Observed Matching under Projection Constraints: A Theory of Viewpoint-Relative Economics*

*Working Paper Summary. Full draft available upon request.

Chaeyeon Renée Eunice Xon
School of Economics
Yonsei University
Seoul, Republic of Korea
eunixon@yonsei.ac.kr

***Abstract*—This paper introduces a framework for understanding economic phenomena through the lens of viewpoint-relative observation. We posit that economic data is generated via a projection map $\Psi_o : W \to \mathbb{RP}^2$, where W is the true structural state space and o is the observer's viewpoint. This projection can cause fundamentally different structures ($B_1 \neq B_2$) to become observationally indistinguishable ($\Psi_o(B_1) = \Psi_o(B_2)$). This structural compression has profound implications: strategic choices are optimized over projected data, not objective reality; matching patterns reflect observational equivalences; and policy interventions may fail by targeting appearances rather than underlying structures. We argue that what is often attributed to informational friction or noise is, in fact, an endogenous feature of the observational architecture itself. Rationality is not broken but is viewpoint-dependent, and economic reality is shaped by the geometry of observation.**

***Index Terms*—Matching Theory, Structural Inference, Viewpoint Dependence, Projection, Observational Equivalence, Constrained Optimization**

I. Introduction: Observation as a Structural Filter

Standard economic models often assume that observed data, such as trade flows or matching outcomes, uniquely reflect underlying fundamentals. This paper challenges that assumption by proposing that the act of observation is itself a structural filter. We introduce a **projection map**, Ψ_o, which represents the geometric apparatus through which an observer from a viewpoint o captures data from the true state of the world, W.

The core insight is that this projection can lead to **observational equivalence**: two fundamentally different structural states, $B_1 \neq B_2$, can appear identical to the observer because their projections coincide, i.e., $\Psi_o(B_1) = \Psi_o(B_2)$. This implies that identification failure can arise not from noise or data limitations, but from the compressive nature of the observational process itself. The central theme is that "what looks the same may not be the same".

II. Viewpoint-Relative Continuity and Strategic Choice

The observational framework of an agent determines the data upon which they act, including fundamental properties like continuity and the basis for their strategic choices.

A. Observer-Continuous Paths

Continuity is often treated as an objective property, but our framework defines it relative to the observer's viewpoint. A path $\gamma(t)$ in the true state space is **observer-continuous** if its projection, $\Psi_o \circ \gamma$, is continuous. This means that agents and policymakers might observe a smooth trend, even when the underlying structure experiences an abrupt, discontinuous shock. This observational smoothing can delay belief updating and misguide real-time responses.

B. Optimization over Projected Data

Agents optimize not over the true state of the world, but over its projection. We model this by defining a cost functional where actions are guided by minimizing the distance in the *observed* space:

$$R(\gamma) = \int_0^T \left(\frac{1}{2}\|\dot{\gamma}(t)\|^2 + V(\gamma(t))\right)dt \tag{1}$$

where the potential term $V(x)$ penalizes deviation from an observed reference state:

$$V(x) = \lambda \cdot \mathrm{dist}_{\mathbb{RP}^2}(\Psi_{o(t)}(x), \Psi_{o(t)}(B_2))^2 \tag{2}$$

This implies that motion follows gradients of **geometric coherence**; agents choose paths that align with the data available from their viewpoint, prioritizing observational stability even if it leads to structurally suboptimal outcomes. Rationality is not broken; it is simply **viewpoint-dependent**.

III. Implications for Matching and Trade

The concept of observational compression directly impacts fields that rely on distinguishing types, such as matching and international trade.

A. Matching on Observed Types

Many-to-many matching models assume that agent types are fully identifiable. However, if two distinct types or bundles, B_1 and B_2, are indistinguishable under an observer's projection ($\Psi_o(B_1) = \Psi_o(B_2)$), any matching function defined on observed types will treat them identically. This creates an **observational partition** of the world, where the market operates over coarsened equivalence classes, $[B]_o$, rather than true structural identities. As a result, equilibrium outcomes reflect this observational equivalence, collapsing structural heterogeneity that is invisible to the matching mechanism.

B. Indistinguishable Trade Flows

Similarly, in international trade, two countries with different technologies and endowments can produce identical trade flows and prices if their underlying structures project to the same observation. This means that inference from trade data alone may be invalid, as apparent similarity could arise from a shared observational apparatus, not shared fundamentals.

IV. Conclusion: Policy and Inference in a Projected World

The framework of viewpoint-relative observation holds critical implications for policy and economic inference. When policymakers react to observed data, they may be targeting appearances rather than the true underlying structure. If two distinct problems, B_1 and B_2, look the same, a policy designed for one will inadvertently affect the other, potentially undermining the intervention.

The core insight is that what is often treated as informational friction may be an intrinsic feature of the **observational architecture**. This does not render inference impossible, but it calls for a new approach: one that explicitly models the projection geometry. The goal shifts from inferring the true world state directly to first decoding the projection, thereby recovering the structure up to its observational equivalence class. The ultimate question is not just "what is the state of the world?" but "what is the structure of the viewpoint through which we observe it?".

References

[1] R. Hartley and A. Zisserman, *Multiple View Geometry in Computer Vision*, 2nd ed. Cambridge, UK: Cambridge University Press, 2003.

[2] D. Marr, *Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco, CA, USA: W. H. Freeman, 1982.

[3] B. K. P. Horn, *Robot Vision*. Cambridge, MA, USA: MIT Press, 1986.

[4] S. Ullman, "The interpretation of structure from motion," *Proceedings of the Royal Society of London. Series B. Biological Sciences*, vol. 203, no. 1153, pp. 405–426, 1979.