Dealer Simulation Design Changes

1 Overview of Proposed Changes

The goal of the next simulation iteration is to design a setup in which the presence of the dealer (and VBT) is both (a) realistically scaled relative to the market and (b) meaningfully comparable to a pure passive baseline. The changes below are intended to respect the original version 1.0 / 1.5 design principle that agents are balance sheets whose actions are driven by settlement constraints, without introducing ad hoc mechanisms that force trading or special pricing regimes.

1.1 Balanced Initial Balance Sheets for Passive vs Active Regimes

We want a clean "control vs treatment" design where the only difference between the passive and active runs is whether the large holders are allowed to act as dealers/VBTs and whether traders are allowed to trade. Concretely:

- For each maturity bucket $m \in \{\text{short}, \text{mid}, \text{long}\}$, we define:
  - A large *VBT-like* passive holder with approximately 25% of total claims of maturity m and an equal value of money (cash).
  - A large *dealer-like* passive holder with approximately 12.5% of total claims of maturity m and an equal value of money (cash).
- In the passive regime, these entities are simply large passive holders that never trade.
- In the active regime, the *same* balance sheets are reused, but the large passive entities are reinterpreted as:
  - Value-Based Traders (VBTs) for the 25% blocks.
  - Dealers for the 12.5% blocks.

In other words, passive and active runs start from *identical* balance sheets; we only switch on/off behaviour.

1.2 Many-Trader Environment

Instead of a very small number of traders (e.g. a ring of 5 households), we move to a setting with a larger population of traders, e.g. $N = 100$.

- The dealer and VBT become "large but few" agents in a market populated by many smaller traders.
- The ratio of trader count to dealer/VBT agents should more closely resemble a realistic market structure: one or a few dealers and VBTs, many heterogeneous traders.

This avoids artefacts where each dealer effectively intermediates a negligible or excessively concentrated part of the system.

1.3 Default-Avoidance Trading as the Sole Driver of Trades

Trader behaviour in the active regime should be driven explicitly by default avoidance rather than by generic or random strategy tags.

- Each trader evaluates a forward-looking liquidity gap over some horizon H (e.g. up to the longest maturity).
- If the projected cash inflows plus current cash are insufficient to meet upcoming liabilities within horizon H, the trader attempts to sell assets to close this gap.
- Traders without a projected shortfall do not trade in this baseline version (apart from any minimal exploratory trading we might optionally add later).

This keeps trading tightly linked to the original goal of version 1.0: meeting payment requirements in time.

1.4 Continuous Issuance via Rollover

To avoid a one-shot cohort where longer-maturity claims simply disappear as time passes, we introduce simple rollover:

- Each liability/claim pair records its original maturity distance ΔT (e.g. $1, 5, 10$).
- When a claim is repaid at time t, the borrower immediately issues a new claim of the same size and maturity distance ΔT to the same holder, maturing at $t + \Delta T$.
- If a claim defaults, it is not rolled over; the corresponding relationship disappears.

This produces an approximately stationary environment in which each maturity bucket remains active over time, and the dealer repeatedly sees new paper in all buckets.

1.5 Pairwise Run-by-Run Comparison

We keep the paired experiment structure from earlier work, but emphasise strict comparability:

- For each parameter set and random seed, we build a single initial state and run it twice:
  1. A passive regime: no trading by traders, and large holders remain purely passive.
  2. An active regime: trading enabled for traders, and the same large holders act as dealers/VBTs.
- We compare outcomes run-by-run (e.g. defaulted face value, default rates, distribution of defaults across traders) rather than only at the population level.

The presence or absence of dealers/VBTs is then evaluated as the difference between these paired runs, not as a difference between two unrelated ensembles.

1.6 No Structural Forcing of Flow or Special Pricing Regimes

We explicitly *avoid* two types of interventions:

- We do not impose exogenous quotas or structural rules that "force" some fixed share of debt to trade through the dealer.
- We do not introduce ad hoc rescue pricing regimes where near-default trades get different spreads than others.

Dealer pricing remains whatever baseline bid/ask rule the model uses; dealer activity increases only because it has a realistic balance sheet and traders genuinely need liquidity.

2 Implementation Instructions for the New Setup

This section lists the concrete changes that need to be made in the code and experiment configuration. The intent is to provide a direct blueprint for implementation, not to redesign concepts that already exist in the codebase.

2.1 Ensure Balanced Dealer/VBT Initialisation is Enabled

The codebase already contains logic to initialise large dealer/VBT balance sheets proportionally to the size of the market. In the last attempt this was effectively turned off (e.g. by setting the dealer share to zero and using a generic initialiser).

1. Identify and re-use the existing "balanced dealer" initialisation path, i.e. the one that:
   - allocates a fixed fraction of system claims of each maturity to large passive entities,
   - and provides them with matching cash of equal value.
2. For the new experiment, set the target shares per maturity bucket to:

$$\text{VBT share} \approx 25\% \text{ of total face value at that maturity,}$$
$$\text{Dealer share} \approx 12.5\% \text{ of total face value at that maturity.}$$

3. In the passive regime, treat these entities as ordinary large passive holders with no trading.
4. In the active regime, map the *same* balance sheets onto the dealer/VBT agents:
   - The large VBT-like holders become the VBT agents (one per maturity bucket).
   - The large dealer-like holders become the dealer agents (one per maturity bucket).

The main requirement is: do not use the "empty dealer" initialiser (with zero capital); instead, ensure the proportional balanced initialisation path is active with the shares above.

2.2 Construct a Many-Trader Ring Scenario

1. Introduce a configuration parameter N for the number of traders (e.g. $N = 100$).
2. Modify or extend the scenario builder so that:
   - A ring (or another chosen network structure) is constructed over N traders only.
   - Liabilities among traders are assigned with a given maturity structure (e.g. short/mid/long buckets such as $T = 1, 5, 10$).
3. Ensure that total face value per maturity bucket Q_m is well-defined and recorded, since this is needed for the proportional dealer/VBT initialisation.

2.3 Augment Traders with Big Passive Holders per Maturity

1. After building the trader-only ring, augment the system with large passive holders per maturity bucket m as described in the previous section.
2. For each maturity m, compute total face value Q_m of trader liabilities.
3. Create two new agents:
   - A VBT-like passive holder with target face value $0.25 \cdot Q_m$.
   - A dealer-like passive holder with target face value $0.125 \cdot Q_m$.
4. Allocate additional liabilities from each trader to these holders, distributed symmetrically across traders, and provide traders with matching cash so that the augmentation is balanced (each new liability comes with equal cash received).
5. Initialise the VBT/dealer agents with sufficient cash to honour these payments; after augmentation they should end up with claims on traders and minimal net cash (or a well-specified funding structure, depending on existing conventions in the code).

2.4 Define Passive vs Active Regime Wiring

1. From the fully initialised state (traders + large passive holders), create two identical copies:
   - One for the passive regime.
   - One for the active regime.
2. In the passive regime:
   - Disable trading for all traders.
   - Keep large VBT/dealer-like entities as purely passive holders that only receive payments.
3. In the active regime:
   - Attach the dealer behaviour module to the dealer-like entities in each maturity bucket.
   - Attach the VBT behaviour module to the VBT-like entities.
   - Attach default-avoidance trading behaviour to traders (next subsection).

Importantly, no changes are made to the initial balance sheets between the passive and active copies; only the behaviour modules attached to the agents differ.

2.5 Implement Default-Avoidance Strategy for Traders

1. Introduce a simple default-avoidance strategy module for trader agents:
   - At each time step t, each trader evaluates a forward liquidity gap over a configurable horizon H.
   - The liquidity gap compares projected cash inflows (cash and asset maturities) to projected payment obligations (liabilities coming due) up to $t + H$.
2. If a trader detects a negative liquidity gap (projected shortfall) exceeding a minimal threshold:
   - Compute the required cash to close the gap.
   - Translate this into required face value to sell at current mid prices in the relevant maturity buckets.
   - Select assets to sell (e.g. prioritising longer maturities, or proportional to existing holdings).
   - Submit SELL orders of that face amount into the dealer/VBT subsystem.
3. Traders without a projected shortfall do not submit orders in this baseline configuration.
4. There is no structural quota forcing a given amount of trading and no special-case pricing for distressed traders; orders are treated like any others by the dealer/VBT logic.

2.6 Implement Continuous Issuance via Rollover

1. Extend the representation of each liability/claim pair to record its original maturity distance ΔT.
2. After processing payments at each time step:
   - For each liability that has matured and has been successfully repaid (no default), immediately create a new liability/claim pair:
     - Borrower and lender are the same as for the repaid contract.
     - Face value is equal to the repaid face value.
     - Due date is advanced by ΔT from the current time.
     - Cash moves from the lender to the borrower as part of the new issuance, consistent with existing conventions.
   - For liabilities that have defaulted, do not create new contracts.
3. This rollover logic should be applied identically in both passive and active regimes so that the comparison remains symmetric.

2.7 Maintain Pairwise Comparison Workflow

1. Retain the existing experiment runner structure that pairs passive and active runs with identical parameter sets and random seeds.
2. For each pair:
   - Record total face value, defaulted face value, and default rates by maturity and by agent type in both regimes.

- Compute per-pair metrics (e.g. difference in default rates) rather than relying solely on ensemble averages.

3. Existing instrumentation for repayment events and dealer usage can be reused to analyse which liabilities were associated with trading and how default outcomes differ between regimes.