Scientific Realism, 'No Miracles', and Microeconomic Theory: The Case for Design

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"Yes, I do think we are simply the tellers of fables, but is that not wonderful?"

(Rubinstein 2006, p882)

1 Introduction

In the past few decades the profession of economics has become increasingly involved in the design of institutions and markets. This ascendancy of "design economics" (Roth 2018) is well-documented across the economics profession, as well as outside of it[1]. Part of this rise has undoubtedly been due to some very high-profile success stories; examples that seem to indicate that the application of microeconomic theory leads to some kind of empirical success. Awards like the Nobel Prize and the John Bates Clark medal have been given to economic theorists working in associated theoretical disciplines of mechanism design and matching markets on the basis of their technical contributions and "how basic research can subsequently generate inventions that benefit society" (The Royal Swedish Academy of Sciences 2020).

Two primary[2] examples of the success of "design" economics are the design of the FCC auctions in 1994 and the redesign of the residency matching in 1995:

[1] See (Roth and Wilson 2019; Spiegler 2024) for a contemporary view of this rise by economists. From a complementary perspective in philosophy of science, see (Alexandrova and Northcott 2009; Guala 2001).

[2] Here, I need to emphasize that there are *lots* of examples of auctions, matching markets, etc. Also worth including 'behind-the-scenes' auctions we know comparatively little about (e.g., Google, Ebay). The goal here is to introduce two case studies that are paradigmatic of the two core theoretical approaches to design problems: mechanism design and matching.

- (**FCC Spectrum Auctions**) Since beginning in 1994, the Federal Communications Commission (FCC) has auctioned off the rights for specific bands of the electromagnetic spectrum, raising $230 billion dollars of revenue by 2023 (Lee and Malamud 2023).

- (**Residency Matching**) The National Resident Matching Program (also called 'The Match') was redesigned in 1995 to better accommodate the problem of couples with pairs of preferences for positions, a problem that had only increased in prevalence since the original algorithm was developed in the 1950s. (See Roth 2018, §3 for extended discussion)

In the first example the amount of revenue raised by the government is taken as an indication of its success and, in the second example, the success of the endeavor is considered the stability of the matching in the presence of couples.

The question that remains is this: *insofar as the 'success stories' of design share common theoretical features, what about these features must be true in order for these success stories not to be miracles?* Critics both in philosophy and inside the economics profession have cast doubt on the utility of economic theory both generally (Rubinstein 1991) and specifically in the case of the examples above (Nik-Khah 2008). In the spirit of the 'no miracles' argument for scientific realism (Putnam 2012), I argue that the theoretical approach to "design economics" used in these 'success stories' overcomes a particular problem of representation that typically plagues the special sciences. In the case of design, it is possible to construct a model that is "isomorphic" to the world in a way that was previously beyond the scope of economic theory (Rubinstein 1991).

1.1 What is Success?

The key idea animating the realist account of economic theory used here is to shift the goalposts from scientific theories as 'literally' or 'approximately' true to something closer to 'useful'. Philosophically, this is akin to saying a scientific theory "successfully capture[s] real patterns of [behavior]" or "track[s] regularities" (Alexandrova and Northcott 2009)[3]. Furthermore, following the account of (Alexandrova and Northcott 2009) it is helpful to think of the success of a (social) scientific theory as context-dependent. For example, a theory of collusion in auctions does not have to be a theory of collusion in *every* auction, instead it might be

[3]This is still playing the wrong game... Ideally, I want some operational notion of realism closer to a Hacking-esque endorsement of engineering as the empirical warrant for the claim of realism.

tailored to a specific auction format or population.

On the side of economics *qua* practical science, the most obvious notion of success is defined with reference to failures of institutional design. Examples should include failures of auction design (Wolfstetter 2001) and (Palacios-Huerta, Parkes, and Steinberg 2022, §3.2) or more specific problems with couples and residency matching (Roth and Wilson 2019). Further evidence can be garnered from *post hoc* computational simulations showing the efficiency of the chosen auction format compared to counterfactual alternatives (Newman et al. 0000). The animating idea of scientific success is simple: insofar as we're not failing (in the senses enumerated above) then this is indicative of *something* going right. That "something" is the sense of success I will work with throughout this chapter.

1.2 What is Design?

A very reasonable question remains: are there any common theoretical features across the set of problems that commonly characterize 'design economics'? Here, it is helpful to consider the words of academic economist and market designer Al Roth:

> "Design" is a noun as well as a verb, and market design has its origins in the noun, in the study of the designs of existing marketplaces, and how different designs—different marketplace institutions, rules, and customs—can induce different strategies and produce different outcomes. (Roth and Wilson 2019, p131)

If there is any common theoretical content across the domains of 'design economics' it is best encapsulated by the idea of inducing certain behavior through rules or institutions. Philosopher of Science Francesco Guala notes the *projective* character of this kind of theory:

> Theory can be used to produce new technology, by shaping the social world so as to mirror a model in all its aspects. The 'idealised' character of a theory may thus be a virtue rather than a defect, as the explicit role of theory is to point to a possibility. Theory *projects*, rather than describing what is already there. (Guala 2001, p456, emphasis original)

This projective[4] quality of the theories of 'design economics' is distinct from other kinds of economic theory

[4] How much to make of this? Do I want to contrast this with the existing descriptive/normative distinction? (It fits cleanly in neither category...)

(e.g., the fundamental welfare theorems of microeconomics) and is also shared across all the success stories outlined above.

It is otherwise worth noting the *lack* of substantive theoretical unity of 'design economics'. Most notably, design economics comprises the diverse subfields of mechanism design and matching theory. These share multiple differences: from primitives (in matching theory there are no transfers) to goals (revenue/welfare maximization vs stability/equity). Moreover, even within theoretical subfields there are vociferous debates about the 'correct' approach. Examples of this abound: from "Minimalist" approaches to market design (Sönmez 2023) to the 'Wilson Doctrine' approach to designing simple mechanisms (Milgrom 2004, p23).

2 Explaining Success: The Questionable Role of Theory

The approach of 'design economics' has received much fanfare both within economics and outside of it. At its core, it's encapsulated by Al Roth's slogan "economist as engineer" (Roth 2018)[5]. The idea behind this slogan is that "in the service of design, experimental and computational economics are natural complements to game theory" (Roth 2018, p1342). Parallels are drawn between the design of economic institutions and suspension bridges, where bridge design

> ... also concerns metallurgy and soil mechanics, and the sideways forces of water and wind. Many questions concerning these complications can't be answered analytically, but must be explored using physical or computational models. These complications, and how they interact with the parts of the physics captured by the simple model, are the domain of the engineering literature. Engineering is often less elegant than the simple underlying physics, but it allows bridges designed on the same basic model to be built longer and stronger over time, as the complexities and how to deal with them become better understood. (Roth 2018, p1342)

Thus, it should be noted that the approach of 'design economics' is not so much a theoretical approach as an opportunistic methodological dictum: use what works!

[5] Draw attention to the contrast between this and an older view of economics:

"If I had to name one major shift in the sensibilities of economic theorists in the past half century, a prime candidate would be the way we conceptualize markets—from quasi-natural phenomena admired from afar to manmade institutions whose design can be tweaked by economist-engineers." (Spiegler 2024, p137)

Philosophers of science have also paid much attention to the role of experiment and computation in their desire to correct the narrative[6] that the success stories above can be (primarily) attributed to economic theory (Alexandrova and Northcott 2009; Guala 2001; Nik-Khah 2008). Philosophical views range from a balanced consideration of the role of theory in engineering (Alexandrova and Northcott 2009) to an outright dismissal of economic theory as "demonstrably irrelevant" to the important aspects of the construction of FCC auctions ("[*c*]*orporate imperatives demonstratively played the decisive role in determining the auction.*" Nik-Khah 2008, p89, emphasis original).

The scepticism of many philosophers of science about the utility and realism of economic theory is matched by many economists themselves. Noted microeconomic theorist Ariel Rubinstein, originator of the 'Rubinstein bargaining model' (Rubinstein 1982), has pessimistically noted

> "I never imagined that bargaining theory would make me a better bargainer. When people approached me later in life for advice in negotiating the purchase of an apartment or to join a team planning strategy for political negotiations, I declined. I told them that as an economic theorist I had nothing to contribute. I did not say that I lacked commonsense or life experience that might be useful in such negotiations, but rather that my professional knowledge was of no use in these matters." (Rubinstein 2006)

He is widely held to be one of the most vocal proponents of the 'economic theory as fable'-viewpoints (Rubinstein 1991). On this view, the role of economic theory is to tell a compelling story with a model, nothing more[7].

3 The Realism of Design

The goal is not to argue that these successes can be explained solely with reference to their 'true' theoretical content, but instead that it is *unlikely* that the collection of successes, which share some common theoretical feature, do not offer (at least some) empirical warrant for the claim of realism concerning their theoretical commonality. In broad strokes, the argumentative strategy is to establish something like Mill's 'Method of Agreement' for isolating the projective element of the theories of design economics as a necessary causal

[6] Here cite the accounts of (McAfee and McMillan 1996; McMillan 1994), who are the boogeymen of this philosophical project.
[7] This is too glib. Reread (Rubinstein 1991) with care and attention to the role of intuition (etc).

condition for its empirical success. Thus, the goal is to show (i) across diverse examples (ii) there is a common factor.

Claim 3.1 (No-Miracles Argument) *Insofar as a common theoretical feature is shared across all manifestations of its empirical success, it would be miraculous if it were not—in some minimal sense—'true'.*

The challenges associated with establishing Claim 3.1 are as follows:

1. (**Isolating a common theoretical feature**) The challenge is to show this feature is common to every theory behind a 'success story'. We don't care about uniqueness—there can absolutely be multiple—nor do we care if the feature is present when there are failures—since the realism we advocate for economics is 'context-specific' (Alexandrova and Northcott 2009)[8].

2. (**Establishing empirical success**) We need some clear and unambiguous criterion to appeal to in order to establish the set of 'success stories'.

3. (**What kind of 'truth' in economics?**) We need to operationalize the philosophical concept of realism outside of fundamental physics. Need a notion of 'empirical success' that's relevant here.

4. (**Establish a statistical 'miracle'**) We need some intuitive sense of 'extraordinary' that is not reducible to divine intervention. The set of positive cases ('success stories') needs to be sufficiently large that it is *extraordinary unlikely* for their happenings to be a coincidence[9].

My argument is that the *projective* quality of the many theories of design lurking behind the wide range of success stories is the theoretical quality that best explains these disparate success stories. From mechanism design to matching theory, these theories model choices that designers subsequently get to make. As such, they can capture—almost exactly—the institutional constraints that dictate the implementation. To use the language of Ariel Rubinstein (1991), who notoriously indicted economic theory on this count, theories of design can be made "isomorphic" to the physical rules of the world. For example, in the case of auctions for advertisements used by Google, the mechanism implemented in code is isomorphic to the economic

[8]With respect to the 'Method of Agreement', in the case of failures any number of things maybe have gone awry and, therefore, we can't 'pin' the failure on a specific element.

[9]Don't get bogged down in the Bayesian no-miracles argument reading. Goal is not to talk base rates (etc) but instead to acknowledge there is a sufficiently broad set of 'success stories' to rule out the miraculous explanation.

model that uses real-valued random variables *up to floating point error*. The algorithm designed to match residents to hospitals can be—and, in the case of (Roth and Peranson 1999), actually *was*—used to do just that! Subsequent implementations of mechanisms and matching markets in code or as explicit rules that govern and constrain human activity facilitate a much 'tighter' correspondence between a key facet of the abstraction of a model and the underlying phenomenon it represents. The key facet of the model that better corresponds to the underlying phenomenon is the choice the designer subsequently makes. The tightness of this correspondence between theoretical abstraction and the empirical phenomena it represents in the case of "design economics" is, I believe, what best accounts for the 'truth' of Claim 3.1.

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Outline

1. (structure) the successes of design (McMillan 1994; McAfee and McMillan 1996) (see (Sönmez 2023) for examples and more citations!)

    - Not just theory! See (Roth 2002) for "engineering approach" or (Milgrom 2004) for role of experiments
    - Alternate views of 'design' (Sönmez 2023) or the "Wilson doctrine" (see Milgrom 2004, p23)
    - Recent nobel prizes in econ ('07 mech. design, '20 auction theory, '12 market design)
    - See also computational approaches to measure success (Newman et al. 0000, §1.3)
    - Other examples of success/failure (see Palacios-Huerta, Parkes, and Steinberg 2022, §3.2 for combinatorial auctions)
    - Google / ebay (etc) (Varian 2009)
    - **Auctions + Matching Markets**

        > Centralized auctions and matching markets were fertile grounds for market design due to coincidence of several features. The key design element specifies rules of a game. The contexts are often sufficiently circumscribed that, if the design yields efficient (or better, core) outcomes, then one can expect agents to play that game rather than some larger game with myriad other possibilities. And the contexts usually justify assumptions of rational optimizing behavior rather than various behavioral possibilities. Moreover, the game is sufficiently simple that it can, to a limited extent, be modeled and analyzed, or in any case rough predictions of performance can be based on applications of basic concepts, simulations, experimental evidence, and prior experience. (Roth and Wilson 2019, p130)

2. What is design?

    - See Plott quotation in (Guala 2001, p456)
    - "Design" as noun

        > "Design" is a noun as well as a verb, and market design has its origins in the noun, in the study of the designs of existing marketplaces, and how different designs—different

marketplace institutions, rules, and customs—can induce different strategies and produce different outcomes. Centralized marketplaces are a good place to start the study of market designs, because, by virtue of being centralized, a significant portion of their design may reside in well-codified rules and procedures that are easy to observe. For the same reason, when it becomes necessary to design new rules and procedures, the work involved in designing centralized marketplaces can have a very mechanism-design "look and feel," with well-defined kinds of messages communicated and processed in precisely specified ways that offer a concrete path to implementation in practice. (Roth and Wilson 2019, p131)

- "Design" and it's relation to 'irony'

  "The increasing appeal of the "market design" field lies in its practitioners' ability to go through the regular motions of an economic-theory exercise while insisting on a straightforward, nonironic connection to an economic reality. The "economist as engineer," as Al Roth (2002) called it; irony is not meant to be an engineer's thing. Market design methodology focuses on tightly regulated economic environments whose actors are expected to follow rigid rules. As a result, the gap between model and reality appears small enough to curb the irony impulse." (Spiegler 2024, p178)

3. The charge of antirealism

   - Rather, what *must* be real, in order to not make the successes of design 'miraculous' (cf Putnam 2012)
   - game theory need not be "isomorphic" to reality (Rubinstein 1991); "Yes, I do think we are simply the tellers of fables, but is that not wonderful?" (Rubinstein 2006, p882)

     "The ironic style describes a big chunk of my own academic work. It is probably the professional communication mode I am most comfortable with. I cook up a model, enjoy the subtle ways in which it corresponds to an economic reality, and keep this correspondence at arm's length, leaving it to the reader to connect some of the dots. I tend to shyaway from "taking the model seriously," in the customary sense of offering policy prescriptions

or staking refutable (and typically refuted) scientific predictions. (Spiegler 2024, p176) (also references rubinstein!)

- see (Erev et al. 2002) — helpful?
- 'A Realist Philosophy of Economics' (Mittermaier) (critique of micro)
- "... most of this literature [on theoretical auction design] is of much less use for actually designing auctions." (Klemperer 2002, p170)
- "*Corporate imperatives demonstratively played the decisive role in determining the auction.*" (Nik-Khah 2008, p89)
- "... the mechanism-design perspective impels the analyst to expand the set of instruments at the designer's disposal, even if these instruments aren't realistic." (Spiegler 2024, p157)

4. the kernel of design
    - something by varian about auctions @ google?

Random Quotations

"I never imagined that bargaining theory would make me a better bargainer. When people approached me later in life for advice in negotiating the purchase of an apartment or to join a team planning strategy for political negotiations, I declined. I told them that as an economic theorist I had nothing to contribute. I did not say that I lacked commonsense or life experience that might be useful in such negotiations, but rather that my professional knowledge was of no use in these matters." (Rubinstein 2006)

"mechanism theory expanded our general view of the economic problem to include incentive constraints as well as resource constraints" (Myerson 2008, p587)