Beyond the PSR: A Necessary Entity from a Transmundane Condition of Possibility

Abstract: Traditional cosmological arguments are often thought to rely fatally on the Principle of Sufficient Reason (PSR). This paper develops a contingency argument that does not. We adopt a two-sorted first-order logic with predicates for world-membership and symmetric accessibility between possible worlds. Within this framework, we formulate four axioms, each verified to be consistent and independent both from one another and from the PSR. We provide philosophical justification for each axiom. Then, we demonstrate that, if the empty world does not access any non-empty world, the existence of a necessary entity follows from the well-foundedness of a transmundane material condition of possibility.

Keywords: Cosmological Argument, Principle of Sufficient Reason, Grounding, Inheritance of Being

1. The Principle of Sufficient Reason and Cosmological Arguments

Among the classical arguments for the existence of God, the cosmological argument has long been the most appreciated. Traditionally, this argument proves the existence of a necessary entity, without the need to derive the other divine properties. Consider, for instance, Leibniz's version (Pruss 2009):

P1. Every contingent fact has an explanation.

P2. There is a contingent fact that includes all other contingent facts.

P3. Therefore, there is an explanation of this fact.

C. This explanation must involve a necessary being — namely, God.

P1 expresses the *Principle of Sufficient Reason* (PSR). This principle exists in many different versions:

Strong PSR (S-PSR). Every fact has a reason.

Limited PSR (L-PSR). Every fact with property x has a reason.

Weak PSR (W-PSR). For every fact, it is possible that it has a reason.

Weak Limited PSR (WL-PSR). For every fact with property x, it is possible that it has a reason.

Virtually all major contemporary cosmological arguments assume some version of the PSR[1]. Yet few philosophers still endorse it. According to Bourget & Chalmers (2023), 57.26% of metaphysicians reject it, while only 32.66% affirm it. Indeed, some have challenged its logical coherence. Van Inwagen (1983, 202) and McDaniel (2019) argue that it leads to modal collapse, rendering all facts necessary. Briceño (2023, §5) contends that it entails the existence of a single entity with no relations, thereby undermining the relational nature of explanation itself.

Such challenges, while not conclusive against every conceivable version of the PSR, expose a pressing need for a cosmological argument that dispenses with it. There are two main recent attempts to do this: Kremer 1997, and Flynn & Gel 2026. However, both of these attempts imply weak forms of the PSR. Indeed, Kremer's premise 2 ("There is a possible explanation of the fact that there are contingent beings") is an instance of the WL-PSR. Similarly, Flynn and Gel try to show that a contingent entity without cause would be self-contradictory, which implies the L-PSR. In what follows, instead, we aim to show that the existence of a necessary being can be demonstrated even under the radical assumption that contingent entities may exist—or fail to exist—without any reason, coming into and going out of existence brutally.

The paper proceeds as follows. §2 introduces the logical framework. §3 provides philosophical justification for each axiom. §4 presents the formal derivation showing that these axioms entail the existence of a necessary entity.

2. Formal system and axioms of the argument

2.1. Adoption of a two-sorted FOL with symmetric accessibility

Our argument is formulated in a two-sorted first-order-logic (FOL) with predicates expressing world membership and the accessibility relation, supplemented with the B axiom (symmetry of accessibility):

[1] For instance, L-PSR is adopted by Koons (1997), Craig & Sinclair (2009: 101, 192), Sandsmark & Megill (2010), Wahlberg (2017), Dumsday (2018), Loke (2018: ch.5), and Byerly (2019). WL-PSR appears in Gale & Pruss (1999: 463), Pruss (2010), Rasmussen (2009), and Weaver (2016).

Category	**Variables/Symbols**	**Description**
Sort E	$a, b, c, \ldots$	Entities
Sort W	$w, v, u, t, \ldots$	Possible worlds
Predicates	$In(a, w)$, $A(w, v)$	Membership (In) and accessibility (A)
B axiom	$\forall w \forall v(A(w, v) \rightarrow A(v, w))$	Symmetry of accessibility[2]

Standard FOL quantifiers, connectives, syntax, semantics, and inference rules apply.

This system mimics the QKB modal system in FOL. However, QKB can refer to other worlds only through $\Box$ and $\Diamond$, which quantify exclusively over accessible worlds. It therefore cannot express the metalinguistic statements we need, such as "if a exists in world w, then it also exists in some world v inaccessible from w". Our logic can express such statements directly. Furthermore, FOL is well-understood, minimalist in its commitments, and facilitates formalisation in proof assistants, theorem provers, and model searchers.

2.2. Axioms of the theory

Our argument is based on the following axioms:

(α) $\forall w \forall v(\forall a \neg In(a, w) \ \wedge \ \exists b In(b, v)) \rightarrow \neg A(w, v)$

No non-empty world is accessible from an empty world.

(β) $\exists a \forall b \forall w \forall v(\neg In(a, v) \ \vee \ \neg A(w, v) \ \vee \ \neg In(b, w) \ \vee \ In(a, w))$

There exists an entity that exists in all the worlds accessible from the worlds where it exists.

(ɣ) $\forall a \exists w In(a, w)$

Every entity exists in some world.

[2] The argument can be reformulated without the B axioms by modifying at least one axiom in §2.2 to explicitly cover both directions of the accessibility relations; however, this yields a less perspicuous axiom set. Since QKB is one of the weakest normal modal logics, we adopt it as a standalone axiom.

(δ) $\forall a(\exists w \exists v(In(a, w) \land \neg In(a, v)) \rightarrow \exists u \exists t(In(a, u) \land \neg In(a, t) \land A(u, t)))$

If an entity is contingent, then at least one world in which it exists accesses one in which it does not.

Now consider WL-PSR*, an especially weak version of the PSR:

$$\forall a((In(a, w_0) \land \exists v \neg In(a, v)) \rightarrow \exists b \exists u(R(b, a) \land In(b, u))) \qquad \text{(WL-PSR*)}$$

R is an irreflexive, asymmetric, transitive *reason* relation, and w_0 is the actual world. Accordingly, WL-PSR* reads "for every entity in the actual world w_0, there exists, in some actual or non-actual world, a reason".

We used the theorem prover Prover9 (ver. LADR-2009-11A) to prove that WL-PSR* is weaker than S-PSR, L-PSR, and W-PSR: in fact, WL-PSR* combines the most restrictive antecedent with the broadest consequent. Then, we used the model searcher Mace4 (ver. LADR-2009-11A) to prove the consistency of the four axioms, their mutual independence, and their independence from any version of PSR as strong as WL-PSR* or stronger. However, the independence of the axioms from WL-PSR* is made intuitive by the fact that no axiom includes the R relation. The source code is archived and available (Montagner 2026).

3. Philosophical grounds of the axioms

3.1. Philosophical grounds for (α)

(α) states that no non-empty world is accessible from an empty world — or, as Billy Preston puts it, that "nothin' from nothin' leaves nothin'":

$$\forall w \forall v(\forall a \neg In(a, w) \land \exists b In(b, v)) \rightarrow \neg A(w, v) \qquad (\alpha)$$

This principle is explicitly stated by Armstrong (1989, 64). He takes it as a consequence of combinatorialism — the view that possible worlds are recombinations of actual entities and properties. Among the three major theories of possible worlds, combinatorialism enjoys a clear advantage: unlike concretism and abstractionism, it avoids ontological inflation by not positing additional entities (whether concrete or abstract), while preserving a realist account of possibility and necessity, immanently realised in actual entities. But in the empty world, by definition, there are no entities or properties, and thus no recombinations. If nothing can be recombined, no world can be constructed from it; hence, no world is accessible from the empty one.

If one rejects the combinatorialist framework, (α) is still defensible via modal dispositionalism — the view that the accessibility relation represents the causal dispositions, or propensities, of the world (see Vetter 2015). In this framework, "something is possible" is interpreted as "the world has the disposition to bring something into existence." If the empty world, as such, has no dispositions, one automatically concludes that "something is possible" is false — that is, the empty world does not access any non-empty world.

Suppose instead the empty world has some dispositions. The conclusion is still reachable via a temporal argument. If the empty world has a disposition that makes “something is possible” true, then something may begin to exist from nothing. Such a beginning would constitute a change—a transition from nothing to something. As Shoemaker (1969) observed, time seems irreducible to change. Yet change presupposes time. On the two dominant views, time is either an entity (substantivalism) or emerges from relations between entities (relationism). But in a state of nothingness, there are neither entities nor relations from which time could arise. Therefore, nothingness cannot change, and no entity can begin to exist from nothing. Consequently, “something is possible” is false in the empty world.

Finally, (α) can also be economically defended by rejecting metaphysical nihilism: if the empty world is impossible—as both Lewis (2001) and Armstrong (1989) argue— the axiom is vacuously true.[3]

These lines offer independent support for (α). Each could be developed further, but doing so would require defending substantive positions in debates that lie beyond our scope. However, the considerations above suffice to justify (α) as a principled axiom within our argument’s framework.

[3] For discussion on metaphysical nihilism within the context of the cosmological argument, see Hansen (2012).

3.2. Philosophical grounds for (β)

Let us assume that every entity is such that a world w where it does not exist accesses a world v where it does exist:

$$\forall a \exists w \exists v(\neg In(a, w) \wedge In(a, v) \wedge A(w, v)) \tag{1}$$

Take any world v in which an entity a is actual. Given (1), there is a world w where it does not exist that accesses to v. If w were empty, then, by (α), w would not access v. Therefore, w is not empty, and a certain b exists in w. Likewise, by (1), there exists a world u in which b is not actual but, given (α), some c is. And so on. Thus, (α) implies that, if (1) holds, each entity is in a transmundane F-relation with something else:

$$F(b, a) \leftrightarrow \exists w \exists v(\neg In(a, w) \wedge In(b, w) \wedge In(a, v) \wedge A(w, v)) \tag{F}$$

(F) reads: "b exists in a world w where a does not exist, and w accesses a world v where a exists". The derivation of (F) for every entity from (α) and (1) was proven via Prover9 (Montagner 2026).

Given (1), the chain of F-relations will form either a circularity or an infinite regress. This can be rigorously demonstrated using graph theory. Let G be a directed graph whose vertices represent entities and whose edges represent the relation F. Each entity e_n requires the existence of some e_{n+1} such that (e_{n+1}, e_n) is an edge in G. Thus every vertex has an in-degree of at least 1. In a finite graph, this mathematically necessitates the existence of a directed cycle — i.e., a circularity; in an infinite graph, it necessitates either a directed cycle or an infinite descending chain — i.e., an infinite regress.

Infinite dependency chains (whether circular or not) are often considered problematic. Consider the following *pedagogical example*. Assume that a contingent entity can *begin* to exist only if *first* there is an *already* existing entity. Hence, every contingent entity has a dependency relation with some other entity. However, if there were only contingent entities, no entity would be *already* existing — each would require some *prior* existence elsewhere. Hence, none could ever begin to exist. As Schaffer (2010, 62) says: if everything required something else, "being would be infinitely deferred, never achieved".[4]

[4] This captures a familiar intuition. Aquinas (2017, Iª q. 2 a. 3 co.) writes: "if everything is possible not to be, then at one time there could have been nothing in existence [and] if this were true, even now there would be nothing in

This pedagogical example is expressed in temporal terms.[5] The F-relation is transmundane and therefore atemporal, but it still represents a dependency relation: given (α) and (1), the existence of a in w implies the existence of b in v; hence, the existence of b is formally a necessary condition for the existence of a, and there is thus an intuitive ontological—not temporal—precedence of b over a. Since, under (1), this applies to every entity, the intuition underlying the pedagogical example remains valid even in an atemporal context: the dependency chain created by F is infinite, and the possibility of existence of each entity is infinitely deferred. It therefore seems that no entity can be possible under these conditions. Instead, since something indeed exists, one should deny the possibility that every entity is in an F-relation, and affirm its well-foundedness:

$$\exists a \forall b \neg F(b, a) \tag{2}$$

Yet justifying this intuition has proven difficult. Although metaphysical foundationalism is often treated as the standard view, no argument against the possibility of actual downwardly non-terminating dependency chains commands general assent. Foundationalism thus appears axiomatic. At most, one can argue for the modesty of this specific form of foundationalism.

Indeed, (2) is relatively modest, especially when compared to Schaffer's foundationalism. Schaffer appeals to the concept of *inheritance of being*: a non-fundamental entity a must have received being from another entity b. This requires a specific relation between a and b — namely grounding. (2) instead describes a mere material condition, (F), without committing to any specific ontological or explanatory relations between a and b. Furthermore, (2) concerns the well-foundedness of a strictly transmundane relation, allowing for non-well-founded relations within the actual world.

Now, if we write the $F(b, a)$ in (2) in its extensive form—as in (F)—and then apply De Morgan's law, we obtain (β):

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existence". Similarly, Leibniz (1989, 85) states that "every being derives its reality only from the reality of those beings of which it is composed, so that it will not have any reality at all if each being of which it is composed is itself a being by aggregation".

[5] Bohn (2018: 170) rightly objects that the pedagogical example treats certain relations as "a diachronic, dynamic physical relation", whereas they are instead "synchronic, static mathematical relation[s]".

$$\exists a \forall b \forall w \forall v (\neg In(a, v) \lor \neg A(w, v) \lor \neg In(b, w) \lor In(a, w)) \qquad (\beta)$$

The (β) axiom is therefore nothing other than the affirmation of the well-foundedness of the F-relation. We can thus accept it in light of the above considerations.

3.3. Philosophical grounds for (ɣ)

(ɣ) assumes that every entity exists in some world:

$$\forall a \exists w In(a, w) \qquad (ɣ)$$

This axiom is nothing other than the denial of Meinongism. It formalises the Quinean dictum "to be is to be the values of a bound variable": we cannot existentially quantify over entities outside the domain of any world because there is no sense in which such entities *are*.

Stock arguments against meinongism include: that it leads to an inflated ontology; that nonexistent entities lack identity criteria and thus it is impossible to say how many there are and how one can gain knowledge of them; that it requires a different semantics for the existential quantifier and a nonclassical logic to tolerate self-contradictory properties. Thus, our decision to adopt a classical logic suffices to justify (ɣ).

3.4. Philosophical grounds for (δ)

In metaphysics, most arguments are framed within S5. In S5, accessibility is a reflexive, symmetric, transitive relation — that is, an equivalence relation. Thus, accessibility forms equivalence classes: mathematically, interaccessible worlds form sets of equivalent elements. Although S5 is compatible with the existence of multiple independent equivalence classes, most metaphysicians assume that accessibility forms a single equivalence class — that of the actual world. This entails universal accessibility: every world is accessible from every other.

One reason for accepting universal accessibility is that, if a world is inaccessible, it is not a possible world in the first place. Indeed, possibility is defined in terms of accessibility: "x is possible" is true in the actual world if x obtains in some *accessible* world. Possible worlds are not parallel universes: they are abstractions useful for evaluating the truth value of modal propositions in the actual world. Worlds inaccessible from the actual world do not change the evaluation of any proposition and are therefore to be considered useless theoretical constructs.

Another reason is combinatorialism. On combinatorialism, a world v is accessible from w iff v is a recombination of the entities and properties of w. Since every possible world is a recombination of actual entities and properties, every world is accessible from the actual world. Thus, if accessibility is an equivalence relation, every world is accessible from every other.

The axiom (δ) is significantly weaker than universal accessibility:

$$\forall a(\exists w\exists v(In(a,w)\ \wedge\ \neg In(a,v)) \rightarrow \exists u\exists t(In(a,u)\ \wedge\ \neg In(a,t)\ \wedge\ A(u,t))) \qquad (\delta)$$

It states that if an entity exists in some worlds and not in others, then at least one pair of worlds—one in which it exists and one in which it does not—is interaccessible. Given the popularity of the stronger thesis of universal accessibility, this axiom is modest and requires no extensive defense. Indeed, any argument supporting universal accessibility, as well as weaker versions of it, *a fortiori* supports (δ).

4. Exposition of the argument

The axioms were encoded for Prover9, which verified that the existence of a necessary entity follows. Then, we developed a complete proof in Lean (v4.26.0-rc2). All source code is archived and publicly available (Montagner 2026). For clarity, we intuitively present our proof.

Let us consider again the (β) axiom:

$$\exists a\forall b\forall w\forall v(\neg In(a,v)\ \vee\ \neg A(w,v)\ \vee\ \neg In(b,w)\ \vee\ In(a,w)) \qquad (\beta)$$

It asserts the existence of an entity for which at least one of the following disjuncts is true:

$\exists a\forall w(In(a,w))$ Case 1: It exists in every possible world

$\exists a\forall v(\neg In(a,v))$ Case 2: It exists in no possible world

$\forall w\forall v(\neg A(w,v))$ Case 3: The worlds where it does or does not exist are not interaccessible

$\forall b\forall w(\neg In(b,w))$ Case 4: The worlds where it does not exists are empty

Our strategy is to use the other axioms to eliminate cases 2, 3, and 4.

Let us assume, for *reductio*, that the entity satisfying (β) is contingent. By definition, there must exist at least one world where it does not exist; we can therefore discard Case 1.

Given the (ɣ) axiom

$$\forall a\exists w In(a,w) \qquad (\gamma)$$

the entity satisfying (β) exists in some world; thus, we discard Case 2.

Given this, the (δ) axiom

$$\forall a(\exists w\exists v(In(a,w)\ \wedge\ \neg In(a,v)) \rightarrow \exists u\exists t(In(a,u)\ \wedge\ \neg In(a,t)\ \wedge\ A(u,t))) \qquad (\delta)$$

implies that at least one of the worlds where the entity satisfying (β) exists accesses to a world where it does not exist. Therefore, we discard Case 3.

We are thus left with Case 4: the worlds in which the entity satisfying (β) does not exist are empty. However, (δ) stipulates that one of these empty worlds must access a non-empty world in which such an entity exists. This contradicts (α)

$$\forall w\forall v(\forall a\neg In(a,w)\ \wedge\ \exists b In(b,v)) \rightarrow \neg A(w,v) \qquad (\alpha)$$

which prohibits an empty world from accessing a non-empty one. This contradiction forces the rejection of the initial assumption by *reductio*. Therefore, the entity that satisfies (β) is necessary

5. Conclusion

At its core, this paper is driven by a metaphysical intuition: if the empty world cannot access any non-empty world (that is, if nothing is possible in absolute nothingness), then the possibility of any contingent entity requires the existence of *something else*. If there are only contingent entities, this generates a dependency chain that must either be circular or infinitely retrogressive. In such a system, the possibility of every entity is, so to speak, “waiting” for the existence of another entity. To avoid this, the dependency chain must be well-founded, terminating in a necessary entity.

The logical derivation of this argument is straightforward. Instead, its metaphysical breakthrough lies in demonstrating that the PSR is superfluous for reaching the traditional conclusion of the cosmological argument. Our framework requires only the well-foundedness of a transmundane material condition for possibility which, unlike the PSR, does not require any specific relation between a and its necessary condition b. Within this framework, entities in the actual world can come into and go out of existence brutally, without any cause, ground, or explanation. Although their possibility has a material condition, it does not account for why they can exist — just like space is the material condition, but not the explanation, of the existence of extended entities.

Computational methods were not employed to solve a complex puzzle, but to maximise both rigour and conciseness: indeed, they guarantee a higher standard of rigour than derivation tables while keeping the formal machinery outside the main text. The extreme simplicity of the derivation does not exempt us from seeking the highest possible degree of rigour. Furthermore, the availability of machine-checkable proofs and model-finding procedures facilitates the exploration of alternative axiomatic systems.

The philosophical justification of the axioms has been intentionally kept minimal. Like any deductive argument, this one rests on unproven assumptions. Nevertheless, the results establish the main claim: the role typically assigned to the PSR can be covered by totally different assumptions. This opens the avenue for cosmological arguments capable of reaching their traditional conclusion from more modest commitments.

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