Against Unpriced Worlds

Observer-Equivalence and Ontological Economy in Everettian Branching

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Working paper draft — philosophical/foundational version; no new quantum dynamics claimed

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Abstract

Everettian quantum mechanics is often presented as ontologically economical because it preserves unitary dynamics and avoids physical collapse. This paper argues that this economy is incomplete unless Everettian realism supplies a principled criterion for counting worlds, branches, histories, or observer-relevant realities. The central worry is not mathematical branching, but ontological overcounting: the move from microphysical or branch-level multiplicity to full world-multiplicity may assign ontological weight to distinctions that make no difference to any observer-constituting record. I introduce an observer-equivalence constraint: two physical or branch-relative realizations are equivalent for an agent A if they agree with respect to all physically accessible, persistent, update-constraining records available to A within its finite integration window. Such realizations may be physically distinct, but they do not define distinct observer-worlds for A. In the conscious case, the relevant observer-constituting record-structure should be understood as temporally integrated over a finite window rather than as an instantaneous observer-slice. This does not refute Everettian quantum mechanics, nor does it deny decoherence or branch structure. It challenges the interpretation of branch multiplicity as unpriced ontological multiplicity. A record-based alternative treats many micro-realizations as equivalent until they generate observer-relevant record differences. The resulting picture is not a new collapse theory, but a constraint on ontological economy: worlds should not be counted more finely than the record-structures that make them difference-making for observers.

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1. Introduction

The many-worlds interpretation of quantum mechanics is often admired for its simplicity. It keeps the Schrödinger dynamics intact, avoids a mysterious collapse postulate, and treats measurement outcomes as branch-relative rather than dynamically selected.

This simplicity is real at the level of dynamics. But it is not automatically ontological simplicity.

Everettian realism appears to pay a large ontological price. If the universal state contains a vast branching structure, and if each branch is treated as a real world or world-like structure, then the ontology becomes enormously populated. This may be acceptable. The problem is not that the ontology is large. The problem is whether the cost is priced.

That is, what justifies counting each branch, sub-branch, micro-variation, or decohered structure as a distinct world, history, or observer-relevant reality?

The present paper raises a specific challenge:

> Many physical or branch-relative distinctions may be invisible to, and non-constitutive of, an observer's record-structure. Why should such distinctions be counted as distinct observer-worlds?

The argument is not that Everettian quantum mechanics is mathematically wrong. It is not that decoherence fails. It is not that branch structure cannot emerge. The argument is that branch multiplicity does not automatically entail world multiplicity at the level relevant to observers.

A record-based criterion suggests a more economical alternative:

> Physical structures should be counted as distinct observer-worlds only when they differ with respect to observer-constituting records.

This is an ontological-economy constraint. It asks Everettian realism to explain why microphysical or branch-level multiplicity should receive full ontological status when many of those distinctions do not generate any difference for the observer.

The central formula is:

> no observer-world multiplicity without observer-relevant record differentiation.

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2. The Ontological Price of Many Worlds

Everettianism avoids collapse by allowing all outcomes to occur. Where Copenhagen-style views speak of one actual outcome and unrealized alternatives, Everettian views speak of branch-relative outcomes. The cat is alive in one branch and dead in another. The observer sees up in one branch and down in another. Nothing is dynamically eliminated.

This is often described as parsimonious because it avoids adding a collapse mechanism to quantum theory. But parsimony has more than one dimension. A theory may be dynamically simple while ontologically expensive.

The issue is not whether a large ontology is automatically unacceptable. Scientific theories may require large or counterintuitive ontologies. The issue is whether the ontology is disciplined by a criterion of individuation.

Everettianism needs to answer questions such as:

1. What counts as a branch?
2. When do branches become worlds?
3. Are all decohered differences world-making?
4. Do microphysical variations that never enter any observer's record count as distinct worlds?

5. What is the relation between physical branch structure and observer-world structure?

If these questions are not answered, many-worlds ontology risks overcounting. It may treat physical distinctions as world distinctions without specifying what makes them observer-relevant.

The problem can be put bluntly:

> If no observer-constituting record differs, what exactly has been multiplied?

This question is not rhetorical. It identifies a gap between formal multiplicity and ontological multiplicity.

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3. Branches, Worlds, and Observer-Worlds

The terms “branch” and “world” are often used flexibly in Everettian discussions. Sometimes a branch is a quasi-classical component of the universal state. Sometimes a world is a branch-like emergent structure. Sometimes the language is explicitly pragmatic: branches are approximate, emergent, and context-dependent.

This flexibility is defensible at the level of physics. Decoherence does not produce perfectly sharp branches. Branching structure is emergent, approximate, and scale-relative.

However, flexible branch structure creates pressure on world-counting. If branches are approximate, then world ontology cannot be naively counted by exact mathematical components. If worlds are emergent, then their individuation conditions must be specified.

For the purposes of this paper, I distinguish three notions:

1. **Physical branch structure:** decoherence-supported structure in the universal quantum state.
2. **World structure:** a branch-like quasi-classical history treated as ontologically real.
3. **Observer-world:** the world as differentiated relative to an observer’s accessible, persistent, update-constraining records.

The last notion is central. An observer-world is not the entire physical universe. It is the world as constituted for an observer by the record-structure that constrains that observer’s experience, expectations, and future updates.

This does not make the world subjective in a crude idealist sense. It means that the world relevant to an observer is structured by the records that make differences difference-making for that observer.

Thus, the paper’s challenge is not:

> Are there physical branch structures?

but:

Which branch distinctions count as distinct observer-worlds?

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4. Observer-Equivalence

To make the challenge precise, introduce an observer-equivalence relation.

Let A be a finite agent or observer. Let τ be A's finite integration window. Let $A_A(\tau)$ denote the domain of observables, differences, or records physically accessible to A over τ. Accessibility here is not psychological attention or subjective awareness. It is an operational relation: a difference is accessible to A when it is physically coupled to A's input, memory, inferential, or update channels in a way that can in principle be distinguished above the relevant noise floor within A's finite integration window.

Let R_A be the set of records that are:

1. physically accessible to A within $A_A(\tau)$;
2. persistent enough to remain available for integration;
3. update-constraining for A's future state, expectations, actions, or experiential continuation.

These are the observer-constituting records for A. They are not chosen by the subject at will, and they are not defined by introspective report. They are fixed by A's physical coupling, retention structure, resolution, memory channels, and update dynamics. In the case of a conscious observer, some of these records may be experiential. In the case of an apparatus or non-conscious agent, they may be purely operational. What matters is their role in constituting the observer-world relevant to A. For conscious observers, these records should be understood as contributing to a finite temporally integrated configuration rather than to a point-like observer-state at an instant.

Two physical or branch-relative realizations M1 and M2 are observer-equivalent for A iff they agree with respect to all records in R_A.

Symbolically:

> $M1 \sim_A M2$ iff for every observer-constituting record r in R_A, $r(M1) = r(M2)$.

This equivalence does not imply physical identity. M1 and M2 may differ microscopically, environmentally, or globally. They may occupy different regions of branch structure. The claim is narrower:

> if M1 and M2 agree on all observer-constituting records for A, then they do not define distinct observer-worlds for A.

This gives the observer-equivalence constraint:

> **Observer-Equivalence Constraint.** Physical or branch-relative multiplicity should not be counted as observer-world multiplicity unless it induces observer-relevant record differentiation.

This is not an epistemic claim about what A happens to know. It is an ontological claim about what individuates the world for A. The issue is not ignorance but record-constitution.

If a difference is inaccessible, non-persistent, and non-update-constraining for A, then it may be physically real, but it is not part of A's observer-world.

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5. Microphysical Multiplicity Without Observer Multiplicity

Consider two physical realizations that differ only in microphysical details inaccessible to an observer A and irrelevant to all of A's future updates. From the global physical perspective, these realizations are distinct. From A's record-structure, they are equivalent.

Should they count as different worlds?

A strong Everettian realist may say yes: any sufficiently decohered physical difference belongs to the ontology. But if the difference never enters any observer-constituting record, then calling it a distinct observer-world seems unmotivated.

The record-based view proposes a more economical treatment:

> microphysical multiplicity does not entail observer-world multiplicity.

This mirrors familiar practices in physics. We often quotient over irrelevant micro-details. Thermodynamics treats many microstates as realizing the same macrostate. Classical measurement treats many microscopic variations as producing the same recorded outcome. Information theory groups physical states by equivalence relative to a code or channel.

The proposal here is analogous:

> observer-worlds should be individuated by record-equivalence classes, not by every microphysical distinction.

Thus, the ontology relevant to A is not the set of all micro-realizations, but the quotient space of micro-realizations under ~_A.

This is not a denial of underlying physics. It is a discipline on counting.

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6. The Quotient Ontology

The observer-equivalence relation suggests a quotient ontology.

Instead of counting worlds at the level of raw branch/microphysical multiplicity, we count observer-worlds at the level of equivalence classes:

> [M]_A = {M' : M' ~_A M}.

An observer-world for A is then not a single microphysical realization, but an equivalence class of realizations that agree with respect to A's observer-constituting records.

This has several advantages.

First, it respects finite accessibility. No observer has access to the full microphysical state of the universe.

Second, it respects record structure. What matters to the observer-world is what can be recorded, retained, and used.

Third, it avoids gratuitous overcounting. Micro-differences that never become observer-relevant do not multiply observer-worlds.

Fourth, it fits naturally with decoherence and coarse-graining. Branches are already emergent and approximate; a quotient approach makes explicit that world-counting is also relative to a relevant equivalence structure.

The resulting ontology is not smaller because it denies physics. It is smaller because it refuses to count distinctions that do not make record-based differences.

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7. Two Kinds of Economy: Dynamical and Ontological

Everettianism is often said to be economical because it does not add collapse. The record-based challenge grants this point but distinguishes two kinds of economy.

7.1 Dynamical economy

A theory is dynamically economical if it avoids adding extra laws or mechanisms. Everettianism scores highly here. It preserves unitary dynamics and avoids collapse postulates. The universal state evolves according to the same quantum dynamics; no additional collapse trigger, hidden variable, or stochastic reduction law is introduced.

This is a genuine virtue. The present paper does not deny it.

7.2 Ontological economy

A theory is ontologically economical if it avoids unnecessary entities, distinctions, or individuation commitments. Here Everettianism faces pressure. If every branch-like structure, sub-branch, or microphysically distinct decohered realization is treated as a distinct world, and if no principled equivalence relation limits world-counting, then the ontology may become inflated.

The point is not that a large ontology is automatically false. The point is that a large ontology must be priced. It must say what earns the status of a distinct world, and why that distinction is not merely a difference in the underlying physical realizer.

The distinction between dynamical and ontological economy matters because Everettianism often trades on the former while under-specifying the latter. Avoiding collapse is a saving in laws. It is not automatically a saving in ontology.

The record-based view is dynamically conservative but ontologically more selective:

- it does not add new dynamics;
- it does not require physical collapse;
- it counts observer-worlds by record-relevant equivalence classes.

This makes the comparison sharper. Everettianism may be law-economical but world-expensive. A record-equivalence approach may preserve much of the same dynamical economy while refusing to count worlds more finely than observer-relevant records require.

The question is therefore not simply:

> Which theory has fewer laws?

but:

> Which theory has a better justified criterion for counting what it says exists?

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8. Objection: Is This Just Coarse-Graining?

One might object that the observer-equivalence proposal is just ordinary coarse-graining. Physics routinely groups microstates into macrostates. Everettianism already uses decoherence, quasi-classicality, and emergent branch structure. Why introduce a new constraint?

The answer is that ordinary coarse-graining is usually descriptive or pragmatic, while observer-equivalence is an ontological individuation constraint.

A coarse-graining may group microstates for calculational convenience. It tells us which details can be ignored for a given model or scale. Observer-equivalence asks a different question:

> which distinctions count as distinct observer-worlds?

The proposal is therefore not merely:

> ignore micro-details for convenience.

It is:

> do not treat micro-details as distinct observer-worlds unless they make observer-constituting record differences.

This moves the issue from description to ontology. The relevant question is not whether the physicist may ignore a difference. The question is whether the theory should count that difference as world-making.

The difference can be put this way:

1. **Descriptive coarse-graining:** many microstates are represented by one macro-description.
2. **Observer-equivalence:** many micro-realizations instantiate the same observer-world because they agree on all observer-constituting records.

An Everettian may accept ordinary coarse-graining while still treating the underlying branch/microstructure as fully world-real. The observer-equivalence constraint resists that move. It says that if worlds are supposed to be observer-relevant structures, then their individuation should occur at the level where differences become record-relevant to observers.

Thus, Everettianism can adopt the proposed constraint, but doing so changes the metaphysical status of its world-talk. Worlds become record-equivalence classes, not raw branch components.

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9. Relation to the A=A Problem

The observer-equivalence argument is not merely parallel to the A=A problem for subject individuation. It is a generalization of it.

The A=A problem says:

> no subject multiplicity without subject-constituting record difference.

The present paper extends the same principle from subjects to observer-worlds:

> no observer-world multiplicity without observer-relevant record difference.

In the subject case, two physical realizers of the same subject-configuration do not automatically produce two subjectively distinct subjects. In the world case, two branch or microphysical realizations that agree on all observer-constituting records do not automatically produce two observer-worlds.

Both arguments instantiate a more general principle:

> multiplicity at the physical-realizer level does not automatically imply multiplicity at the record-constituted level.

The A=A paper applies this principle to the individuation of conscious subjects. The present paper applies it to the individuation of worlds relative to finite observers. This explains why the two arguments should be kept distinct. Subject-counting and world-counting are different problems, but both require an equivalence criterion. Everettianism cannot simply infer either from branch multiplicity alone. The companion paper treats the subject-side problem more directly; the present paper extends the same record-based logic from subject-counting to observer-world counting.

This principle is not anti-physical. It is anti-overcounting.

10. Relation to Quantum Darwinism and Records

Quantum Darwinism explains how information about pointer states becomes redundantly encoded in the environment. This supports the emergence of objective classical records. In that framework, objectivity is not primitive; it is achieved by redundancy, stability, and accessibility.

The observer-equivalence proposal is compatible with this idea. Indeed, it depends on a similar insight:

> what matters for observer-world structure is not raw microphysical difference, but stable record difference.

Quantum Darwinism focuses on how records become public and objective. Observer-equivalence asks how those records individuate worlds for finite observers.

The relation can be stated as follows:

- QD/SBS: records make classical objectivity possible.
- Observer-equivalence: records determine which distinctions count as observer-world distinctions.

If a difference is not recorded, not accessible, not persistent, and not update-constraining, it may remain outside the observer-world equivalence class. It may exist in the global physical description, but it does not individuate the world for the observer.

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11. Relation to Relational Quantum Mechanics

Relational Quantum Mechanics denies that states are absolute. A system's state is relative to another system. This relational impulse supports the present proposal, but the record-based account adds an individuation criterion.

RQM may say that a fact is relative to a system. Observer-equivalence asks:

> which differences define the same fact-structure for that system?

The proposed answer is record-based:

> differences define distinct observer-worlds only when they differ in accessible, persistent, update-constraining records.

Thus, observer-equivalence can be viewed as a record-theoretic refinement of relational ontology. It does not merely say that facts are relative. It specifies the equivalence relation under which physically distinct realizations count as the same observer-world.

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12. Objection: Everett Already Has Emergent Branches

A natural objection is that Everettianism already treats branches as emergent, approximate, and decoherence-defined. Therefore, it does not need a new observer-equivalence criterion.

This is the strongest Everettian reply. Branches are not supposed to be sharply countable fundamental objects. They are emergent quasi-classical structures. Wallace, for example, emphasizes that branching is approximate, high-level, and dependent on decoherence and macroscopic structure. If so, perhaps Everettianism is already committed to an appropriate kind of coarse-grained, emergent ontology.

The reply is that emergent branches do not by themselves settle observer-world counting. In fact, the more approximate and emergent branches are, the more need there is for an individuation criterion. If there is no sharp branch count at the fundamental level, then the metaphysics of worlds must specify what counts as the same or different world at the emergent level.

Observer-equivalence supplies such a criterion for finite agents:

> branch distinctions count as observer-world distinctions only when they induce differences in accessible, persistent, update-constraining records for the relevant observer.

This does not conflict with emergent branching. It refines it. The Everettian can accept that branch structure is emergent and also accept that observer-worlds are equivalence classes over branch/microphysical realizations relative to record structure.

But accepting this refinement has a cost. It softens naive many-worlds realism. Worlds are no longer simply “all the branches” in an unqualified sense. They are record-relative structures individuated by what becomes difference-making for finite observers.

The present paper’s challenge is therefore not destructive. It asks Everettianism to choose:

1. treat worlds as raw branch structures and explain the individuation cost;
2. treat worlds as record-relative equivalence classes and accept a more economical ontology.

The second option may be the more defensible Everettian route. But then the record-equivalence principle is not an external objection; it becomes part of the ontology Everett needs.

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13. Objection: Observer-Equivalence Is Too Subjective

Another objection is that observer-equivalence makes worlds observer-dependent and therefore subjective.

This misunderstands the proposal. Observer-equivalence is not based on preference, belief, introspective report, or voluntary attention. It is based on physically accessible, persistent, update-constraining records. These are objective features of the agent-world relation.

The ontology is relational, not arbitrary.

An analogy may help. A reference frame in relativity is not subjective merely because quantities are frame-relative. A code in information theory is not subjective merely because equivalence depends on the code structure. Similarly, an observer-world is not unreal merely because its individuation depends on the observer's record-accessibility structure.

Observer-equivalence therefore gives a disciplined relational ontology:

> worlds are individuated relative to record-bearing agents, not invented by them.

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14. Objection: Microphysical Differences May Matter Later

A microphysical difference that is irrelevant now may later amplify and enter records. If so, should it already count as a distinct world?

This is the most important dynamic objection. Quantum and classical systems often amplify tiny differences. A microscopic fluctuation may later become a macroscopic event; a currently inaccessible distinction may later enter an observer's records. If observer-equivalence is applied only at the present time, it may seem to undercount worlds that are destined to diverge.

The record-based answer is temporal and conditional.

Before amplification, the difference may not individuate an observer-world for A. After amplification and record-integration, it may. The ontology tracks record relevance over time.

Thus:

> a difference becomes world-making for A when it becomes record-making for A.

This does not deny the physical existence of the earlier micro-difference. Nor does it deny that the earlier difference may be dynamically important. It denies only that the earlier difference already constituted a distinct observer-world for A before it became record-relevant to A.

The distinction is analogous to the difference between a latent physical cause and an actual recorded event. A microscopic difference may be part of the causal history of a later observer-world without already being a distinct observer-world at the earlier stage.

This gives a temporally indexed equivalence relation:

> M1 ~_{A,t} M2 iff M1 and M2 agree on all observer-constituting records for A at time t, within A's integration window.

If a micro-difference later amplifies, then the equivalence relation may fail at a later time:

> M1 *~{A,t} M2, but not M1* ~{A,t'} M2.

This is not a contradiction. It is precisely what record-based differentiation predicts.

The view therefore handles amplification naturally:

- pre-record: microphysical difference without observer-world difference;
- record formation: difference becomes persistent and accessible;
- update: observer-world differentiation occurs.

This mirrors the treatment of subject differentiation in the A=A paper.

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15. Objection: The Universal State Still Contains Everything

The Everettian may insist that the universal state contains all branch structure regardless of observer-equivalence. Observer-world equivalence classes do not remove physical multiplicity.

The record-based view can accept this. The aim is not to deny the universal state. The aim is to distinguish levels of ontology.

There may be:

1. universal-state structure;
2. decoherence-defined branch structure;
3. quasi-classical world structure;
4. observer-world structure;
5. subject-state structure.

The paper argues only that levels 3–5 require individuation criteria. The universal state alone does not automatically tell us how many worlds, observer-worlds, or subjects there are.

If Everettianism accepts this hierarchy, then the record-based challenge has succeeded: world-counting is not free. It requires explicit equivalence relations.

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16. Ontological Economy Without Collapse

The observer-equivalence proposal may be mistaken for a collapse theory. It is not.

It does not say that unrealized alternatives disappear. It does not introduce a physical reduction of the wavefunction. It does not claim that observer-world equivalence classes replace the universal quantum state.

It says:

> the ontology relevant to finite observers should be counted at the level of record-equivalence classes.

This allows a position that is dynamically conservative but ontologically disciplined.

It keeps the formal structure but refuses to overinterpret every microphysical distinction as a distinct observer-world. In this sense, it offers ontological economy without collapse.

This may be attractive even to some Everettians. It preserves unitary dynamics while making branch/world language more precise and less inflated.

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17. What This Paper Does Not Claim

This paper does not claim that Everettian quantum mechanics is false. It does not deny decoherence, branching, or the reality of the universal quantum state. It does not derive the Born rule. It does not propose a new physical dynamics or a new collapse mechanism.

It claims only that:

> branch or microphysical multiplicity should not be automatically counted as observer-world multiplicity.

And it proposes:

> observer-worlds are equivalence classes of physical realizations under observer-relevant record structure.

This is an ontological constraint, not a new physics.

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18. Conclusion

Many-worlds interpretations gain dynamical economy by avoiding collapse. But they risk ontological inflation if they treat branch or microphysical multiplicity as full world multiplicity without a principled counting criterion.

The observer-equivalence constraint offers such a criterion:

> do not count worlds more finely than the record-structures that make them difference-making for observers.

Two physical or branch-relative realizations may differ in many ways. But if they agree on all accessible, persistent, update-constraining records for an observer A, then they do not define distinct observer-worlds for A. They are multiple realizations of the same record-constituted world.

The resulting picture is not anti-Everettian in dynamics. It is anti-overcounting in ontology.

The final challenge is therefore precise:

> Everettian realism must explain why branch-distinct but observer-equivalent structures should count as distinct worlds rather than equivalent realizations of the same observer-world.

Until that explanation is given, the worlds remain unpriced.

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Author note

This paper is part of a broader project on record-based subjectivity, observer-equivalence, and quantum definiteness. It is a philosophical/foundational argument and does not propose a modification of quantum mechanics. AI tools were used for drafting assistance, critical review, and editing; the author takes responsibility for all claims, sources, and final wording.