to ΔS is:

$$C_{\mathrm{gross}} = \Delta S \cdot r_{\mathrm{curr}}$$

4. A redemption fee f_{red} (1%) is applied:

$$\mathrm{Fee}_{\mathrm{red}} = C_{\mathrm{gross}} \cdot f_{\mathrm{red}}$$
$$C_{\mathrm{net}} = C_{\mathrm{gross}} - \mathrm{Fee}_{\mathrm{red}}$$

5. The collateral pool is reduced by $C_{\mathrm{net}} + \mathrm{Fee}_{\mathrm{red}} = C_{\mathrm{gross}}$.
6. ESA tokens ΔS are burned.
7. The user receives C_{net} DAI.
8. The redemption fee $\mathrm{Fee}_{\mathrm{red}}$ is retained in the collateral pool (i.e. not distributed externally).

This mechanism ensures that after redemption, the remaining pool's collateral-to-supply ratio increases (or at least does not decrease).

2.3 Fee Compounding and Flywheel

- All fees (deposit-side and redemption-side) remain inside the contract's DAI pool and increase the total collateral.
- Because the total ESA supply only increases by net minting amounts, and redemption burns tokens while adding the fee portion back into collateral, the collateral-to-supply ratio tends to grow over time with continued usage.
- As redemptions happen, the DAI in the collateral pool per ESA increases, producing a flywheel of value accrual: each token's backing (NAV) can only stay the same or increase.
- Over time, the accumulated surplus (i.e., delta) between collateral and ESA supply acts as a buffer and source of resilience.

3 Architectural Principles

ESA protocol design avoids external dependencies, discretionary governance, and mutable parameters. The system operates with complete transparency, determinism, and resilience, embodying a minimal but complete financial primitive.

3.1 Permissionless

All core operations – minting and redemption – are fully permissionless. Any participant can interact directly with the contract at any time.

3.2 Monolithic

ESA is implemented as a single, self-contained smart contract. All protocol logic is encoded natively, with no reliance on modular extensions or external systems. This simplifies security assumptions and reduces attack surface.

3.3 Immutable and Non-Upgradable

The contract is immutable from the moment of deployment. No upgradeability hooks, administrative keys, or governance functions exist. The system's rules are fixed and cannot be changed post-launch.

3.4 Oracle-Free

The protocol does not rely on external data feeds or oracles. Since DAI is the sole collateral and its balance is fully observable on-chain, all pricing and accounting functions are internally derived.

3.5 Censorship Resistance

There are no mechanisms for freezing, blacklisting, or intervening in user balances or transactions. The contract contains no administrative override functions, ensuring neutrality.

3.6 Deterministic

All outcomes in the protocol are determined strictly by on-chain state and predefined parameters. There is no randomness, probabilistic behavior, or discretionary execution, ensuring full auditability and predictability.

3.7 Neutral

ESA enforces no monetary policy, imposes no inflationary issuance, and includes no governance layer. The system operates with no active intervention or economic discretion.

4 System Dynamics

4.1 Notation

Let:

- C = total DAI collateral held in the pool
- S = total ESA supply
- $r = \frac{C}{S}$ = NAV per ESA (in DAI / USD)
- f_{dep} = deposit fee rate (0.5% = 0.005)
- f_{red} = redemption fee rate (1.0% = 0.01)
- ΔS_{mint} = ESA minted (net)
- ΔS_{redeem} = ESA redeemed

4.2 Mint Dynamics

When a user deposits C_{in} DAI:

- Fee: $F_{\text{dep}} = C_{\text{in}} \cdot f_{\text{dep}}$
- Net deposit: $C_{\text{net}} = C_{\text{in}} - F_{\text{dep}}$
- ESA minted:

$$\Delta S_{\text{mint}} = \frac{C_{\text{net}}}{r}$$

After mint:

$$C' = C + C_{\text{net}} \ , \ S' = S + \Delta S_{\text{mint}}$$

The new ratio:

$$r' = \frac{C'}{S'} = \frac{C + C_{\text{net}}}{S + \frac{C_{\text{net}}}{r}}$$

One can verify that $r' \geq r$ if (and only if) $f_{\text{dep}} = 0$. With a positive deposit fee, r' will slightly increase as well (the extra fee adds to collateral without proportionally increasing supply). So minting actually tends to improve NAV per token marginally.

3.3 Redemption Dynamics

When a user redeems ΔS_{redeem} ESA:

- Gross collateral corresponding: $C_{\text{gross}} = \Delta S_{\text{redeem}} \cdot r$
- Fee: $F_{\text{red}} = C_{\text{gross}} \cdot f_{\text{red}}$
- Net payout: $C_{\text{net}} = C_{\text{gross}} - F_{\text{red}}$
  After redemption:

$$C' = C - C_{\text{net}} - F_{\text{red}} = C - C_{\text{gross}} \; , \; S' = S - \Delta S_{\text{redeem}}$$

But note that F_{red} remains in the pool (i.e. retention of fee), so:

$$C' = C - C_{\text{gross}} + F_{\text{red}} = C - (\Delta S_{\text{redeem}} \cdot r) + (\Delta S_{\text{redeem}} \cdot r \cdot f_{\text{red}})$$

Simplify:

$$C' = C - \Delta S_{\text{redeem}} \cdot r \cdot (1 - f_{\text{red}})$$

Thus the new ratio:

$$r' = \frac{C'}{S'} = \frac{C - \Delta S_{\text{redeem}} \cdot r \cdot (1 - f_{\text{red}})}{S - \Delta S_{\text{redeem}}}$$

One can show that $r' \geq r$. Intuitively, since the fee portion is retained and collateral falls by less than gross collateral, the per-unit backing for remaining tokens increases.

3.4 Non-Decreasing NAV

The ESA protocol is engineered such that the net asset value (NAV) per ESA token is monotonically non-decreasing across all sequences of minting and redemption operations (§ B.4). This behavior is guaranteed by the internal accounting model: both minting and redemption incorporate protocol fees that are retained within the collateral pool rather than extracted or distributed.

During minting, the deposit fee ensures that users receive slightly fewer ESA tokens than the DAI contributed, resulting in a net surplus that benefits existing holders. Redemptions are executed at the current NAV minus a fixed fee, reducing total supply while further concentrating collateral among remaining supply.

The result is a protocol where NAV per ESA can never decline, regardless of user behavior. This creates a structural bias toward capital preservation and incremental value accumulation over time – without requiring inflationary issuance, external yield, or discretionary monetary policy.

3.5 Protocol behavior in edge cases

Bootstrap

At deployment, $S = 0$. The first depositor sets the initial ratio, where 1 ESA = 1 DAI (§ C.1).

Zero supply

If S drops to zero (all tokens redeemed), collateral may remain as residual (due to fees). In that case, a new minting process restarts from the residual pool (§ C.2).

Large redemption

If a protocol participant redeems nearly the full supply, the remaining supply becomes small and the NAV jumps – this is expected behavior.

4 Self-Contained Financial System

The ESA protocol is conceived as a self-contained financial system.

The protocol is implemented as a single, immutable smart contract – a monolithic architecture in which all financial logic, accounting, and risk management are embedded natively. This design ensures complete self-sufficiency: every core function of the system operates without reliance on external contracts, oracles, governance mechanisms, or discretionary agents. The result is a fully autonomous, minimal, and deterministic financial structure.

At its core, the ESA system consolidates the roles traditionally distributed across multiple financial nodes and infrastructure layers:

1. **Asset issuance and redemption:** ESA tokens are minted and redeemed directly through the protocol at real-time prices derived from the on-chain accounting of collateral and outstanding supply. The protocol continuously enforces accurate pricing based on internal NAV calculations, removing the need for external pricing sources or liquidity providers.

2. **Integrated market mechanism:** The ESA contract maintains a continuous, on-chain two-sided market, facilitating primary issuance (minting) and redemption at protocol-defined terms. This structure serves as an embedded automated market, functionally replacing the need for third-party DEXs or CEXs for price discovery or liquidity.

3. **Internal order book dynamics:** By design, the protocol implicitly creates a time-prioritized entry mechanism: participants mint at the prevailing net asset value, which increases incrementally over time through fee accrual. This creates a non-custodial, non-explicit order book dynamic, in which the effective cost basis of ESA varies by minting time, and each position is recorded on-chain without intermediaries.

4. **Risk management and solvency guarantees:** The protocol enforces full collateralization using DAI. The system is parameterized such that ESA cannot be undercollateralized under any condition (when measured in DAI). Deposit and redemption fees act as built-in buffers and compounding mechanisms, increasing the collateral per ESA over time. No leverage, undercollateralized minting, or credit risk exists within the system.

5. **Comptroller and accounting layer:** All ledger entries – collateral, supply, fees, redemptions – are handled entirely within the smart contract's internal state. The protocol acts as its own comptroller, ensuring that all balances reconcile precisely and transparently on-chain, without reliance on external auditors or off-chain reporting systems.

6. **Native vault infrastructure:** The DAI collateral deposited into the protocol is custodied within the contract itself. No third-party vault or asset manager is required. All user balances, surplus fees, and NAV calculations are stored and enforced directly on-chain, offering complete verifiability, auditability, and neutrality.

5 Conclusion

This initial draft of the ESA whitepaper is meant to establish a conceptual understanding of the high-level design and architecture of the proposed protocol. It should not be considered complete or final. The version 1.0 of this paper will be published for public review and community input on https://github.com/elevadoxyz.

A Illustrative scenario

Step 1: Alice mints ESA

Alice is the first participant to interact with the ESA protocol. She deposits 10,000 DAI.

- Deposit fee (0.5%):

$$10,000 \times 0.005 = 50 \text{ DAI}$$

- Net DAI retained in the pool:

$$10,000 \text{ DAI} \quad \text{(entire deposit remains)}$$

ESA minted to Alice:

$$10,000 - 50 = 9,950 \text{ ESA}$$

Since Alice is the first depositor, the protocol initializes from a clean state. The entire 10,000 DAI is stored as collateral, but only 9,950 ESA is in circulation. Thus, the net asset value (NAV) per ESA is:

$$\text{NAV} = \frac{10,000}{9,950} \approx 1.0050251256 \text{ DAI per ESA}$$

This means that each ESA is backed by slightly more than 1 DAI, due to the retained fee. The surplus of 50 DAI is immediately distributed across all ESA holders (in this case, just Alice).

Step 2: Bob mints ESA

Bob arrives after Alice and deposits 5,000 DAI to mint ESA. Importantly, Bob's ESA will be minted at the current NAV, which is now greater than 1 due to Alice’s retained fee.

- Deposit fee (0.5%):

$$5,000 \times 0.005 = 25 \text{ DAI}$$

- Effective amount used to mint ESA:

$$5,000 - 25 = 4,975 \text{ DAI}$$

- Current NAV per ESA:

$$\frac{10,000}{9,950} \approx 1.0050251256 \text{ DAI per ESA}$$

- ESA minted to Bob:

$$\frac{4,975}{1.0050251256} \approx 4,950.25 \text{ ESA}$$

The protocol state now updates as follows:

- Total DAI in the pool:

$$10,000 + 5,000 = 15,000 \text{ DAI}$$

- Total ESA in circulation:

$$9,950 + 4,950.25 \approx 14,900.25 \text{ ESA}$$

- Updated NAV per ESA:

$$\frac{15,000}{14,900.25} \approx 1.006695 \text{ DAI per ESA}$$

Even Bob's deposit slightly increases the NAV, as his own 25 DAI deposit fee is retained in the collateral pool and benefits all ESA holders, including himself.

Step 3: Alice redeems a portion of her ESA

Alice now decides to redeem 1,000 ESA. She will receive DAI based on the current NAV, minus the 1% redemption fee.

- Current NAV per ESA:

$$\frac{15,000}{14,900.25} \approx 1.006695 \text{ DAI per ESA}$$

- Gross redemption value:

$$1,000 \times 1.006695 \approx 1,006.70 \text{ DAI}$$

- Redemption fee (1%):

$$1,006.70 \times 0.01 \approx 10.07 \text{ DAI}$$

- DAI sent to Alice:

$$1,006.70 - 10.07 \approx 996.63 \text{ DAI}$$

- DAI retained in pool:

$$10.07 \text{ DAI (added to surplus)}$$

- New pool collateral:

$$15,000 - 996.63 = 14,003.37 \text{ DAI}$$

- New ESA supply:

$$14,900.25 - 1,000 = 13,900.25 \text{ ESA}$$

- Updated NAV per ESA:

$$\frac{14,003.37}{13,900.25} \approx 1.007426 \text{ DAI per ESA}$$

Key observations

- ESA's design ensures that each new deposit or redemption increases NAV per ESA, via retained fees.
- New minters always mint at the current NAV, meaning later participants receive fewer ESA per DAI as time goes on.
- ESA functions as a non-pegged stable asset, where value preservation is enforced mathematically, not through a 1:1 peg.
- The longer users hold, the more they benefit from system-wide fee accumulation – making ESA particularly well-suited for value preservation over time.

B Formal properties and economic invariants

This appendix presents the core economic and mathematical properties that govern the ESA protocol. These properties are derived directly from the protocol's accounting logic and fee structure. Together, they define the system's invariant behavior across all valid user interactions.

Let:

- $C_t \in \mathbb{R}_{\geq 0}$ be the total DAI collateral held in the contract at time t.
- $S_t \in \mathbb{R}_{\geq 0}$ be the total supply of ESA tokens at time t.

- $r_t = \dfrac{C_t}{S_t}$ be the net asset value (NAV) per ESA at time t, defined only for $S_t > 0$.
- $\alpha \in [0, 1]$ be the deposit fee rate (0.005).
- $\beta \in [0, 1]$ be the redemption fee rate (0.01).

All minting and redemption operations are assumed to be atomic and to respect the contract's internal rules.

B.1 Monotonicity of NAV

The NAV per ESA unit is monotonically non-decreasing over time under any sequence of minting and redemption operations with fixed, non-negative fees.

B.1.1 Proof Sketch

Minting adds collateral D and issues tokens equal to $(1-\alpha) \cdot \dfrac{D}{r_t}$. The retained fee αD remains in the pool, increasing the numerator (collateral) without proportionally increasing the denominator (supply), hence $r_{t+1} \geq r_t$.

Redemption removes X ESA tokens at NAV r_t, yielding gross value $X \cdot r_t$, from which a fee β is deducted. The retained portion of the fee remains in the collateral pool, while the token supply decreases by X, yielding:

$$r_{t+1} = \frac{C_t - (1-\beta) X r_t}{S_t - X} \geq r_t$$

A detailed algebraic proof confirms that under $\alpha, \beta \geq 0$, this inequality holds strictly unless the fees are zero, in which case NAV is constant – which is not the ESA case.

B.2 Non-negativity and boundedness of collateral

Collateral C_t remains non-negative and bounded below by 0 at all times. It increases monotonically during minting and decreases during redemption, subject to fee retention.

There is no scenario by which collateral can become negative. Fee accumulation creates a lower bound buffer even under frequent redemptions.

B.3 NAV invariance under arbitrary sequences

Given fixed parameters $\alpha, \beta \geq 0$, and any sequence of mint and redeem operations M_i, R_j, the system satisfies the invariant:

$$r_{t+1} \geq r_0, \quad \forall t$$

This means that the NAV per ESA never falls below its initial value, and strictly increases as long as any activity (minting or redeeming) occurs. Fundamentally, there is no economic path by which NAV per ESA declines.

B.4 No dilution guarantee

Each mint operation increases collateral more than it increases supply, under any $\alpha > 0$. That is:

$$\frac{C_{t+1}}{S_{t+1}} \geq \frac{C_t}{S_t}$$

Minting is non-dilutive to existing ESA holders. This is in contrast to traditional stablecoin systems or seigniorage models, where expansion may reduce the value of existing units. In ESA, each new deposit increases the system's delta between DAI and ESA.

C Edge cases

This appendix explores edge cases. All results assume the contract's internal accounting is precise, and that fees are fixed, non-negative constants applied uniformly to all users.

C.1 Initial mint (zero supply)

If $S = 0$, the system is in an uninitialized state. The first mint defines the initial NAV. In ESA:

- By default, the first minter mints at $r = 1$ (i.e., 1 ESA = 1 DAI).
- The first minter receives:

$$\frac{D(1-\alpha)}{1} = D(1-\alpha) \text{ ESA}$$

- Collateral becomes $C = D$, supply becomes $S = D(1-\alpha)$, so:

$$r = \frac{D}{D(1-\alpha)} = \frac{1}{1-\alpha} > 1$$

This defines the first NAV increase, immediately establishing a surplus and a non-1:1 minting ratio for subsequent participants.

C.2 Full redemption (zero supply afterward)

If a redemption causes $S' = 0$, the system retains residual collateral from the redemption fee:

- Final collateral:

$$C' = xr \cdot \beta > 0$$

- Supply:

$$S' = 0$$

In this state, NAV is undefined (division by zero), but upon the next mint, the protocol reinitializes at $r = 1$, using the new deposit. The leftover collateral from the previous cycle remains in the system, benefiting the new minter as additional surplus.

This dynamic allows capital continuity across economic cycles without external resets.