Fool's Gold: How the USD lost its shine

Kai Arvai* Nuno Coimbra† Marco Pinchetti ‡

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Abstract

This paper investigates the determinants of international investors' portfolio choices between gold and sovereign bonds in an environment shaped by economic and geopolitical shocks. We ask under what conditions investors reallocate wealth from interest-bearing but potentially sanctionable government debt toward a non-yielding but politically neutral and universally accepted asset like gold. We document that periods of elevated geopolitical risk coincide with an increase in the real price of gold, and a shift in central bank reserve holdings toward gold among non-Western economies. Our model shows how U.S. convenience yields decline, signaling that safe-asset demand is increasingly fragmented along geopolitical lines.

Keywords: Dominant Currency, Safe Assets, Sanctions, Geopolitics

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*European Central Bank. E-mail address: kai.arvai@ecb.europa.eu
†Banque de France and CEPR. E-mail address: nuno.coimbra@banque-france.fr
‡Banque de France. E-mail address: marco.pinchetti@banque-france.fr

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1 Introduction

The global financial system relies on a limited set of assets that are both safe and liquid enough to serve as stores of value and as collateral in international transactions. Since the mid-20th century, U.S. Treasury bonds have played this role as the world's dominant "safe asset," underpinned by deep markets, legal protections, and the political stability of the United States. Yet recent years have witnessed an apparent resurgence of gold as an alternative reserve asset for both private and official investors, particularly in the face of rising geopolitical tensions and concerns about the weaponization of the dollar-based financial system. The renewed accumulation of gold by central banks in China, India, and other non-Western economies suggests a shift in the global hierarchy of safe assets—one that cannot be explained purely by fundamentals of return or storage costs, but instead by changing perceptions of liquidity, safety, and geopolitical risk.

The starting point of our analysis is empirical. The historical data from 1947 to 2025 reveal that gold's role as a safe asset is episodic but recurring: gold tends to gain value in moments when confidence in dollar-denominated debt is eroded. This pattern holds across a range of crises—from the collapse of Bretton Woods, to the oil shocks of the 1970s, but is strongest in more recent events, such as the Lehman Brothers bankruptcy, Covid and the recent invasion of Ukraine by Russia. This suggests that the "safe haven" properties of gold are contingent, not static or unconditional. The convenience yield of the gold market itself should also be state-dependent: during episodes of financial stress, demand for gold as a store of value is expected to rise, compressing its available supply and raising its marginal liquidity value, similar to the scarcity premium that underpins the dominance of the U.S. dollar in tranquil periods[1].

To rationalize these empirical facts, we develop a theoretical framework in which international investors face a portfolio choice between two types of safe assets: risky but high-yielding sovereign bonds and riskless gold with a fixed supply. The model features endogenous sanctions and convenience yields that arise from imperfect substitutability between gold and bonds in satisfying investors' liquidity needs. Investors choose between holding U.S. bonds, which can be seized or frozen under geopolitical conflict, and holding gold, whose supply is exogenous but which cannot be repudiated or sanctioned. Holding safe assets generates liquidity services, with the marginal convenience yield of each asset depending on equilibrium portfolio composition, so that a fall in bond holdings raises the scarcity premium on gold, and vice versa.

[1] See Arvai and Coimbra (2025).

We introduce two key shocks. The first is a fundamental economic shock, capturing fluctuations in output and fiscal capacity, which affect the solvency of the bond issuer. The second is a geopolitical shock, which captures the time-variation in the geopolitical utility of sanctioning. The decision to sanction is then composed of a geopolitical dimension (how useful sanctioning is geopolitically) and an economic one (how many resources are captured through the sanction). We consider the presence of two stochastic regimes to capture geopolitical dynamics in reduced form. In one, the geopolitical motive to sanction is absent and any sanctioning is exceedingly rare and purely driven by economic motives. We call this the '*tranquil*' regime. In the second regime, the geopolitical motive is strictly positive and follows a persistent stochastic process. We call this the 'Turbulent' regime. In this setup, in the *tranquil* regime, bonds carry high convenience yields and investors tilt their portfolios more heavily toward them. On the other hand, as the economy moves to the *turbulent* regime, the elevated sanction risk compresses bond yields and raises the scarcity premium on gold, inducing a flight to safety. The equilibrium allocation thus depends not only on economic fundamentals but also on the perceived credibility of international commitments and the political neutrality of financial assets.

Our framework highlights that global safe-asset demand is shaped by both economic safety and political safety. While U.S. bonds remain the dominant safe asset due to their scale and convenience yield in normal times, their political safety declines as geopolitical fragmentation increases. Gold, in turn, functions as the "asset of last resort"—a store of value whose scarcity premium rises endogenously when global trust erodes, but which is a more costly and imperfect safe asset during tranquil periods owing to lower yields and international transportation frictions. The model generates testable implications for the co-movement of bond convenience yields, gold prices, and reserve accumulation patterns, providing a unified interpretation of recent trends in global capital allocation.

This perspective situates our work within a growing literature on dominant currencies and safe assets (e.g. Farhi and Maggiori, 2018, Clayton et al., 2025, Bianchi et al., 2023; Chahrour and Valchev, 2022; Corsetti and Maeng, 2024). However, unlike standard approaches that treat the safety of the dollar as exogenous, we emphasize its endogenous and geopolitical nature. By linking default risk, liquidity, and geopolitical tensions, our analysis sheds light on how the global monetary system can transition from a dollar-dominated equilibrium to one in which gold plays an important role as a hedge against geopolitical risk. Ultimately, the paper contributes to understanding when and why international investors abandon yield for sovereignty—substituting bonds with bullion as the primary safeguard against both market and political risk.

2 Empirical Motivation

Figure 1 plots the real price of gold from the early 1970s to the present, with major geopolitical and financial events marked. Three broad episodes stand out. First, gold appreciated sharply through the 1970s, driven by the collapse of Bretton Woods (1971), the oil shocks— a period of acute uncertainty about the stability of the dollar-based international monetary order. Prices then declined and stagnated through the 1980s and 1990s, when the dollar's reserve-currency status was broadly uncontested after the Fall of the Berlin Wall. Second, a secular upswing began around 2000–2001, accelerating through the Global Financial Crisis of 2008–09 to a peak in 2011. This episode caused a reappraisal of US fiscal sustainability in the aftermath of the crisis. Third, gold prices surged again after 2020 — through the Covid pandemic, the 2022 invasion of Ukraine and the associated freezing of Russian foreign reserves, and the subsequent escalation of US–China strategic rivalry. A striking feature of the series is that each price spike coincides with an event that raised doubts about either the solvency or the political neutrality of US sovereign debt, suggesting that gold's safe-haven role is specifically linked to concerns about the *political safety* of dollar-denominated assets, not merely their credit risk.

Figure 1: Real gold price and major geopolitical events, 1949–2024. Vertical lines indicate selected events. *Source: Bloomberg.*

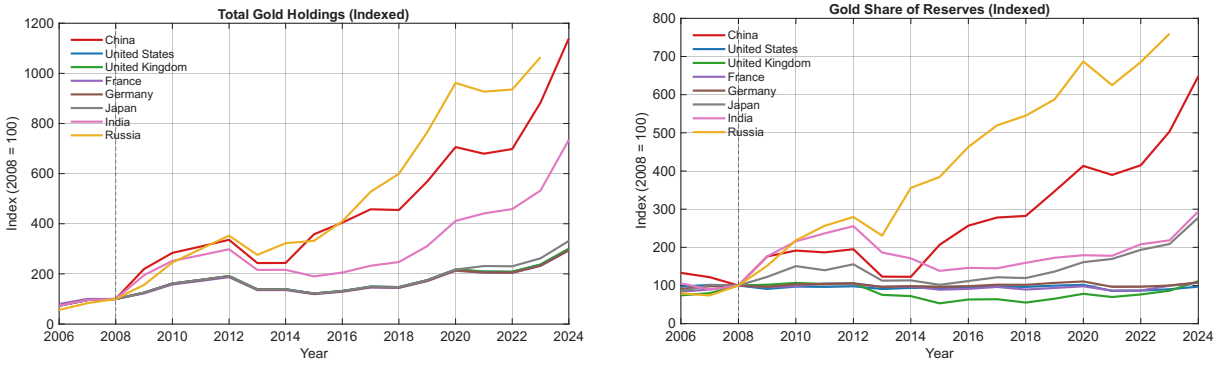


The price pattern in Figure 1 has a direct counterpart in the reserve portfolios of non-Western central banks. Figure 2 contrasts the post-2008 accumulation of gold by the countries most exposed to US financial sanctions risk to western aligned countries. Both panels are indexed to 2008, the year of the Global Financial Crisis, to isolate the structural shift from the long pre-crisis period of relative stability. The left panel shows

that total gold holdings — measured in US dollars — rose dramatically for China, India, and Russia, while remaining broadly flat for the major Western economies. Russia's gold accumulation is the most pronounced: following the 2014 Crimea sanctions it essentially doubled its gold stock, a deliberate de-dollarisation strategy that accelerated further after 2022. China's and India's accumulation, though less abrupt, represents a similarly persistent reorientation away from US Treasuries.

The right panel shows that this is not merely a price effect. Gold's *share* of total reserves also rose sharply for these countries, confirming that central banks actively shifted the composition of their portfolios toward gold and away from foreign-currency assets. For Russia, the gold share roughly tripled between 2008 and 2022. These patterns are consistent with the model's core mechanism: as the perceived probability of selective sanctions rises, the incentive to hold the politically immune asset increases even at the cost of lower yields and higher storage or transportation costs.

Figure 2: Gold reserve accumulation since 2008 (index: 2008 = 100). *Left:* total gold holdings in USD. *Right:* gold as a share of total foreign reserves. *Source: World Bank, IMF IFS.*



3 Model

3.1 Environment

The model features an infinite-horizon discrete-time economy populated by a sovereign borrower (e.g., the US) and two representative lenders: a domestic representative household (the U.S. private sector) and a foreign representative lender (e.g., China). There are two tradable assets: a physical safe asset (gold, A) with a fixed global supply $\bar{A}$, and one-period, non-contingent bonds B issued by the sovereign borrower.

The economy is subject to exogenous shocks $S_t = (Z_t, Z_{cn,t}, M_t, G_t)$, which follow a joint Markov process. Z_t and $Z_{cn,t}$ are total factor productivity (TFP) endowments.

$M_t \in \{0, 1\}$ dictates the overarching geopolitical regime (tranquil vs. turbulent), and G_t is a geopolitical utility shock that penalizes the borrower upon the imposition of an endogenous sanction event.

Crucially, the realizations of G_t depend entirely on the regime M_t:

- **Tranquil Regime ($M_t = 0$):** The geopolitical penalty is strictly $G_t = 0$, and the probability of transitioning to a severe penalty state in the immediate next period is zero.
- **Turbulent Regime ($M_t = 1$):** The economy is subjected to fluctuating, strictly positive geopolitical penalties driven by an underlying autoregressive process. In this regime, even if the current penalty realization is relatively small, the probability of transitioning to a severe, large-penalty state remains highly significant.

3.2 The Lenders

The foreign lender (cn) receives exogenous endowments $Z_{cn,t}$ and derives additive utility from consumption C_t and from a portfolio of safe assets L_t which is a function of gold A_{t+1} and sovereign bonds B_{t+1}. Utility from consumption is log to capture some degree of risk aversion and willingness to smooth intertemporally. The foreign lender (cn) maximizes:

$$U_{cn} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{cn}^t \left[\log(C_{cn,t}) + \phi \frac{L_{cn,t}^{1-\eta}}{1-\eta} \right] \tag{1}$$

where the inner liquidity index $L_{cn,t}$ is:

$$L_{cn,t} = \left[\omega A_{cn,t+1}^{\rho} + (1-\omega) B_{cn,t+1}^{\rho} \right]^{\frac{1}{\rho}} \tag{2}$$

We model liquidity services using a Constant Elasticity of Substitution (CES) aggregator nested inside a Constant Relative Risk Aversion (CRRA) utility framework with curvature parameter η. This flexible functional form allows us to capture the imperfect substitutability between physical gold and sovereign bonds in satisfying the lenders' liquidity needs. The parameter $\rho < 1$ governs the elasticity of substitution $(1/(1-\rho))$ between the two safe assets, while ω determines the overall importance of an asset in satisfying liquidity needs. The budget constraint is given by:

$$C_{cn,t} + Q_{A,t} A_{cn,t+1} + Q_{B,t} B_{cn,t+1} + \frac{\tau_g}{2} (\Delta A_{cn,t})^2 = Z_{cn,t} + B_{cn,t}(1 - d_t \kappa) + Q_{A,t} A_{cn,t} \tag{3}$$

where $Q_{i,t}$ is the price[2] of asset i, $d_t \in \{0,1\}$ is the sovereign's strategic decision to impose sanctions, κ is the targeted financial haircut applied to foreign-held bonds, and the last term on the left-hand side is the shipping cost incurred when China changes its gold stock. These costs capture the physical, legal, and logistical frictions involved in moving physical gold across borders.

Taking first-order conditions yields the asset pricing equations.

$$Q_{A,t} + \tau_g \, \Delta A_{cn,t} = C_{cn,t} \left(\beta_{cn} \mathbb{E}_t \left[\frac{Q_{A,t+1}}{C_{cn,t+1}} \right] + MU_{A,cn,t} \right) \tag{4}$$

$$Q_{B,t} = C_{cn,t} \left(\beta_{cn} \mathbb{E}_t \left[\frac{1 - d_{t+1}\kappa}{C_{cn,t+1}} \right] + MU_{B,cn,t} \right) \tag{5}$$

The marginal utilities for liquidity are:

$$MU_{A,cn,t} = \phi \left[\omega A_{cn,t+1}^{\rho} + (1-\omega) B_{cn,t+1}^{\rho} \right]^{\frac{1-\eta}{\rho} - 1} \omega A_{cn,t+1}^{\rho-1} \tag{6}$$

$$MU_{B,cn,t} = \phi \left[\omega A_{cn,t+1}^{\rho} + (1-\omega) B_{cn,t+1}^{\rho} \right]^{\frac{1-\eta}{\rho} - 1} (1-\omega) B_{cn,t+1}^{\rho-1} \tag{7}$$

To formalize the analysis of risk premia, we define the Stochastic Discount Factor (SDF) for the foreign lender as $\mathcal{M}_{cn,t+1} \equiv \beta_{cn}(C_{cn,t+1}/C_{cn,t})^{-1}$. In SDF form the gold and bond Euler equations are:

$$Q_{A,t} + \tau_g \, \Delta A_{cn,t} = \mathbb{E}_t \left[\mathcal{M}_{cn,t+1} Q_{A,t+1} \right] + \mathcal{L}_{A,cn,t} \tag{8}$$

$$Q_{B,t} = \mathbb{E}_t \left[\mathcal{M}_{cn,t+1} (1 - d_{t+1}\kappa) \right] + \mathcal{L}_{B,cn,t} \tag{9}$$

where $\mathcal{L}_{i,cn,t} \equiv C_{cn,t} MU_{i,cn,t}$ is the marginal liquidity yield in units of consumption.

The domestic US lender has an identical preference structure, maximizing:

$$U_{us} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{us}^t \left[\log(C_{us,t}) + \phi \frac{L_{us,t}^{1-\eta}}{1-\eta} \right], \qquad L_{us,t} = \left[\omega A_{us,t+1}^{\rho} + (1-\omega) B_{us,t+1}^{\rho} \right]^{\frac{1}{\rho}} \tag{10}$$

subject to the budget constraint:

$$C_{us,t} + Q_{A,t} A_{us,t+1} + Q_{B,t} B_{us,t+1} + \frac{\tau_g}{2} (\Delta A_{cn,t})^2 = (1 - \psi d_t)(1-\tau) Z_t + B_{us,t} + Q_{A,t} A_{us,t} \tag{11}$$

[2]With shipping costs both lenders face different gold prices when altering their gold positions. $Q_{A,cn,t} - Q_{A,us,t} = \tau_g \, \Delta A_{cn,t}$ The aggregate gold price is the portfolio-weighted average $Q_{A,t} = (A_{cn,t} Q_{A,cn,t} + A_{us,t} Q_{A,us,t})/\bar{A}$. For ease of notation we keep $Q_{A,t}$ in the main text which is valid for considering steady states, but the numerical solution along transitions considers this price wedge.

The output loss ψ in case of sanctions is economy-wide: it reduces US TFP Z_t in the period, shrinking both the government's tax revenue τZ_t and the private sector's endowment $(1-\tau)Z_t$ by the same factor $(1-\psi)$. China's endowment $Z_{cn,t}$ is unaffected, as the output disruption is purely domestic. Two further features distinguish the domestic lender from the foreign lender. First, domestically held debt carries *no default risk*: the sovereign never imposes a haircut on B_{us}, so the bond payoff is always $B_{us,t}$ in full regardless of d_t. Second, the domestic lender is less patient ($\beta_{us} < \beta_{cn}$), reflecting that the US private sector has a higher opportunity cost of holding long-duration safe assets relative to the structurally savings-driven foreign sector. The bond and gold FOC mirrors the one of China with $\kappa = 0$:

$$Q_{B,t} = C_{us,t}\left(\beta_{us}\mathbb{E}_t\left[\frac{1}{C_{us,t+1}}\right] + MU_{B,us,t}\right) \tag{12}$$

$$Q_{A,us,t} + \tau_g\,\Delta A_{us,t} = C_{us,t}\left(\beta_{us}\mathbb{E}_t\left[\frac{Q_{A,us,t+1}}{C_{us,t+1}}\right] + MU_{A,us,t}\right) \tag{13}$$

Bond and gold prices Q_B are equated across investors in equilibrium. with the global supply $A_{cn,t} + A_{us,t} = \bar{A}$ and the bond market share $\mathrm{Sh}_t \equiv B_{cn,t}/B_t$ adjusting until both investors are willing to hold their respective portfolios.

3.3 Imperfect Substitutability and Liquidity Scarcity

The assumption that $\rho < 1$ guarantees that gold and bonds are imperfect substitutes for providing liquidity. When the borrower imposes sanctions, foreign-held bond wealth collapses and access to new sovereign debt is restricted. This loss of bond wealth causes the total liquidity index L_{cn} to shrink. Provided that the lender's aversion to liquidity squeezes is sufficiently high (governed by the outer curvature η), their marginal valuation of the remaining safe asset—gold—spikes upward. This functional form dynamically captures the scarcity premium that emerges when sanctions remove a key safe asset from the international financial system.

3.4 The Sovereign Borrower (US)

The sovereign borrower acts as a Stackelberg leader, maximizing flow utility from consumption while internalizing the followers' pricing schedules $Q_A(B')$ and $Q_B(B')$. Unlike the lenders, the sovereign holds no gold and derives no direct utility from safe-asset liq-

uidity; its flow payoff is standard CRRA over government consumption:

$$u(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma} \tag{14}$$

Value Functions and Preference Shocks The sovereign's discrete decision between contractual compliance and sanctioning is subject to additive, idiosyncratic preference shocks $\epsilon \sim \text{Gumbel}(0, \sigma)$. These shocks capture unmodeled political or institutional frictions that influence the sovereign's strategic choices at the margin. Consequently, the ex-ante value function takes a log-sum-exp form:

$$V(B, S) = \sigma \log \left(\exp \left(\frac{V_{com}(B, S)}{\sigma} \right) + \exp \left(\frac{V_{san}(B, S)}{\sigma} \right) \right) \tag{15}$$

If the borrower chooses compliance (V_{com}):

$$V_{com}(B, S) = \max_{B'} \{u(C_{com}) + \beta \mathbb{E}\left[V(B', S')|S\right]\} \tag{16}$$

subject to $C_{com} + B = \tau Z + Q_B B'$.

If the borrower imposes sanctions (V_{san}), they exclude the foreign lender from the bond market ($B'_{cn} = 0$), pay a recovered fraction $(1-\kappa)B_{cn} + B_{us}$, suffer an output loss ψ (retaining $(1-\psi)$ of τZ), and reap the geopolitical utility benefit G:

$$V_{san}(B, S) = \max_{B'} \{u(C_{san}) + G + \beta \mathbb{E}\left[\theta V(B', S') + (1-\theta) V_{aut}(B', S')|S\right]\} \tag{17}$$

subject to $C_{san} + (1-\kappa)B_{cn} + B_{us} = (1-\psi)\tau Z + Q_{B,us} B'$, where $\psi \in (0, 1)$ is the output loss in case of default. The parameter θ represents the exogenous probability of market normalization and re-entry.

3.5 Regime Shifts: Predictions for the Turbulent Transition

We derive predictions for a regime shift from tranquility ($M = 0$) to turbulence ($M = 1$). Let $\mathbb{P}(d'|M)$ be the probability of sanctions in $t+1$. By construction, $\mathbb{P}(d'|M = 1) > \mathbb{P}(d'|M = 0)$.

Bond Price Depreciation and SDF Comovement The transition to turbulence triggers an immediate collapse in bond prices through a *geopolitical risk premium*. Ap-

plying the covariance decomposition to Equation 9:

$$Q_{B,t} = \mathbb{E}_t[\mathcal{M}_{cn,t+1}]\mathbb{E}_t[1 - d_{t+1}\kappa] + \mathrm{Cov}_t(\mathcal{M}_{cn,t+1}, 1 - d_{t+1}\kappa) + \mathcal{L}_{B,cn,t} \tag{18}$$

In the turbulent regime, $\mathrm{Cov}_t(\mathcal{M}_{cn,t+1}, 1 - d_{t+1}\kappa) < 0$. This occurs because the sanction is imposed in states where the foreign lender's bond wealth is expropriated, compressing their consumption and causing their SDF $\mathcal{M}_{cn}$ to spike. The negative correlation between the payoff and the SDF drives Q_B significantly lower than the actuarial probability of sanctions alone would suggest.

Flight to Safety: Portfolio Rebalancing The relative demand for assets satisfies the ratio of marginal liquidity yields. Dividing the bond FOC (9) by the gold FOC (8):

$$\frac{Q_{B,t} - \mathbb{E}_t[\mathcal{M}_{cn,t+1}(1 - d_{t+1}\kappa)]}{Q_{A,t} + \tau_g\,\Delta A_{cn,t} - \mathbb{E}_t[\mathcal{M}_{cn,t+1}Q_{A,t+1}]} = \frac{\mathcal{L}_{B,cn,t}}{\mathcal{L}_{A,cn,t}} = \frac{1-\omega}{\omega}\left(\frac{B_{cn,t+1}}{A_{cn,t+1}}\right)^{\rho-1} \tag{19}$$

As $\mathbb{P}(d')$ rises, the bond liquidity yield in the numerator falls (bond payoffs become riskier) while the gold liquidity yield in the denominator rises (gold becomes scarcer). Given $\rho - 1 < 0$, restoring equality requires increasing A_{cn} relative to B_{cn}: the lender sheds the sanctionable asset in favour of the immune one. The transportation cost term in the denominator moderates the speed of this rebalancing — a large desired flow into gold raises the effective marginal cost of acquiring it, slowing the adjustment relative to the frictionless case.

Gold Price Spikes as a Geopolitical Hedge Unlike bonds, gold prices are predicted to appreciate during the turbulent transition. This is driven by gold's positive comovement with the lender's SDF. In states where bond wealth is expropriated, gold provides a high return or high liquidity services precisely when the marginal utility of wealth is highest.

$$\frac{\partial Q_{A,t}}{\partial M} \approx \underbrace{\mathrm{Cov}_t(\mathcal{M}_{cn,t+1}, Q_{A,t+1})}_{>0 \text{ (Hedge Property)}} + \underbrace{\frac{\partial \mathcal{L}_{A,cn,t}}{\partial M}}_{>0 \text{ (Scarcity Premium)}} - \underbrace{\tau_g \frac{\partial \Delta A_{cn,t}}{\partial M}}_{\geq 0 \text{ (Friction Dampening)}} \tag{20}$$

Gold serves as a *geopolitical hedge*; its price increases because it provides insurance against the endogenous sanctions that impair the sovereign bond market.

3.6 Equilibrium

A Recursive Markov Perfect Equilibrium consists of value functions $\{V, V_{com}, V_{san}, V_{aut}\}$, borrower policy function $\{B', d\}$, lender portfolio policies $\{A'_{cn}, A'_{us}, B'_{cn}, B'_{us}\}$, and pricing schedules $\{Q_A, Q_B\}$ such that:

1. Given prices, the borrower's policies maximize their value functions.
2. The asset pricing schedules satisfy the lenders' Euler equations (4) and (5).
3. The global gold market clears: $A_{cn,t} + A_{us,t} = \bar{A}$.
4. The probability of sanctions satisfies the logistic distribution derived from the preference shocks: $P_S = \frac{\exp(V_{san}/\sigma)}{\exp(V_{com}/\sigma)+\exp(V_{san}/\sigma)}$.

4 Calibration and Simulation Results

We calibrate the model to a stylized representation of the US–China financial relationship. We then simulate a transition from a geopolitically safe state to a more turbulent state, in which sanctioning becomes more common.

4.1 Calibration

The parameters are collected in Table 1 and organized into four groups: preference parameters, the CES liquidity block, asset-market and default parameters, and the stochastic environment.

Preference Parameters The government's discount factor $\beta_{gov} = 0.93$ is set below the standard value to reflect the short political horizon of policymakers. The foreign lender (China) is highly patient, with $\beta_{cn} = 0.97$, consistent with the view that China's structural current-account surplus generates a persistent demand for US dollar assets. The domestic US private sector is calibrated to the same impatience as the government ($\beta_{us} = 0.93$), reflecting a higher opportunity cost of holding long-duration safe assets relative to productive capital. The CRRA coefficient is set to $\gamma = 2$, a standard value in international macroeconomics.

CES Liquidity Block The liquidity aggregator $L_t = [\omega A_{t+1}^{\rho} + (1-\omega)B_{t+1}^{\rho}]^{1/\rho}$ is calibrated with weight $\omega = 0.4$ on gold and $1-\omega = 0.6$ on bonds, reflecting the larger role sovereign bonds play in international liquidity portfolios relative to physical gold. The substitution parameter $\rho = 0.5$ implies an elasticity of substitution $1/(1-\rho) = 2$, reflecting meaningful but imperfect substitutability between the two safe assets. The outer curvature parameter $\eta = 1.1$ generates a convex marginal value of liquidity, so that even small reductions in the liquidity index produce large spikes in safe-asset demand. The scale parameter $\phi = 0.001$ is chosen to match a moderate convenience yield in normal times without allowing liquidity motives to dominate consumption.

Asset-Market and Default Parameters The global supply of gold is normalized to $\bar{A} = 0.30$. The selective haircut $\kappa = 0.50$ is applied exclusively to China's bond holdings upon default, consistent with the legal and institutional barriers that prevent full enforcement of sovereign debt claims across borders. This value is broadly in line with historical haircut estimates of Graf von Luckner et al. (2025). The re-entry probability is set to $\theta = 0.10$, implying that the expected exclusion from normal international bond markets lasts ten periods, capturing the persistent nature of geopolitical freezes in practice. The output loss parameter is $\psi = 0.010$, a 1% TFP contraction in the sanctioning period that is assumed to be economy-wide, reducing both government tax revenue τZ_t and the domestic private-sector endowment $(1-\tau)Z_t$ by the same factor. The transportation cost coefficient is set to $\tau_g = 1.0$, which makes large instantaneous gold flows expensive while leaving small rebalancing nearly frictionless; the key consequence is to spread gold portfolio adjustment over several periods rather than concentrating it at impact. The maximum debt-to-GDP ratio is capped at $B_{\max} = 0.12$ to focus computational resources on the empirically relevant debt range while providing high grid resolution.

Stochastic Environment The government's revenue share of output is fixed at $\tau = 1/3$. US TFP follows an AR(1) in logs with mean one, persistence $\rho_Z = 0.80$, and standard deviation $\sigma_Z = 0.03$. China's TFP similarly follows an AR(1) with mean $1-\tau \approx 0.67$ (calibrated so that in the symmetric steady state China's endowment equals the private share of US output), persistence $\rho_{Zcn} = 0.80$, and standard deviation $\sigma_{Zcn} = 0.05$. The geopolitical regime M_t switches between tranquility ($M = 0$) and turbulence ($M = 1$) with regime persistence $\rho_M = 0.90$. Within the turbulent regime, the geopolitical penalty G_t follows an AR(1) with mean $\mu_G = 0.02$, persistence $\rho_G = 0.80$, and dispersion $\sigma_G = 0.70$; in the tranquil regime $G_t \equiv 0$. The joint shock state space has $n_S = 12$ grid points.

Table 1: Baseline Calibration

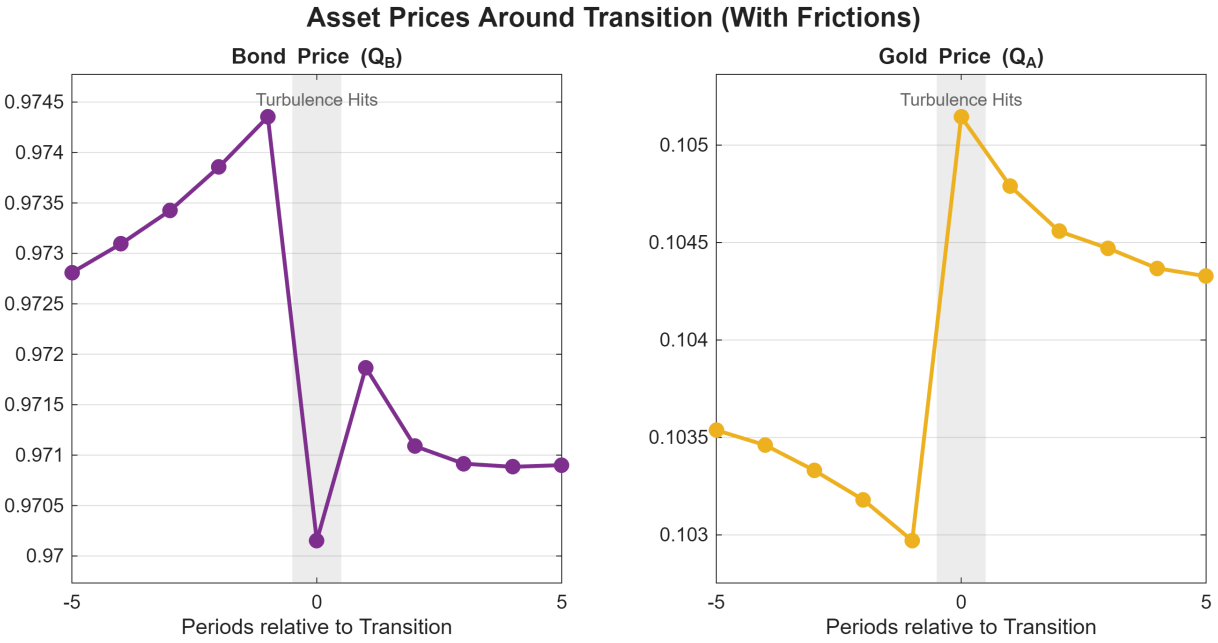
Group	Parameter	Symbol	Value
Preferences			
	Government discount factor	β_{gov}	0.93
	China discount factor	β_{cn}	0.97
	US private discount factor	β_{us}	0.93
	CRRA coefficient	γ	2.00
CES Liquidity			
	Liquidity scale	ϕ	0.001
	Gold weight in CES	ω	0.40
	CES substitution parameter	ρ	0.50
	Outer curvature	η	1.10
Asset Market & Default			
	Global gold supply	$\bar{A}$	0.30
	Haircut on China's bonds	κ	0.50
	Market re-entry probability	θ	0.10
	Output loss (default)	ψ	0.010
	Gold transportation cost	τ_g	1.00
	Maximum debt (grid bound)	$B_{\max}$	0.12
	Government revenue share	τ	1/3
Stochastic Environment			
	US TFP persistence	ρ_Z	0.80
	US TFP standard deviation	σ_Z	0.03
	China TFP persistence	ρ_{Zcn}	0.80
	China TFP standard deviation	σ_{Zcn}	0.05
	Regime persistence	ρ_M	0.90
	Mean geopolitical penalty	μ_G	0.02
	Penalty persistence	ρ_G	0.80
	Penalty dispersion	σ_G	0.70

4.2 Asset Prices and Reallocation Around Regime Change

Figures 3 and 4 present event-study averages centered on the simulated transitions from the tranquil ($M = 0$) to the turbulent ($M = 1$) regime. Each panel plots the mean of the relevant variable over a window of five periods before and five periods after the transition date ($t = 0$).

Bond prices (Figure 3, left panel). In the five tranquil periods preceding the shift, Q_B rises gradually from roughly 0.973 at $t = -5$ to a peak near 0.974 at $t = -1$. This pre-transition run-up reflects a selection effect: the economy tends to enter the turbulent regime from states in which public finances are unusually sound and credit risk is low, so bonds are priced near their safest level just before the shock arrives. At $t = 0$ the mean bond price drops sharply by approximately 0.4 percentage points to around 0.970, consistent with the geopolitical risk premium mechanism in equation (9). The negative

Figure 3: Mean bond and gold prices around the onset of geopolitical turbulence ($t = 0$). Mean over a simulation length of 11,000 periods with 1,000 burn-in periods. Model with gold transportation costs ($\tau_g = 1.0$).

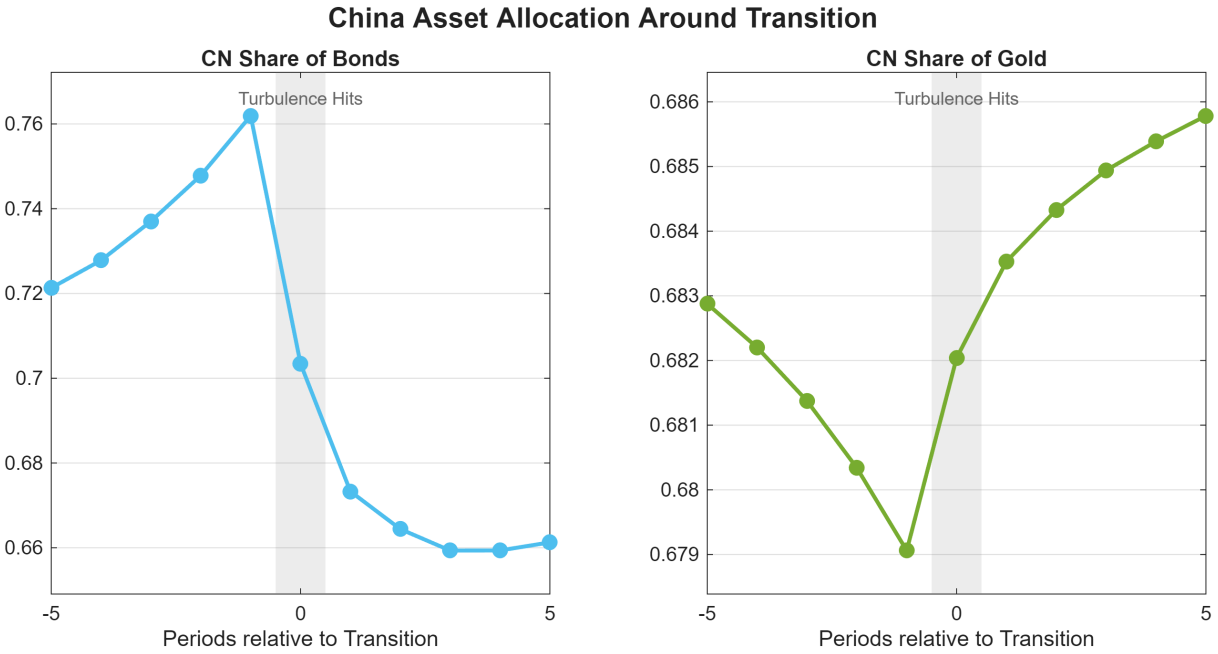


covariance between China's SDF and the bond payoff — both spiking in states where the sanction is imposed — compresses Q_B well below its actuarially fair value. Bond prices stabilize in the post-transition periods near 0.971, reflecting the permanently elevated probability of sanctions in the turbulent regime.

Gold prices (Figure 3, right panel). The aggregate gold price Q_A drifts slightly downward before the transition, from approximately 0.1035 at $t = -5$ to a trough near 0.1030 at $t = -1$, mirroring the bond price run-up: as bonds become more attractive, China modestly tilts toward them, reducing demand for gold. At $t = 0$ the pattern reverses: Q_A jumps to roughly 0.1050, an appreciation of about 2 percentage points. This sharp appreciation at impact reflects two complementary forces: (i) a positive hedge covariance, since gold delivers high returns precisely in the states where China's marginal utility of wealth is highest; and (ii) a scarcity premium, since China's forced reallocation out of bonds concentrates demand on the fixed global gold supply $\bar{A}$. Gold prices ease slightly after impact, settling near 0.1040–0.1045 as portfolios gradually complete their adjustment.

Portfolio reallocation (Figure 4). The pre-transition window exhibits the familiar selection effect in quantities: China's bond share rises from roughly 72% at $t = -5$ to a peak of approximately 75% at $t = -1$, while its gold share falls slightly. In tranquil times, China aggressively accumulates the high-yielding, apparently safe bond as the incentive to hold gold as a hedge is dormant.

Figure 4: China's mean portfolio shares in bonds and gold around the onset of geopolitical turbulence ($t = 0$). Mean over a simulation length of 11,000 periods with 1,000 burn-in periods. Model with gold transportation costs ($\tau_g = 1.0$).



At $t = 0$, the bond share collapses by approximately 5 percentage points to around 70%, and continues falling to roughly 65–66% over the following periods while starts to increase its gold holdings, pushing China's total share of global gold holdings to 68.6% by $t = 5$. The flight-to-safety in gold is spread over several periods as the physical transportation costs prevent an immediate adjustment.

Table 2 summarises the average immediate impact in a compact form, complementing the event-study graphs with precise estimates. Based on 4,532 simulated transition events, the dominant effect at impact is a sharp reduction in government debt issuance (-18.3%) as tighter borrowing conditions force the sovereign to scale back. Bond prices fall by 0.5% and China's bond share drops 8.3%, with absolute bond holdings declining by 24.7%. The gold share rises 0.5% at impact — a muted adjustment that spreads gradually over subsequent periods rather than occurring in one sharp jump.

4.3 Reaction to a Geopolitical Shock in Turbulent Times

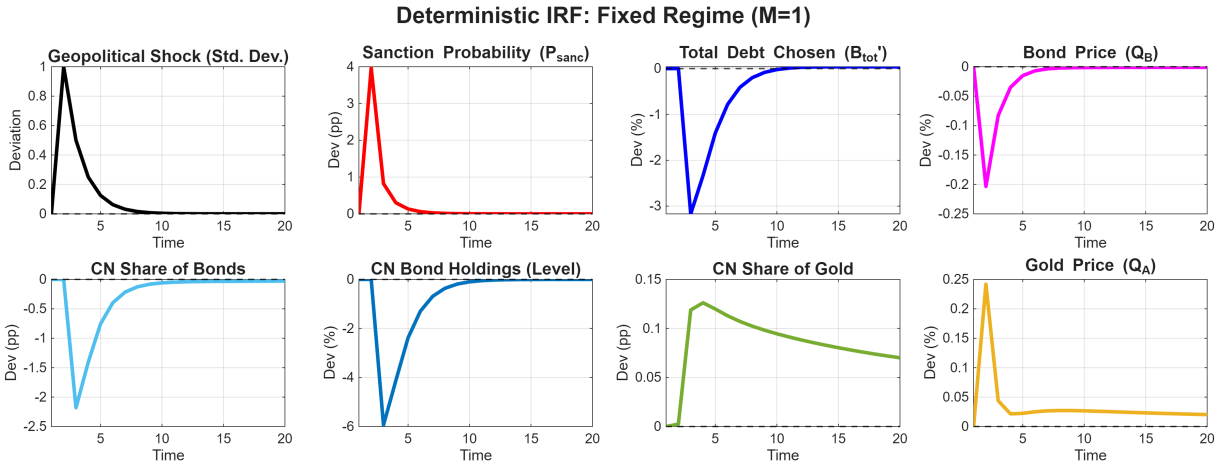
Next we examine what happens to prices and holdings, once a geopolitical shock arises in already turbulent times. The impulse response function (IRF) shown in Figure 5 traces how the equilibrium responds to a one-standard-deviation shock to the geopolitical utility parameter G_t, holding the economy in the turbulent regime ($M = 1$) throughout. The pre-shock baseline is the turbulent steady state, obtained by iterating the policy functions

Table 2: Average Immediate Impact of Transition (Tranquil → Turbulent, $N = 4532$ events)

Variable	**% Change**
Chosen Debt (B')	-18.29%
Gold Price (Q_A)	$+2.38\%$
Bond Price (Q_B)	-0.50%
CN Share of Bonds	-8.27%
CN Share of Gold	$+0.45\%$
CN Bond Holdings (level)	-24.67%
CN Gold Holdings (level)	$+0.45\%$

forward at mean TFP levels ($Z = \bar{Z}$, $Z_{cn} = \bar{Z}_{cn}$) and mean G within the turbulent regime until all endogenous states converge. The shock itself enters as a one-standard-deviation impulse to the AR(1) log-geopolitical process at $t = 1$, which then decays geometrically at rate $\rho_G = 0.80$, dissipating over roughly 15–20 periods. At each step the economy is propagated forward by evaluating the 6-dimensional policy functions — interpolated continuously over $(A_{cn}, \text{Sh}, B_{tot}, Z, Z_{cn}, G)$ for $M = 1$ — with TFP and the regime held fixed, so that all responses are cleanly attributed to the G shock alone.

Figure 5: Deterministic IRF to a one-standard-deviation geopolitical utility shock (G) in the turbulent regime ($M = 1$). All panels show deviations from the turbulent steady state. TFP and the regime are held fixed throughout; the shock decays at rate $\rho_G = 0.80$.



The impulse responses in Figure 5 demonstrate how a heightened geopolitical threat propagates through the model's asset markets.

Default probability. The most immediate effect of the G shock is a sharp spike in the sanctioning probability P_{sanc} of roughly 20 percentage points on impact. This is mechanical: a higher geopolitical utility gain from imposing sanctions (G) tilts the sovereign's discrete choice in favor of default, shifting the Gumbel distribution rightward. The probability then decays smoothly as G reverts to its mean, following the AR(1)

persistence of the shock.

Government borrowing. In response to the elevated default probability, the government reduces total debt issuance B'_{tot} by approximately 0.3% on impact. This reflects a decline in the debt capacity as demand for US bonds is more likely to sharply decline in the future. The adjustment is gradual and persists for several periods beyond the initial shock.

Bond prices and China's portfolio. The bond price Q_B drops by around 0.15% on impact, driven by the higher probability of a haircut on China's holdings. In response, China reduces both its share of bonds (-2 pp) and its absolute bond holdings (-6%), reallocating toward gold. The bond price briefly overshoots above zero during the recovery phase, reflecting the portfolio dynamics as China gradually rebuilds its bond position once the geopolitical threat subsides.

Gold as a geopolitical hedge. China's gold share rises by approximately 0.5–0.6 percentage points on impact, while the gold price Q_A appreciates by roughly 0.2%. Both responses are muted relative to the large swing in default probability, because gold's fixed global supply $\bar{A}$ limits how much China can increase its gold position, and because the domestic US lender partially absorbs the shift in portfolio demand. As the shock dissipates, gold prices and shares return smoothly to their turbulent-regime baseline, consistent with gold serving as a temporary hedge rather than a permanent store of accumulated safe-asset demand.

Overall, the IRF confirms the transmission mechanism embedded in the model: a rise in G raises the probability of sanctions, lowers bond prices, triggers a flight-to-safety portfolio reallocation, and appreciates gold.

5 Conclusion

This paper develops and solves a general equilibrium model of international safe-asset choice in which a sovereign borrower, a foreign lender, and a domestic private sector interact under the threat of selective default and geopolitical sanctions. Two features distinguish our framework from the existing literature. First, liquidity services arise from a CES aggregator over gold and sovereign bonds, so that the convenience yield of each asset responds to portfolio composition rather than being imposed exogenously. While gold is politically neutral and save, it has inferior liquidity properties paired with transportation

costs. Second, the sovereign acts as a Stackelberg leader whose default and sanctioning decision is strategic and probabilistic.

The model's core mechanism is a regime-contingent amplification loop. In the tranquil regime, investors coordinate on bonds, enjoying high convenience yields and low gold demand. When the geopolitical regime shifts to turbulence, gold becomes substantially more valuable for the country that is at risk of sanctioning, leading to a dramatic portfolio reallocation. An event-study simulations confirm this prediction quantitatively—bond prices drop sharply at the transition, China's bond share falls by roughly five percentage points on impact, and gold prices and gold shares rise persistently thereafter.

Several extensions remain for future work. The current model features only two assets, and could be extended to accommodate new financial products such as stablecoins and cyrpto currency. Furthermore, future work could aim to demonstrate empirically how geopolitical shocks lead to portfolio reallocation and relative asset price changes.

A Numerical Implementation of Preference Smoothing

Standard sovereign debt and sanction models feature a discrete choice $d \in \{0, 1\}$ over whether to comply or impose sanctions. This generates non-convexities and discontinuous policy functions, which complicate numerical convergence. To ensure differentiability and stability, the borrower's choice is smoothed by assuming they draw idiosyncratic, additive taste shocks ϵ_{com} and ϵ_{san} for each option before making a decision.

A.1 Theoretical Formulation

Let $V_{com}(x)$ and $V_{san}(x)$ denote the fundamental values of compliance and sanctioning in state $x = (B, S)$. The realized value of choosing option $j \in \{com, san\}$ is given by $\tilde{V}_j(x) = V_j(x) + \epsilon_j$, where ϵ_j is drawn independently from an Extreme Value Type I (Gumbel) distribution with location 0 and scale parameter $\sigma > 0$.

In this nested optimization framework, these fundamental values are calculated by optimizing over the continuous control variable B', taking tomorrow's smoothed expected value function $V(x')$ as the continuation value. Specifically, the compliance value evaluates the maximum utility over the choice of total debt issuance:

$$V_{com}(B, S) = \max_{B'} \{u(C_{com}) + \beta \mathbb{E}_{S'} [V(B', S')|S]\} \tag{21}$$

Similarly, the sanction value optimizes over domestic debt B' (with $B'_{cn} = 0$ imposed by market exclusion):

$$V_{san}(B, S) = \max_{B'} \{u(C_{san}) + G + \beta \mathbb{E}_{S'} [\theta V(B', S') + (1 - \theta) V_{aut}(B', S')|S]\} \tag{22}$$

Following the continuous portfolio choices, the borrower makes the discrete decision by choosing the option that maximizes $\tilde{V}_j(x)$. By the properties of the Gumbel distribution, the ex-ante expected value function (prior to observing the taste shocks) has a closed-form analytical solution known as the log-sum-exp function:

$$V(x) = \mathbb{E}_\epsilon [\max \{V_{com}(x) + \epsilon_{com},\ V_{san}(x) + \epsilon_{san}\}] = \sigma \log \left(\exp \left(\frac{V_{com}(x)}{\sigma} \right) + \exp \left(\frac{V_{san}(x)}{\sigma} \right) \right) \tag{23}$$

(Note: A standard Euler-Mascheroni constant shift is conventionally omitted for brevity,

as it does not affect optimal policies or relative probabilities).

The probability of choosing to sanction, evaluated before the realization of the shocks, is given by the standard logistic function:

$$P_S(x) = \Pr\left(V_{san}(x) + \epsilon_{san} > V_{com}(x) + \epsilon_{com}\right) = \frac{\exp\left(\frac{V_{san}(x)}{\sigma}\right)}{\exp\left(\frac{V_{com}(x)}{\sigma}\right) + \exp\left(\frac{V_{san}(x)}{\sigma}\right)} \tag{24}$$

A.2 Computational Implementation

Evaluating Equation 23 directly in computational software often leads to numerical overflow (evaluating to `Inf` or `NaN`). This occurs when the fundamental values $V_j(x)$ are large or, equivalently, when the smoothing parameter σ approaches zero (reflecting a highly precise choice), causing the term $\exp(V_j(x)/\sigma)$ to exceed machine precision.

To guarantee numerical stability, the model code applies the *Log-Sum-Exp Trick*. We define the maximum fundamental value as $\bar{V}(x) = \max\{V_{com}(x), V_{san}(x)\}$. By factoring $\exp(\bar{V}(x)/\sigma)$ out of the logarithm, the value function is identically rewritten as:

$$V(x) = \bar{V}(x) + \sigma \log\left(\exp\left(\frac{V_{com}(x) - \bar{V}(x)}{\sigma}\right) + \exp\left(\frac{V_{san}(x) - \bar{V}(x)}{\sigma}\right)\right) \tag{25}$$

Because the maximum exponent in the sum is exactly 0 (which evaluates to $\exp(0) = 1$), and all other exponents are strictly negative, the terms inside the logarithm are bounded between 1 and 2. This absolutely prevents overflow regardless of the scale of σ.

Similarly, to prevent overflow or divide-by-zero errors when computing the probability of sanctions, the fraction is rearranged by dividing the numerator and denominator by $\exp(V_{com}(x)/\sigma)$, yielding a highly stable logistic form:

$$P_S(x) = \frac{1}{1 + \exp\left(\frac{V_{com}(x) - V_{san}(x)}{\sigma}\right)} \tag{26}$$

This formulation ensures that if $V_{com} \gg V_{san}$ (compliance is heavily favored), the exponent grows large and positive, driving the denominator to infinity and $P_S(x)$ cleanly to 0 without numerical instability.

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