The Quantum–Tunneling Equities Project: An Overview

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Abstract

This paper summarizes the central idea behind the Quantum–Tunneling Equities project: that financial markets, when viewed through a probabilistic and dynamical lens, share structural similarities with systems in quantum mechanics. Specifically, the project explores how equity prices can be modeled using a wave-like probabilistic representation rather than a purely deterministic or diffusive one. The long-term goal is to derive, not assume, a Schrödinger-style equation for financial dynamics, and to test how such a framework can capture price "tunneling" through valuation barriers.

1 Motivation

Traditional finance assumes that given a set of information, a stock has a single "correct" price reflecting the expected value of its future cash flows. However, this assumption fails to explain why prices often differ across times or markets even when the information set appears identical.

The project begins with a different hypothesis:

> Even if all fundamental information were exactly the same at two different points in time, there is still a nonzero probability that a stock would be priced differently.

This hypothesis, if true, implies that price is not a deterministic function of information—it must instead have a probabilistic structure. That observation opens the door to describing prices as *probability waves* that evolve under laws similar to those governing quantum systems.

2 Core Goals

The project has three main objectives:

1. Prove that identical information can still yield different prices.

This requires a formal model showing that financial equilibria can produce multiple outcomes even when fundamentals are the same. Mechanisms like heterogeneous beliefs, liquidity constraints, or market "sunspots" can make this possible. Demonstrating this rigorously is the philosophical and mathematical foundation for everything that follows.

2. Derive a Schrödinger-type equation for finance.

Instead of positing a wave equation arbitrarily, the project seeks to derive it from standard principles of no-arbitrage, diffusion, and expectation formation. The goal is to show that under suitable transformations, the pricing equations of stochastic finance resemble the Schrödinger equation in *imaginary time*, linking financial diffusion and quantum evolution.

3. Apply the framework to real market behavior.

Once the foundations are established, the Schrödinger-style formalism can be applied to study:

- Barrier crossings (analogous to tunneling through a potential well)
- Asymmetric volatility or drawdown behavior
- Liquidity constraints and the "shape" of potential wells

These effects could explain how prices sometimes move through apparent valuation boundaries—such as when a stock "breaks out" of a fundamental range—without new information entering the system.

3 Why This Matters

Most models in finance assume that prices follow a random walk or a diffusion process driven by news. This project challenges that by suggesting that even in the absence of new information, endogenous market dynamics—belief updates, liquidity shocks, reflexivity—can cause probabilistic state changes.

If successful, the model could:

- Provide a new theoretical justification for why prices fluctuate in calm markets.
- Offer a principled way to measure "potential barriers" in valuation space.
- Create a bridge between classical stochastic finance and quantum-inspired methods.

4 Current Stage of Work

At present, the project is organized into three parallel threads:

Paper 1: Price Non-Uniqueness: Proving that identical fundamentals can lead to multiple rational prices.

Paper 2: Equation Derivation: Establishing the formal correspondence between stochastic diffusion and the Schrödinger equation.

Paper 3: Applications: Modeling tunneling probabilities and barrier asymmetries in actual equities.

The current draft of this overview corresponds to the conceptual roadmap for these papers.

5 Outlook

The Quantum–Tunneling Equities project is not just a metaphor—it is an attempt to formalize financial uncertainty as a *wave phenomenon*. The aim is to move beyond describing markets as noisy or irrational and instead capture the structured probabilistic dynamics that emerge when traders, beliefs, and liquidity interact in nonlinear ways.

In short:

> Where classical finance sees randomness, this framework seeks the hidden wavefunction beneath it.