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Short Elucidating Note 110: A short overview of the structural paradigm falsification theorem and its applications in detailed form

By

Lucio Muñoz*

*Independent qualitative comparative researcher / consultant Email address: munoz@interchange.ubc.ca

Abstract

The structural paradigm falsification theory suggest that paradigms of the conjunctural form $K_i = L_j$ or inherently conjunctural paradigms that claim to have such a form invalidate themselves when applying unilateral pressures (e.g. Maximization) either to K_i so $K_i \rightarrow L_j$ or to L_j so $L_j \rightarrow K_i$ as then as the conjunctural equality ($K_i = L_j$) becomes structurally destabilized creating sustainability gaps ($SG > 0$), which leads to falsification. This structural falsification theory above can be adapted to accomplish two goals 1) to capture and state key concepts in detailed form such as model consistency/inconsistency, methodology consistency/ inconsistency, frameworks of true sustainability/dwarf sustainability, hard/soft structural kill, strong/weak sustainability, and the theory-practice consistency principle; and 2) to extend Popper an falsification and Kuhn an paradigm evolution into explicitly conjunctural structural systems. The main goal of this paper is to present a short overview of the structural paradigm falsification theorem and its adaptation to link it to key concepts and to key historical thinkers well-known in science based paradigm thinking circles.

Key concepts

1) Conjunctural structure, a system in which all core components must remain simultaneously active and mutually reproduced for the system to preserve its defining identity as no full or partial component separability exists.

2) Non-conjunctural structure, a system in which not all core components do not need remain simultaneously active and mutually reproduced for the system to preserve its defining identity as full or partial component separability exist.

- 3) **Empirical testing**, the popperian way of falsifying paradigms.
- 4) **Structural testing**, the pre-empirical evaluation of whether a paradigm preserves its internal conjunctural balance conditions.
- 5) **Paradigm replacement**, the Kuhnian way of paradigm evolution.
- 6) **Conjunctural paradigm evolution**, the process through which structurally invalidated paradigms are replaced, adjusted, or reorganized to restore structural validation.
- 7) **Conjuncturality**, the condition in which system components are mutually dependent for the preservation and reproduction of the system's defining structure.
- 8) **Separability**, the assumption that conjunctural systems or inherently conjunctural systems can be modeled as fully or partially independent components, thereby permitting unilateral optimization or pressure application.
- 9) **Structural equality**, the conjunctural balance condition whose preservation or restoration leads to structural validation, and whose violation leads to structural falsification.
- 10) **Sustainability gaps**, the structural deviations that emerge when unilateral pressures are applied to non-distorted conjunctural systems, or to inherently conjunctural systems assumed to be fully or partially separable.

Terminology

$K = L$ means a specific conjunctural system

$K_i = L_j$ means a general conjunctural system

$K_i = K_i L_j = L_j K_i = L_j$ means a structural reproduction condition, not arithmetic identities

“=” means structural co-reproduction;

“→” means directional pressure or implication;

“SG” measures deviation from conjunctural balance;

“M” denotes managed status.

A = Active social component

B = Active economic component

C = Active environmental component

a = Passive social component

b = Passive economic component

c = Passive environmental component

A_M = Managed social component

B_M = Managed economic component

C_M = Managed environmental component

TS = ABC = True sustainability → Components in active form

DWS = $A_M B_M C_M$ = Dwarf sustainability → Components in managed form

DGM = $A_M B C$ = Dwarf green market → Social component in managed form

DWRM = $A B C_M$ = Dwarf red market → Environmental component in managed form

SG = Sustainability gap → Structural gap or measurement gap

CRT = Critical threshold → Partial viability

SC = Structural consistency → No sustainability gaps present

SIC = Structural inconsistency → Sustainability gaps present

MAX = Maximization/maximum * = Optimization/optimal

The nature of the structural falsification theorem

The nature of the structural falsification theorem has been recently shared (Muñoz 2026a) and it can be simplified as done below as a special case and as a general case.

a) The special structural falsification case $K = L$

Some special cases that claim to have the inherently conjunctural form $K = L$, but assume component separability are i) the traditional market of Adam Smith where $K = D$ = traditional economic development and $L = B$ = economy; ii) the red socialism model of Karl Marx where $K = M$ = social development and $L = A$ = society; and iii) the deep environmentalism model where $K = E$ = Environmental development and $L = C$ = Environment.

Here the balance condition to be respected or violated here is:

$$K = KL = LK = L$$

Notice that the specific equalities here are not arithmetic identities, but specific structural reproduction conditions indicating mutual conjunctural dependence. In other words, structural equalities in this paper are not arithmetic equalities. They denote mutual reproduction conditions among conjuncturally dependent components.

1) Structural validation

A paradigm K is structurally validated if unilateral pressures ($\rightarrow$ or $\leftarrow$) do not lead to sustainability gaps as system equality $K = L$ is maintained or restored.

$$[K \rightarrow L \text{ or } K \leftarrow L] \rightarrow SG = 0$$

Maintaining conjunctural equality $K = L$ means no sustainability gaps. Structural validation in K or L arises when inherently conjunctural systems are treated as fully codependent systems under joint optimization or maximization pressure.

2) Structural falsification

A paradigm K is structurally falsified if unilateral pressures ($\rightarrow$ or $\leftarrow$) do lead to sustainability gaps as system equality $K = L$ is not maintained or it is violated.

$$[K \rightarrow L \text{ or } K \leftarrow L] \rightarrow SG > 0$$

Violating conjunctural equality $K = L$ so that $K \neq L$ leads to sustainability gaps (SG). Structural falsification in K or L arises when inherently conjunctural systems are treated as fully separable systems under independent optimization or maximization pressure.

b) The general structural falsification case $K_i = L_j$

When all cases that claim to have the inherently conjunctural form $K_i = L_j$, but assume component separability, then the balancing condition to be validated or violated is:

$$K_i = K_i L_j = L_j K_i = L_j$$

Notice that the general equalities here are not arithmetic identities, but general structural reproduction conditions indicating mutual conjunctural dependence.

1) Structural validation

Any paradigm K_i is structurally validated if unilateral pressures ($\rightarrow$ or $\leftarrow$) do not lead to sustainability gaps as system equality $K_i = L_j$ is maintained or restored.

$$[K_i \rightarrow L_j \text{ or } K_i \leftarrow L_j] \rightarrow SG = 0$$

Maintaining conjunctural equality $K_i = L_j$ does not create sustainability gaps. Structural validation in K_i or L_j arises when inherently conjunctural systems are treated as fully codependent systems under joint optimization or maximization pressure.

2) Structural falsification

Any paradigm K_i is structurally falsified if unilateral pressures ($\rightarrow$ or $\leftarrow$) do lead to sustainability gaps as system equality $K_i = L_j$ is not maintained or it is violated.

$$[K_i \rightarrow L_j \text{ or } K_i \leftarrow L_j] \rightarrow SG > 0$$

Violation of conjunctural equality $K_i = L_j$ so that $K_i \neq L_j$ creates sustainability gaps. Structural falsification in K_i or L_j arises when inherently conjunctural systems are treated as fully separable systems under independent optimization or maximization pressure.

Linking the general structural falsification theorem with key concepts

i) The case of model consistency

When the general balance equality is maintained or restored under joint conjunctural pressures (e.g. maximization, optimization) or it is lost or violated after applying pressures under separability (e.g. maximization, optimization) it signals different types of model consistency.

1) Structural consistency

Any model $K_i = L_j$ is structurally consistent (SC) if it preserves the conjunctural equality after transformation as it reflects system optimality requirements(S):

a) The case of optimization (*)

$(K_i = L_j)^* = K_i^* = L_j^* = SC = \text{system optimality consistency} \rightarrow SC$

b) The case of maximization (MAX)

$MAX(K_i = L_j) = MAX(K_i) = MAX(L_j) = S = \text{Optimum minimum balance} \rightarrow SC$

It is important to point out that in this framework here, joint optimization and joint maximization refer to conjunctural adjustments preserving system balance conditions, whereas unilateral maximization and unilateral optimization refers to directional pressure applied independently to one component.

2) Structural inconsistency

Any model $K_i = L_j$ is structurally inconsistent (SIC) if it violates the conjunctural equality after transformation as it does not reflect system optimality requirements(S):

a) The case of optimization (*)

$(K_i = L_j)^* = K_i^* \neq L_j^* \neq S \neq \text{system optimality consistency} \rightarrow SIC$

b) The case of maximization (MAX)

$MAX(K_i = L_j) = MAX(K_i) \neq MAX(L_j) \neq S \neq \text{Optimum minimum balance} \rightarrow SIC$

ii) The case of model's existence

Structural consistency goes one to one with the nature of the existence of the paradigm $K_i = L_j$, if the paradigm $K_i = L_j$ exist fully it means it passes the structural validation test. If the paradigm is feasible under constraints, then the paradigm $K_i = L_j$ exists in a restrictive fashion under structural inconsistency. If the paradigm $K_i = L_j$ does not exist or it is assumed to exist when it does not exist, it is fully structurally invalid.

1) Non-existence and the hard kill criterion

If a paradigm $K_i = L_j$ is fully structurally invalid or it is shown to be fully structurally invalid that paradigm is under the hard kill criterion as the structural gap (SG) tends towards infinity signaling total structural collapse

Full structural invalidation $\rightarrow$ hard structural kill: $SG \rightarrow \infty$

2) Partial existence and the soft kill criterion

If a paradigm $K_i = L_j$ is partially structurally invalid or it is shown to be partially structurally invalid or reflects constrained viability that paradigm is under the soft kill criterion as the structural gap (SG) falls into a positive constrained range signaling restricted structural viability

Partial structural invalidation = Constrained viability $\rightarrow$ Soft structural kill: $SG > 0$ but bounded.

iii) The case of model compensability

1) No compensability and the strong sustainability criterion

The strong sustainability criterion or no compensability for a paradigm $K_i = L_j$ means: i) that full substitution of critical capital by other forms of capital is impossible; ii) that no compensability preserves full conjunctural balance and therefore maintains structural consistency; iii) that strong sustainability is therefore compatible with true sustainability conditions; and iv) this tells us that under true sustainability thinking, assuming full substitutability in inherently conjunctural systems leads to structural invalidation and therefore to the hard kill criterion.

2) Partial compensability and the weak sustainability criterion

The weak sustainability criterion or partial compensability for a paradigm $K_i = L_{jM}$ under management tells us: i) that partial substitution of critical capital by other forms of capital is possible within bounded ranges; ii) that partial compensability generates bounded structural inconsistency rather than full structural collapse; and iii) this means then that under true sustainability thinking, weak sustainability is structurally invalid because true sustainability requires full conjunctural consistency; iv) but under dwarf sustainability thinking, however, weak sustainability may remain operationally viable within constrained ranges because bounded

structural inconsistency is tolerated; and v) Therefore, weak sustainability is linked to the soft kill criterion.

The viability landscape

a) Full viability

If structural gaps or sustainability gaps (SG) are absent or restored toward balance in systems $K_i = L_j$, then structural consistency is maintained and the system remains fully viable:

$$\mathbf{SG = 0 \rightarrow Full\ viability \rightarrow Full\ existence}$$

Notice that this full viability condition is consistent with: i) Structural validation; ii) True sustainability; iii) Strong sustainability; and iv) Non-hard kill conditions.

b) Partial viability

If structural gaps or sustainability gaps (SG) are positive but remain below the critical threshold (CRT), the system $K_i = L_{jM}$ under management may continue functioning under constrained structural inconsistency, either in reality or by assumption:

$$\mathbf{CRT > SG > 0 \rightarrow Partial\ viability \rightarrow Partial\ existence}$$

See that this partial viability condition is consistent with i) weak sustainability; ii) constrained optimization; iii) partial viability; iv) dwarf sustainability; and v) the soft kill criterion. Under expansion, however, accumulated sustainability gaps due to partial viability tend to progressively destabilize the system toward full structural unsustainability ($SG \rightarrow \infty$).

c) Non-viability

If structural gaps or sustainability gaps (SG) reach or exceed the critical threshold (CRT), structural inconsistency in paradigms $K_i = L_j$ or $K_i = L_{jM}$ under management becomes unbounded and the system loses viability and existence.

$$\mathbf{SG \geq CRT \rightarrow Non-viability \rightarrow Non-existence}$$

You can appreciate that this non-viability condition is consistent with i) Structural falsification; ii) True sustainability invalidation; iii) Full unsustainability; and iv) The hard kill criterion.

Linking gap conditions, structural state, and sustainability meaning

Gap condition	Structural state	Sustainability implications
$SG = 0$	Full consistency	True sustainability
$0 < SG < CRT$	Bounded inconsistency	Weak sustainability / soft kill
$SG \geq CRT$	Unbounded inconsistency	Hard kill / collapse

The table above reflects a framework with three zones: i) a stable zone, where full structural consistency holds; ii) a constrained viability zone where partial structural consistency holds; and iii) a collapse zone where full structural inconsistency holds. The table above also introduces the ideas of threshold dynamics, bounded instability and expected progressive degradation logic.

Linking the general structural falsification theorem with sustainability theory

Sustainability theory is based on the existence of exogenous/passive/dominated components /or the existence of endogenous/active/dominant components creating in the process non-distorted conjunctural systems and distorted conjunctural systems.

i) The case of sustainability(S)

The structure of sustainability (S) is in non-distorted conjunctural form as society (A), economy (B) and environment(C) need to be present in active in full form at the same time ($S = ABC$) to exist.

1) Falsification theorem and true sustainability

a) Validation

True sustainability (TS) exist only when society (A), the economy (B), and the environment (C) are active in full form at the same time as then it is structurally valid so that $TS = S = ABC$, and this means that there are no sustainability gaps $SG = 0$; and therefore, there is structural consistency (SC)

$$TS = S = ABC \rightarrow SG = 0 \rightarrow SC \rightarrow \text{validation}$$

b) Falsification

True sustainability does not structurally exist in reality or by assumption when not all components are present in active form at the same time as then it would be structurally invalid,

which means that there are sustainability gaps (SG), and therefore, there is structural inconsistency (SIC).

$TS \neq S = ABC \rightarrow SG > 0 \rightarrow SIC \rightarrow \text{Falsification}$

ii) The case of dwarf sustainability (DWS)

The structure of dwarf sustainability (DWS) is in distorted conjunctural form as society (A_M) is under management or passive and/or the economy (B) is under management or passive and/or the environment (C_M) is under management or passive so its form is ($DWS = A_M B_M C_M$), but to function as dwarf sustainability market requires to have at least one component in dominant form, for example the dwarf green market has the form $DGM = A_M BC$ as only society is an exogenous component while the economy and environment are in active form, and the dwarf red market has the following form $DWRM = ABC_M$ as only the environment is an exogenous component and society and economy are in active form. Notice that dwarf sustainability (DWS) and dwarf markets are defined here as structurally distorted sustainability configurations.

2) Falsification theorem and dwarf sustainability

Dwarf sustainability (DWS) exists when at least one component in the sustainability system (S) is not in active form, which means sustainability gaps (SG) are present but they are bounded as well as structural inconsistency (SIC):

$DWS \rightarrow SIC \text{ viable} \rightarrow SG > 0 \text{ but bounded}$

Dwarf sustainability (DWS) tends towards full unsustainability as the accumulation of structural unsustainability will tend towards full unsustainability in the long term ($SG \rightarrow \infty$).

Linking non-distorted conjunctural thinking with true sustainability thinking

Notice that if we link $K_i = L_j$ and $TS = ABC$ so that $K_1 = TS$ and $L_1 = ABC$, we can see that true sustainability (TS) is a fully non-distorted conjunctural system or specific type of fully conjunctural system reflecting social (A), economic (B) and environmental (C) responsibility at the same time, and hence it has full structural consistency (SC), which can be indicated as follows:

$(K_1 = L_1) = (TS = ABC) \rightarrow SG = 0 \rightarrow SC$

Linking structural context and weak sustainability status

Structural context**Weak sustainability status**

True sustainability = TS = ABC**Structurally invalid**

Dwarf sustainability DWS = $A_M B_M C_M$ **Structurally viable within constraints**

The table above tells us that true sustainability thinking (TS) is inconsistent with weak sustainability, but dwarf sustainability thinking and weak sustainability are both structurally viable within constraints, until the accumulation of sustainability gap pressures pushes them towards full unsustainability as they expand.

Linking sustainability theory, structural conditions and outcomes

Sustainability theory**Structural condition****Outcomes**

Strong sustainability**No substitutability****Structural consistency**

Weak sustainability**Partial substitutability****Bounded inconsistency**

Full substitutability assumption Structural breakdown Hard kill

Partial substitutability assumption Bounded inconsistency Soft kill

The table above links sustainability theory (S) to different forms of structural conditions and the outcomes due to that consistency condition. For example, partial substitutability exists in weak sustainability, which means it has bounded inconsistency.

Linking structural conditions, sustainability form, kill outcome and long term dynamics

Structural conditions	Sustainability form	Kill outcome	Long term dynamics
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Full structural Consistency	Strong sustainability	No hard kill	Preservation/restoration of True sustainability (TS)
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Bounded structural Inconsistency	Weak sustainability	Soft kill	Accumulation of sustainability gaps→ tendency towards full Unsustainability
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Full structural Breakdown	Invalid sustainability	Hard kill	Full unsustainability
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Structural conditions are linked one to one with long term dynamics as i) full structural break down means full unsustainability, ii) bounded structural consistency means sooner or later the system will tend towards full unsustainability; and 3) Full structural consistency means true sustainability.

The true sustainability logic and the dwarf sustainability logic

The sustainability logic can be summarized as follows: i) True sustainability (TS) requires preservation of full conjunctural integrity; ii) Weak sustainability accepts bounded substitutability; iii) Bounded substitutability introduces bounded structural inconsistency; and iv) Therefore, weak sustainability cannot satisfy strict conjunctural validation. The dwarf sustainability logic (DWS) on the other hand can be summarized as follows: i) some structural distortion is already accepted; and ii) therefore bounded inconsistency becomes operationally tolerable. The distinction above separates structural validity at the heart of true sustainability thinking from constrained functionality at the heart of dwarf sustainability thinking.

The theory (T) - practice (P) consistency principle (T–P Consistency)

A paradigm $K_i = L_j$ satisfies the theory–practice (T–P) consistency principle if the structural form assumed in theory matches the structural form embedded in its empirical or operational implementation. In other words, there can be validations and violations of the theory practice consistency principle:

i) Violating the theory-practice consistency principle:

A violation of T–P consistency occurs when: a) A conjunctural system or an inherently conjunctural system like $K_i = L_j$ is modeled using separable (non-conjunctural) methods; and b) Structural interdependence is replaced by independent or additive representations

Conjunctural structure $K_i = L_j$ = Non-conjunctural modeling of $K_i = L_j \rightarrow$ violation

ii) Validating the theory-practice consistency principle

A validation of T–P consistency occurs when: a) A conjunctural system is modeled using non-separable (conjunctural) methods; and b) Structural interdependence is maintained by codependent or conjunctural representations.

Conjunctural structure $K_i = L_j$ = conjunctural modeling of $K_i = L_j \rightarrow$ validation

Linking the general structural falsification theorem with Popperian falsification logic and with Kuhnian paradigm evolution logic

Below is a short summary of Popperian logic (Popper 1965) and Kuhnian logic (Kuhn 1970) and how the structural falsification framework expands that logic into the conjunctural world.

i) Extending Popper's paradigm testing logic

- Karl Popper focused mainly on empirical falsification without structural testing, and this means that he took the empirical paradigm form as given or existing and then he placed it into empirical falsification dynamics as summarized below: ;

- **Empirical paradigm form $\rightarrow$ empirical paradigm falsification dynamics**

In structural terms, it can be said that Popper assumed non-conjunctural paradigms and placed them under non-conjunctural paradigm falsification dynamics, a situation that can be indicated as done below:

Non-conjunctural paradigm assumption $\rightarrow$ Non-conjunctural empirical paradigm falsification dynamics $\rightarrow$ Empirical testing inconsistency

This means that if the paradigms that are being tested using non-conjunctural empirical paradigm falsification tools are actually non-distorted conjunctural paradigms or inherently conjunctural paradigms assumed to be separable, then the theory-practice consistency principle in terms of testing/modeling could be violated as the method used to model the conjunctural structure is not conjunctural. And this situation can be avoided by having a pre-empirical test first, if the paradigm is found to be structurally valid, then empirical conjunctural testing would be expected to ratify its validity by showing it does not have sustainability gaps, but if non-conjunctural empirical testing is carried out, we would run into a theory-practice inconsistency. But if the paradigm is structurally invalid, then we should expect the empirical conjunctural testing to validate the existence of sustainability gaps and validate structural falsification. However, if the paradigm is structurally invalid, then the need for empirical testing is not there as we can predict it has sustainability gaps that sooner or later will push that paradigm towards full unsustainability. By having a structural validity test first we ensure the respect of the theory practice consistency principle, “conjunctural structure $\leftrightarrow$ conjunctural empirical test”. If we apply non-conjunctural empirical testing to conjunctural paradigms we are violating the theory-practice consistency principle. And this means that even a well-built empirical test may be inconsistent with the actual structure of the paradigm that is being tested and we can see now or we should be able to see now that no empirical finding can fix a structurally invalid paradigm.

ii) Expanding Kuhn’s paradigm shift logic

- Thomas Kuhn focused mainly on paradigm replacement dynamics; embedded abnormalities will sooner or later accumulate pressure for paradigm change consensus and shift. Hence, he took the empirical paradigm form and placed it under empirical paradigm replacement dynamics, a thought summarized as follows:

Empirical paradigm form $\rightarrow$ empirical paradigm replacement dynamics

In structural terms, it can be said that Kuhn assumed non-conjunctural paradigms and placed them under non-conjunctural paradigm replacement dynamics, a situation that can be indicated as shown below:

Non-conjunctural paradigm $\rightarrow$ Non-conjunctural paradigm replacement dynamics $\rightarrow$ Paradigm replacement inconsistency

This means that if the paradigms that are being considered for replacement using non-conjunctural paradigm replacement thinking are actually distorted conjunctural paradigms or inherently distorted conjunctural paradigms assumed to be non-conjunctural, then the theory-practice consistency principle in terms of paradigm replacement could be violated as the replacement of the distorted conjunctural structure is not conjunctural. And this situation can be avoided by having a pre-empirical test first, if the paradigm is found to be structurally valid, it is conjunctural and it creates no sustainability gap so it does not need replacement, it is working as expected; and hence we do not need conjunctural paradigm replacement. But if the paradigm is

structurally invalid because it is a distorted conjunctural paradigm, then we know we need a conjunctural paradigm replacement to eliminate the embedded abnormalities. By having a structural validity test first we ensure the respect of the theory-practice consistency principle, “conjunctural structural inconsistency $\leftrightarrow$ conjunctural structural paradigm replacement”. If we apply non-conjunctural paradigm replacement to conjuncturally inconsistent paradigms we are violating the theory practice consistency principle in terms of paradigm replacement. And this means that even a well-intended paradigm replacement process may be inconsistent with the actual structure of the paradigm that is being replaced and we know now or should know now that no non-conjunctural paradigm replacement can fix a structurally invalid conjunctural paradigm.

iii) The structural falsification theorem’s structural testing logic and paradigm replacement logic

- Therefore, falsification emerges from endogenous structural asymmetry rather than merely failed prediction to expand traditional paradigm testing thinking and traditional paradigm replacement thinking.

a) The proposed conjunctural framework

The proposed conjunctural framework has the following steps:

- 1) Structural validation ($K_i = L_j$ conditions)**
- 2) Admissibility decision**
- 3) Empirical testing (only if admissible)**
- 4) Conjunctural paradigm replacement (if structural invalid).**

In other words, a pre-empirical layer of falsification is proposed as structural inconsistency can precede empirical inconsistency, in terms of empirical testing and paradigm replacement.

b) The proposed structural testing procedure

If fully invalidated paradigm $\rightarrow$ non-conjunctural empirical testing dynamics

If partially invalid paradigm $\rightarrow$ Non-conjunctural empirical testing dynamics

However, we expect the empirical test to validate falsification if the structurally invalidated paradigm has been in practice for a long time, perhaps due to paradigm shift knowledge gaps, as the empirical test will find that there are sustainability gaps, but the need for empirical testing may become irrelevant if the structurally invalid paradigm, fully or partial, is

never implemented in the first place as we know it will lead to sustainability gap creation, accumulation, and tendency towards full unsustainability in the long term.

2) The proposed conjunctural paradigm replacement procedure

If fully invalidated paradigm → full conjunctural paradigm replacement dynamics

If partially invalidated paradigm → Partial conjunctural paradigm replacement dynamics

If validated paradigm no need for conjunctural paradigm replacement

Hence, replacing conjunctural paradigms that have structural inconsistencies, full or partial, with conjunctural paradigms without inconsistencies respects or restores the theory-practice consistency principle in terms of paradigm replacement thinking as structural integrity and no sustainability gap creation is now achieved.

3) The proposed restoration of the theory-practice consistency principle

The proposed structural falsification theorem aims at restoring the need for consistency among structural form, testing methodology, and replacement methodology. Therefore, the framework proposes a pre-empirical layer of falsification based on structural admissibility conditions, since structural inconsistency may precede empirical inconsistency in both empirical testing and paradigm replacement dynamics, thereby ensuring continuous respect for the theory-practice consistency principle.

The separability curse

Since separability is the actual mechanism generating falsification in $K_i = L_j$ frameworks, then i) Conjunctural systems require co-reproduction; ii) Separability assumptions impose unilateral pressure (e.g. maximization, optimization); iii) Unilateral pressure destabilizes conjunctural balance; iv) Destabilization generates sustainability gaps; and v) Sustainability gaps generate falsification. The separability curse can be summarized as follows:

Conjuncturality → separability → destabilization → SG → falsification.

The empirical paradigm testing and replacement inconsistency principle

A condition in which a model such as $K = L$ or the general model $K_i = L_j$ is empirically tested or replaced using methods that are not structurally consistent with the nature of the system these models represent or replace, leading to misleading or delayed falsification and paradigm

replacement, a condition that affects traditional empirical testing and traditional paradigm replacement thinking.

Sustainability gaps and transition dynamics

Condition	Meaning
$SG = 0$	Full consistency
$0 < SG < CTR$	Bounded inconsistency
$SG \geq CTR$.....	Collapse

The information in the table above allows to see that the following: i) We can envision a path from full consistency to system collapse; ii) we can contemplate the view that the accumulation of sustainability gap pressures in systems under bounded inconsistency pushes them towards full unsustainability and collapse; and iii) we can appreciate the view that collapsed paradigms and bounded inconsistency based paradigms can be fixed with consistent conjunctural paradigm replacement. In other words, when $SG = 0$ we have structural validation, when $0 < SG < CTR$ then we have partial structural invalidation, and when the $SG \geq CTR$ then we have full structural invalidation.

A two line summary

No empirical finding can fix a structurally invalid paradigm $K = L$ or $K_i = L_j$; and no non-conjunctural paradigm replacement can fix a structurally invalid paradigm. In other words, some paradigm fail before empirical testing because their structural assumptions already violate the reproduction conditions of the systems they claim to model, which means that we are moving the dynamics of failure from empirical contradiction to structural contradiction.

Aspects to keep in mind

1) The general framework presented here is theoretical; 2) The general operational measurements of SG and CTR remain future work; 3) the general theorem currently applies specifically to conjunctural systems or inherently conjunctural systems assumed to be separable; 4) general empirical calibration methods and the general nature of conjunctural paradigm replacement remain open research questions; 5) However, a formal theory of true sustainability (Muñoz 2009), its measurement through general and subsystem specific indices (Muñoz 2003), its links to the structural falsification theorem as falsification tools (Muñoz 2026b) and how sustainability theory and practice are linked structurally one to one (Muñoz 2026b) including in the economic domain (Muñoz 2026c) and how true sustainability based conjunctural replacement can fix the social and environmental issues (Muñoz 2016a) associated with the traditional market of Adam Smith (Smith 1776) through vertical paradigm evolution (Muñoz 2025) in response to fixing its sustainability gap creation problem due to separability assumptions (Muñoz 2026d) leaving traditional economic thinking behind (Muñoz 2016b) already exist, including the idea of dwarf sustainability and the flipping of traditional economic thinking (Muñoz 2019a), and the idea of the direct link between general paradigm evolution dynamics and sustainability dynamics including paradigm death and shift expectations (Muñoz 2019b); and 6) The work on the topic of true sustainability, theory, indices, and measurement, as they apply to social, economic, and environmental components and shared in the citations above is driven by the empirical observation that some paradigms become structurally inadmissible before empirical testing because their internal reproduction assumptions contradict the conjunctural conditions required for their own preservation.

Conclusions

First, it was indicated that full structural falsification arises when inherently conjunctural systems, specific systems such as $K = L$ or general systems such as $K_i = L_j$ are treated as fully separable systems under unilateral optimization/maximization pressure. Second, it was stated that partial structural falsification arises when inherently conjunctural systems, specific systems such as $K = L$ or general systems such as $K_i = L_j$ are treated as bounded separable systems under unilateral optimization/maximization pressure. Third, it was highlighted that full structural validation arises when inherently conjunctural systems, specific systems such as $K = L$ or general systems such as $K_i = L_j$ are treated as fully codependent systems under joint optimization/maximization pressure. Fourth, it was pointed out that partial structural validation arises when inherently conjunctural systems, specific systems such as $K = L$ or general systems such as $K_i = L_j$ are treated as bounded separable systems under unilateral optimization/maximization pressure. Fifth, it was mentioned that full structural falsification is consistent with concepts such as structural hard kill, full non-existence, non-bounded separability, full non-viability and full theory-practice inconsistency principle. Sixth, it was highlighted that partial structural falsification and partial structural validation are consistent with concepts such as bounded separability, partial viability, partial existence, weak sustainability, dwarf sustainability,

bounded theory-practice consistency requirement, and soft structural kill. Seventh, full structural validation is consistent with concepts such as non-distorted conjunctural systems, strong sustainability, true sustainability, and with the full theory-practice consistency principle. Eighth, it was stressed that systems under partial structural falsification or partial structural validation will sooner or later tend towards full unsustainability as their structural sustainability expand towards infinity ($SG \rightarrow \infty$), and hence they tend towards collapse or paradigm replacement. Ninth, it was pointed out that adding the idea of pre-empirical structural testing extends the idea of empirical testing of Karl Popper towards conjunctural thinking, thinking that respect the theory-practice consistency principle in terms of paradigm testing: a structurally invalid conjunctural paradigm cannot be fixed with non-conjunctural empirical findings. And tenth, it was said that adding the idea of conjunctural paradigm replacement to traditional paradigm replacement a la Thomas Kuhn corrects the abnormalities embedded in invalidated inherently conjunctural structures by means of conjunctural paradigm replacement that respect the theory-practice consistency principle in terms of paradigm replacement: a structurally invalid inherently conjunctural paradigm cannot be fixed with a non-conjunctural paradigm replacement.

In general the following key aspects were pointed out: i) Some paradigms are inherently conjunctural, and therefore, its components are inseparable; ii) Separability assumptions structurally destabilize them; iii) Structural falsification can therefore precede empirical falsification; iv) Popperian testing and Kuhnian replacement can be extended through conjunctural structural analysis; v) when doing so we are restoring the theory-practice consistency principle: structural consistency theory-structurally consistent testing and structurally consistent paradigm replacement.

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