REALISTIC ASSUMPTIONS, ECONOMIC MODELS, AND THE ADMISSIBILITY
OF EXPERT TESTIMONY IN THE CLASS ACTION LAWSUIT

DOVER V. BRITISH AIRWAYS

HONORS THESIS

Presented to the Honors College of
Texas State University
in Partial Fulfillment
of the Requirements

for Graduation in the Honors College

by

Hannah Faulkner

San Marcos, Texas
December 2019
REALISTIC ASSUMPTIONS, ECONOMIC MODELS, AND THE ADMISSIONIBILITY OF EXPERT TESTIMONY IN THE CLASS ACTION LAWSUIT

DOVER V. BRITISH AIRWAYS

by

Hannah Faulkner

Thesis Supervisor:

_____________________
Jeff Todd, J.D., PhD.
Department of Finance and Economics

Second Reader:

_____________________
Christopher P. Guzelian, J.D., M.A.
Department of Finance and Economics

Approved:

_____________________
Heather C. Galloway, Ph.D.
Dean, Honors College
ACKNOWLEDGEMENTS

I would like to thank Dr. Jeff Todd for his thorough guidance and thoughtful feedback in his capacity as my supervisor. I am grateful for the challenge and for the opportunity to contribute alongside his scholarship in some small way.

I would also like to acknowledge Dr. Christopher Guzelian for generously agreeing to serve as my second reader in this interdisciplinary endeavor.

Finally, I thank the Honors College for the academic enrichment it has afforded me over the course of my time at Texas State.
ABSTRACT

The “Assumptions Controversy” is a historical debate among economics methodologists regarding whether simplifying assumptions must be realistic for a model to be valid. Nobel Prize-winning economists have occupied both extremes: Milton Friedman claimed that predictive accuracy is the only relevant criterion for a model’s validity, while realists such as Paul Samuelson view realistic assumptions as intrinsically valuable and desirable.

This debate also has implications in the context of litigation. Economics expert testimony is key to establish causation and estimate damages in cases involving antitrust violations, employment discrimination, toxic torts, and more. Experts use idealizations and omissions to transform complex data into a simplified model whose conclusions can be understood by non-experts. These simplifying assumptions are often targeted by opponents as “unrealistic,” prompting motions to exclude the testimony. Judges act as “gatekeepers,” deciding whether the model-based testimony is reliable enough to be admitted to the jury, who weighs the credibility of evidence. Legal precedent and scholarship have failed to provide clear admissibility guidelines, resulting in inconsistent decisions that define multimillion-dollar cases.

Recent developments in the assumptions debate provide a dynamic approach by classifying different types of assumptions and realism. A synthesis of these typologies potentially offers courts a pragmatic solution to admissibility rulings that is based in theory from economics methodologists. This research applies the theoretical framework to Judge Dearie’s admissibility decision in the class action lawsuit Dover v. British Airways, where experts testified regarding whether the airline’s fuel surcharges were correlated with the market price of jet fuel.
# TABLE OF CONTENTS

I. INTRODUCTION..............................................................................................................6

II. ECONOMIC MODELS IN THE METHODOLOGICAL LITERATURE...........11
   A. Models are Analogical Devices and Economists are Storytellers ..............12
   B. Simplifying Assumptions and Realisticness.....\textbf{Error! Bookmark not defined.}
      1. The Origins of the Assumptions Controversy...........................................17
      2. A “Reorientation” of the Assumptions Controversy.................................18

III. ECONOMIC MODELS IN LITIGATION.................................................................27
   A. The Critical Role of Economics Expert Testimony in Complex Litigation......27
   B. The Jury’s Role in Assessing the Credibility of an Expert’s Story...............28
   C. The Ill-Defined Gatekeeper Role for Judges Ruling on Admissibility ..........31
      1. Shortcomings of Current Evidence Law and Case Law on Admissibility ......32
      2. Common Challenges to Economic Models in Litigation..........................35
      3. Proposed Solutions in Legal Scholarship.................................................40

IV. A POTENTIAL SOLUTION BACKED BY ECONOMICS METHODOLOGY.41
   A. \textit{Dover v. British Airways}: Background....................................................44
   B. Plaintiff’s Expert Testimony........................................................................46
   C. Defendant’s Expert Testimony.....................................................................51

V. FRAMEWORK ASSESSMENT AND DISCUSSION.................................................53

VI. CONCLUDING THOUGHTS.........................................................................................61
I. INTRODUCTION

*Dover v. British Airways* is a breach of contract suit brought by lead plaintiff Russell Dover on behalf of an estimated 160,000 class members\(^1\) who were part of the airline’s frequent flyer program, the Executive Club.\(^2\) Members of the club alleged that the airline imposed illegitimate fuel surcharges on rewards-redeemed flights, and thus violated the Executive Club contract.\(^3\) While the airline’s right to levy fuel surcharges (“YQ charges”) was explicitly stated in the contract, plaintiffs asserted that the level of charges was not reasonably related to the actual cost of jet fuel.\(^4\) Each party enlisted the testimony of economics experts to answer the central question of whether there existed a strong correlation between these YQ charges and the market price of jet fuel.\(^5\) Econometricians Jonathan Arnold (representing the plaintiffs) and Andrew Hildreth (representing British Airways) reached opposite conclusions regarding whether this relationship existed.\(^6\) In addition, plaintiff’s expert Arnold proffered multiple damages models that estimated the class members’ entitlement if British Airways was found to have breached the contract.\(^7\) Cross-motions were filed to dismiss the expert testimony, involving challenges to the reliability of the expert’s method and the “realisticness” of his model’s assumptions.\(^8\)

---

\(^1\) 321 F.R.D. 49, 54 (E.D.N.Y. 2017).

\(^2\) *Id.* at 52.

\(^3\) *Id.* at 52-53.

\(^4\) *Id.*


\(^6\) *Id.* at 460, 463.

\(^7\) *Id.* at 461-62.

\(^8\) *Id.* at 457-65.
The use of economics experts—along with these challenges to their testimony and underlying models—is increasingly common in suits involving employment discrimination, business torts, fraud, antitrust violations, and property damage.\(^9\) Experts use statistical techniques such as regression analysis to establish correlation between the defendant’s harmful act and the plaintiff’s injury.\(^10\) Econometric models also help experts perform complex valuation of assets and corporations as well as estimate the amount of damages.\(^11\)

The intended audience for this expert testimony is the jury.\(^12\) As “factfinders,” jurors determine how much weight to give to evidence, which involves “questions of credibility and choice among competing inferences.”\(^13\) When confronted with these models showing causation, discrimination, or damages, the jury evaluates them in the context of other evidence and lay witness testimony.\(^14\) The economic models and accompanying narrative therefore represent a key thread in the jury’s understanding of the dispute.\(^15\)

---

In addition to the increasing necessity of economic models, motions to exclude these models are becoming “routine” due to the high returns that exclusion can bring for the opposing party. Experts and their models often comprise the only proof of causation and damages, so plaintiffs are far less likely to prevail without them. Partial exclusion can “devastate” a plaintiff’s case by increasing the relative strength of the defendant’s evidence, while full exclusion often results in summary judgement since the plaintiff has no proof of damages.

Following motions to exclude expert testimony, judges engage in admissibility determinations that aim to establish the relevance and reliability of the testimony. However, judges struggle to evaluate economic models for objective scientific validity because models are both science and art. Economists wield substantial discretion in the construction of their models by choosing which variables to include and exclude, as well as what idealizations and omissions to make. The realism of a model’s simplifying assumptions are frequent points of attack, placing the judge in a position to weigh

---

16 Id. at 317-18 (noting that “expert testimony is highly desirable in cases involving business damages” and that some courts will not accept damages estimates from non-experts).
18 Id.
19 Todd, supra note 12, at 996-97 (citing In re Am. Booksellers Ass’n v. Barnes & Noble, Inc., 135 F. Supp. 2d 1031 (N.D. Cal. 2001)).
20 Mnookin, supra note 14, at 1569.
22 See infra Part III.C.; see also Allensworth, supra note 9, at 829-34; id. at 830 (stating that this “straddle between art and science has made for the awkward and at times inconsistent treatment of modeling as factual in the eyes of the law”); Mark Klock, Contrasting the Art of Economic Science with Pseudo-Economic Nonsense: The Distinction Between Reasonable Assumptions and Ridiculous Assumptions, 37 PEPP. L. REV. 153, 196-99 (2010).
23 Allensworth, supra note 9, at 829; id at 832 (noting that “like a mapmaker, a modeler makes choices about what are the essential elements (and what are inessential, such as mailboxes and trees) with reference to the task the model is to perform.”).
competing notions of realisticness. This evaluation becomes problematic when the judge encroaches upon the jury’s role by deciding the credibility of the testimony.

Existing legal precedent provides little guidance for admissibility decisions on model-based testimony. The vague language of FRE 702 and the misapplication of scientific standards to the non-scientific aspects of a model leads to unpredictable and often unfounded decisions. These admissibility determinations are high-stakes, often defining the outcome of multimillion-dollar cases such as Dover v. British Airways.

Legal scholars have attempted to fill in the gaps by contextualizing models in the current legal framework, classifying them as issues of law to be decided by the judge or issues of fact to be weighed by the jury, or a combination of the two. However, comments to FRE 702 advise courts to consider the relevant standards of an expert’s field, so these paradigms are misguided because they do not consider economic models in the context of their own discipline.

Heeding these instructions, Todd surveyed the methodological literature to arrive at an understanding of how economic models are built and used within a rhetorical

---

25 See Faigman et al., supra note 13, at 862 (noting how the complexity of scientific evidence creates confusion among courts regarding the boundary between admissibility and weight).
27 Id.
29 Allensworth, supra note 9, at 863-64; see also Hill et al., supra note 15, at 311.
30 Todd, supra note 12, at 989-95 (citing, inter alia, Nebraska Plastics, Inc. v. Holland Colors Americas, Inc., 408 F.3d 410 (8th Cir. 2005); Polymer Dynamics, Inc. v. Bayer Corp., 67 Fed. R. Serv. 201 (E.D. Pa. 2005)).
32 See FED. R. EVID. 702 Committee Notes on Rules—2000 Amendment.
context, and how this knowledge can inform admissibility decisions on model-based testimony in complex litigation.33 In a subsequent article, he surveyed the literature on how the realism of simplifying assumptions affects a model’s validity, a frequent point of contention among both economics methodologists and litigants.34 This survey revealed that all models necessarily involve false or unrealistic assumptions, such as “assuming away” a factor that exists but is negligible in the real world.35 However, targeting these assumptions as unrealistic disregards the reasons for which they are imposed, which may be justified for the purposes of isolation and abstraction.36 Todd proposes a theoretical framework that synthesizes typologies from economics methodologists that classify different types of assumptions and realism.37 The framework prescribes that judges evaluate the realism of assumptions relative to their context and purpose, rather than in isolation.38

In principle, the framework guides judges’ decision-making regarding model-based testimony, which may lead to greater consistency and coherence of admissibility rulings.39 Application to the judge’s rulings in the British Airways class action lawsuit can show whether the framework is effective in practice. Further, Dover presents an opportunity to explore the unique dynamic of competing experts, a need that has been expressed in legal scholarship.40

33 Todd, supra note 12.
34 See infra Part II.B., Part III.C.
35 Todd, supra note 28, at 270-75.
37 Todd, supra note 28.
38 Id. at 273, 275.
39 See id. at 292.
Part II of this article summarizes the multi-decade debate among economics methodologists about what models are and how economists use them. This Part also charts the parallel debate within the discipline regarding whether the realism of assumptions is relevant to a model’s validity, as well as recent contributions to this “assumptions controversy” that classify types of assumptions and realisticness. Part III describes the current legal framework for admissibility decisions, how these standards are lacking, and proposed solutions in legal scholarship. Part IV describes the framework proposed by Todd and applies it to the competing expert testimony in *Dover v. British Airways*. Part V evaluates the framework’s applicability and usefulness for each expert’s testimony. Application to explicit assumptions that are challenged as unrealistic demonstrates a straightforward application of the framework, providing greater depth and precision to the judge’s analysis. Application to tacit assumptions such as choice of methodology requires more inference, but reveals that the framework is also useful for evaluating choices that are external to a model. However, this sort of application requires an understanding of the often ill-defined boundary between the scientific and artistic aspects of a model, a distinction that would need to supplement the framework in order to be applicable to a wide range of challenges to expert testimony. This article concludes in Part VI.

II. ECONOMIC MODELS IN THE METHODOLOGICAL LITERATURE

---

41 See infra Part II.
42 See infra Part II.
43 See infra Part III.
44 See infra Part IV.
45 See infra Part V.
46 See infra Part IV.B.
47 See infra Part IV.C.
48 See infra Part V.
49 See infra Part VI.
A. Models are Analogical Devices and Economists are Storytellers

Economic models are simplified representations of a more complex system, but there is substantial methodological debate regarding the metaphysical relationship between models and the real-world systems they represent. A survey of the economics literature will illustrate how there is no single conception of what models are or how they should be built. This lack of consensus is not fatal, however, because one may distill general points of agreement which will help inform an analysis of economic models in the context of litigation.

Some methodologists posit a high degree of similarity between economics and other sciences. Founder of neoclassical economics Alfred Marshall noted that economic inquiries, like those in other sciences, aim to study an essential cause-and-effect relationship, under the condition that all other things are equal. Mäki extends this reasoning to something more concrete, likening theoretical modelling to the material experiments that are characteristic of natural sciences. The essential similarity between the two lies in the notion of manipulation. Reality is so complex that the ceteris paribus condition, i.e., other things being equal, is not naturally occurring. Thus, in order to isolate a certain causal relationship and examine its properties, investigators must impose a series of controls to craft an “artificial world” that is “free from [the] complications . . . of the rest of the world.”

---

51 Mäki, supra note 36, at 317.
52 Uskali Mäki, Models are experiments, experiments are models, 12:2 J. ECON. METHODOLOGY 303, 308-9 (2005).
53 Id. at 306.
54 Mäki, supra note 36, at 317.
55 Mäki, supra note 52, at 308.
material manipulation, whereas economists use idealizing assumptions to achieve the same effect, that is, of neutralizing or standardizing the myriad elements in a complex system. As a result, Mäki sees models as “surrogate systems,” the properties of which are examined directly in order to indirectly gain knowledge about the systems they represent. This relationship is akin to animal subjects functioning as surrogates for human beings.

Sugden disagrees with the isolationist approach, and instead aims to construct an autonomous model-world that parallels rather than simplifies the real world. For this reason, Sugden’s method is sometimes described as the constructionist approach, since it does not aim to mirror reality but instead crafts from scratch an explicitly counterfactual yet credible world. More succinctly, these model-worlds are “imaginary but imaginable.” A model’s credibility derives from the coherence of its assumptions and whether they construct a world that could be true, given our understanding of how the real world works. Sugden also compares models to novels. Realistic novels do not claim to be anything other than fiction, but they contain certain characters and situations that could conceivably be true. Perhaps most importantly, the story and its characters’ behaviors (like a good model’s assumptions) are coherent and consistent.

56 Id.
57 Mäki, supra note 52, at 304.
58 Id.
59 Robert Sugden, Credible Worlds: The Status of Theoretical Models in Economics, 7 J. ECON. METHODOLOGY 1, 25 (2000) (arguing that the “model world is not constructed by starting with the real world and stripping out complicating factors: although the model world is simpler than the real world, the one is not a simplification of the other.”).
60 Id. at 25, 28.
62 Sugden, supra note 59, at 25.
63 Id.
64 Id.
65 Id. at 26.
Cartwright writes that “models are like fables, and the lesson derived from the model is its moral.”\textsuperscript{66} The key is to translate the concrete, specific results of the model into abstract results that can be more generally applied to other cases.\textsuperscript{67} In this way, the model is both true to reality and useful for inductive inference.\textsuperscript{68} Gibbard and Varian use similar literary language, describing some models as “caricatures” that do not purport to approximate the real world.\textsuperscript{69} Instead, the model is a “deliberate distortion” of reality that aims to exaggerate or illuminate a particular feature of that reality.\textsuperscript{70} This magnification helps the economist to “tell a simple story” about select aspects of the real world, rather than attempt to recount reality in all its complexity.\textsuperscript{71}

Finally, Morrison and Morgan see models as “autonomous instruments” that nevertheless help mediate between theory and the real world.\textsuperscript{72} Like any other tool, models must be “put to work, used, or manipulated” by an external entity in order to be useful.\textsuperscript{73}

Clearly, economists lack a single conception of what model-building entails. Nevertheless, a few points of similarity may be gleaned from the divergent literature. Perhaps most importantly, models are tools that explain real-world phenomena through the mechanism of analogy. Whether they are called surrogate systems, parallel worlds,

\textsuperscript{66} Nancy Cartwright, \textit{Models: Parables v Fables}, in \textit{Beyond Mimesis and Convention: Representation in Art and Science} 19, 26 (Roman Frigg & Matthew C. Hunter eds., 2010).
\textsuperscript{67} \textit{Id.} at 28.
\textsuperscript{68} See \textit{id.} at 29-30 (concluding that increasing the level of abstraction permits “generalizable conclusions” that are “true of new target situations”).
\textsuperscript{70} \textit{Id.}
\textsuperscript{71} \textit{Id.} at 674.
\textsuperscript{72} Margaret Morrison & Mary S. Morgan, \textit{Models as Mediating Instruments}, in \textit{Models as Mediators: Perspectives on Natural and Social Science} 10, 10 (Mary S. Morgan & Margaret Morrison eds., 1999).
\textsuperscript{73} \textit{Id.} at 32.
fables, or caricatures, economists clearly see models as inherently metaphorical devices that help shed light on real-world processes.\textsuperscript{74} Though there may be gaps between the model-world and the real world it represents (due to isolation, distortion, and abstraction), the bridge between the two lies in inductive inference.\textsuperscript{75} This process of induction requires taking the specific propositions of a model—say, a certain factor R causes a change in factor F—and generalizing those to more general situations, inferring that the same causal relationship exists in the real world.\textsuperscript{76}

Crucially, models cannot make these “inductive leaps” themselves and require human interpretation to be useful.\textsuperscript{77} In addition to interpretation, economists must communicate the quantitative results of a model as a qualitative, coherent narrative. The explanations that accompany models are essentially stories, with the modeler as a storyteller.\textsuperscript{78} The modeler must communicate the model and its results to a particular audience, whether they be other economists, academics from other disciplines, or lay audiences.\textsuperscript{79} There is also a rhetorical aspect to these stories, wherein economists aim to convince the audience of the model’s credibility and its similarity with the real world.\textsuperscript{80}

\textsuperscript{74} See Cartwright, supra note 66 (fables); Gibbard & Varian, supra note 69 (caricatures); Mäki, supra note 52, at 304 (surrogate systems); Sugden, supra note 59 (parallel worlds).
\textsuperscript{75} Sugden, supra note 61, at 4.
\textsuperscript{76} Sugden, supra note 59, at 20.
\textsuperscript{77} Id.
\textsuperscript{78} Mäki, supra note 36, at 330-31; see also Mary S. Morgan, Models, Stories and the Economic World, 8 J. ECON. METHODOLOGY 361, 361 (2001) (describing how economists use models “to explain or to understand the facts of the world by telling stories about how those facts might have arisen.”); see id. at 366 (writing that models and stories “go hand in hand”).
\textsuperscript{79} See Mäki, supra note 36, at 330-31 (holding that the story attached to a model “may vary somewhat from audience to audience.”).
\textsuperscript{80} See Itzhak Gilboa et al., Economic Models as Analogies, 124 ECON. J. F513, F518 (2014) (stating that “the similarity judgement is often hinted at by the economist,” but the audience or “readers” of a model may not necessarily agree with these judgements).
As part of this persuasion, the modeler engages in “storied idealizations” to describe the reasons behind his simplifications and omissions.\(^8^1\)

**B. Simplifying Assumptions and Realisticness**

While the metaphysical relationship between the real world and the model-world can be described in a variety of ways, it is undisputed that unrealistic assumptions are a ubiquitous and inescapable component of these model-worlds.\(^8^2\) Simplification and idealization transform a complicated reality into a tractable, useful model that ignores irrelevant elements to shed light on a particular relationship or phenomenon.\(^8^3\) Since the model-world is supposed to inform us about the real-world in some way, the issue of realisticness is perhaps the “most chronic ongoing methodological controversy in economics.”\(^8^4\) Historical approaches to this dispute have generally tended towards two methodological camps: instrumentalism and realism.\(^8^5\) Instrumentalists are concerned with the realism of outputs, and posit that the accuracy of predictions is the only criterion by which a model should be judged.\(^8^6\) Conversely, realists are focused on inputs and see verisimilitude or “truthlikeness” of assumptions as intrinsically valuable and desirable.\(^8^7\)

\(^8^1\) Mäki, *supra* note 36, at 330-31 (writing that “storied idealizations” are particularly important for audiences of non-economists).


\(^8^4\) Mäki, *supra* note 36, at 318.


\(^8^6\) *Id.*

\(^8^7\) See Mäki, *supra* note 82, at 240.
1. The Origins of the Assumptions Controversy

The most notable contribution to this debate is staunch instrumentalist and Nobel Prize laureate Milton Friedman and his essay, *The Methodology of Positive Economics*.

In the essay Friedman proclaims that unrealistic assumptions are not an unfortunate byproduct of simplification, but rather a necessary and welcome element of important theories. Important theories should “explain much by little,” he says, and in general, “the more significant the theory, the more unrealistic the assumptions.” Accordingly, whichever assumptions yield those predictions—no matter their degree of “conformity [] to reality”—have proven themselves to be “sufficiently good approximations for the purpose at hand.”

This bold thesis provoked the response of Nobel Prize winner and realist Paul Samuelson, who dubbed Friedman’s “principle of unreality” the “F-Twist,” and used deductive logic to show that false assumptions necessarily imply false conclusions.

While Samuelson concedes that models cannot perfectly mirror reality, he sees lack of realism as a defect rather than a virtue and denounces Friedman’s flagrant disregard for realism in the name of parsimony. Samuelson feared that the tolerance (or celebration) of unrealistic assumptions could be a slippery slope into complete neglect of empirical

---


89 See id. at 14

90 Id.

91 Id.

92 Id. at 14-15 (asserting that the appropriate test for an assumption’s realism is the accuracy of predictions it yields).


94 Paul Samuelson, *Theory and Realism: A Reply*, 54 AM. ECON. REV. 736, 736 (1964) (arguing that “the doughnut of empirical correctness in a theory constitutes its worth, while its hole of untruth constitutes its weakness.”); see id. at 736 (calling it a “monstrous perversion of science to claim that a theory is all the better for its shortcomings”) (emphasis in original).
validity. He admits that some abstract models may have a certain “psychological usefulness” for understanding some latent patterns of reality, however, this usefulness is entirely different from the empirical accuracy that Friedman claimed to achieve with his instrumentalist models.

2. A “Reorientation” of the Assumptions Controversy

Following the polarized debate between Friedman and Samuelson, the assumptions controversy has evolved beyond the binary issue of whether or not assumptions need to be realistic. More recent developments recognize that assumptions should be evaluated relative to their context and purpose, rather than in isolation. As a result, several methodologists have attempted to categorize assumptions based on this more nuanced understanding.

Alan Musgrave aimed to “un-twist” Friedman’s F-Twist by specifying three main types of assumptions: negligibility, domain, and heuristic. Negligibility assumptions are statements that a certain factor X has no effect—or at least no detectable effect—on Y, the phenomenon under study. As a result, the omission of factor X from the model will not substantially change its results. An example would be Galileo’s assumption of zero air resistance when investigating the motion of free-falling objects. It would be “plain

---

95 Samuelson, supra note 93, at 236.
96 Id.
99 Musgrave, supra note 98, at 378-82.
100 Id. at 378.
101 See id. at 380 (describing how the truth of negligibility assumptions becomes apparent by “examining the consequences of the theory in which they are embedded.”).
102 Id. at 378.
silly,” Musgrave says, to discount Galileo’s theory simply because air resistance does exist and the objects were not, in fact, falling through a vacuum.\(^{103}\) Instead, the proper focus should be on Galileo’s statement about the *negligibility* of air resistance on the object of study, which is a potentially true statement.\(^{104}\)

Domain assumptions specify where a theory may be applied.\(^{105}\) In contrast to the previous type, factor X admittedly has non-negligible effects on Y, so the theory only applies when the factor is absent.\(^{106}\) Musgrave states that domain assumptions should be true of as many actual situations as possible, because if domain assumptions are never true, they can never be tested and the theory or model loses its utility.\(^{107}\)

Finally, heuristic assumptions are early simplifications that ease the logical development of a theory.\(^{108}\) Musgrave provides an example from physics: Newton’s early approximations assumed that only one planet orbited the sun and did not take into account the effects of inter-planetary gravitational forces.\(^{109}\) Implicit in these assumptions is a promise to relax them later on, as they are only intermediate steps towards more precise predictions.\(^{110}\) Since they are only temporary, some descriptively false assumptions are permissible.\(^{111}\)

\(^{103}\) Id. at 379.
\(^{104}\) Id. at 380 (writing that negligibility assumptions are true descriptions of reality because they “do not assert that present factors are absent but rather that they are ‘irrelevant for the phenomena to be explained’”).
\(^{105}\) Id. at 381.
\(^{106}\) Id.
\(^{107}\) Id. at 382 (negating Friedman’s claim that “the more significant the theory, the more unrealistic the assumptions” because the significance of a theory is dependent on how widely it can be applied, *i.e.* how often its domain assumptions are true).
\(^{108}\) Id. at 383.
\(^{109}\) Id.
\(^{110}\) Id. (naming this process “a *method of successive approximation*”) (emphasis in original).
\(^{111}\) See id.
To understand how each of these assumptions functions, consider how the same idealization of factor X can take on various interpretations:

An economist who says ‘assume the government has a balanced budget’ may mean that any actual budget imbalance can be ignored because its effects on the phenomena he is investigating are negligible. But he may also mean precisely the opposite: that budget imbalance would have significant effects, so that his theory will only apply where such an imbalance does not exist.\(^\text{112}\)

A heuristic assumption would be to assume the government has a balanced budget at first, with a subsequent theory that takes the possibility of budget imbalance into account.\(^\text{113}\) In all three cases, the status of the government’s budget is “assumed away,” (factor X is absent) but the implications of each type of assumption represent critical differences that are often imperceptible.\(^\text{114}\) If a successor theory were to build upon this economist’s model, it is crucial that he know whether continuing to assume a balanced budget is appropriate.\(^\text{115}\) An applicability assumption that is misconstrued as a negligibility assumption may cause a violation of the proper domain, resulting in an invalid theory.\(^\text{116}\) Therefore, Musgrave urges economists to be explicit regarding which type of assumptions they are imposing.\(^\text{117}\)

Uskali Mäki supplemented this typology, with improvements that were both semantic and material.\(^\text{118}\) Musgrave’s heuristic assumption was replaced by an essentially identical “early-step” assumption.\(^\text{119}\) Mäki also clarified that Musgrave’s domain

\(^{112}\) Id. at 381 (emphasis in original).
\(^{113}\) Id. at 386.
\(^{114}\) Id. at 381 (noting that identical phrasing for the different types of assumptions can mask their divergent implications).
\(^{115}\) See id.
\(^{116}\) See id. at 385 (speculating on whether changes in the status of assumptions (e.g., from negligibility to domain) have gone unnoticed in the development of economic theory at large).
\(^{117}\) Id.
\(^{118}\) Mäki, supra note 98, at 317-18.
\(^{119}\) Id. at 325.
assumption is simply one component of what is in fact an applicability assumption.\textsuperscript{120} He notes that the domain assumption merely identifies the relevant domain, while the higher-level applicability assumption does the work in restricting the theory to only that domain.\textsuperscript{121} As a result, applicability assumptions typically involve an if-then formulation: \textit{If} the domain assumption is true, \textit{then} the theory applies.\textsuperscript{122} As for the third class of assumptions, Mäki cautioned against the conflation of negligibility with undetectability, the latter of which he feared Musgrave was actually referencing.\textsuperscript{123}

On the topic of realism, Mäki feared that Musgrave’s artful paraphrasing is too flexible, to the point where nearly any statement can become “a potentially true assertion if it is suitably ‘meta-paraphrased.’”\textsuperscript{124} Mäki aims to limit the powers of meta-statements by requiring that they transform a statement into a “factual claim” about economic reality.\textsuperscript{125}

In the latest contribution to the assumptions typology, Frank Hindriks introduces the notion of a tractability assumption, the successor of “heuristic” or “early-step” assumptions.\textsuperscript{126} However, this change was not mere re-packaging of the previous methodologists’ terminology. Instead, Hindriks’ addition better encompasses a third primary reason why an economist might impose a given assumption. Tractability assumptions arise when a problem is unmanageable but-for a certain simplification.\textsuperscript{127}

\textsuperscript{120} Id.
\textsuperscript{121} Id.
\textsuperscript{122} See id. at 323.
\textsuperscript{123} Id. at 320.
\textsuperscript{124} Id. at 331.
\textsuperscript{125} Id. at 331-32.
\textsuperscript{126} Hindriks, supra note 98, 411-14.
\textsuperscript{127} Id. at 412 (stating that because tractability assumptions involve non-negligible factors, “one would prefer to avoid relying on it, if it were not for the fact that it makes the problem under investigation (more) tractable.”); Frank A. Hindriks, Unobservability, Tractability and the Battle of Assumptions, 12 J. ECON.
Hindriks distinguishes between two types of tractability: theoretical and empirical.\textsuperscript{128} The former is reminiscent of Musgrave’s heuristic assumption and refers to the logical development of a theory.\textsuperscript{129} Certain “exogenous constraints,” such as the level of sophistication of mathematics, may necessitate a theoretical tractability assumption.\textsuperscript{130} Such an assumption may also be imposed due to limitations on cognitive capacity, both of the theorists and their audiences alike.\textsuperscript{131}

Empirical tractability, on the other hand, concerns more pragmatic constraints.\textsuperscript{132} Frequently, data are not available for a given variable or factor X, either due to non-collection or confidentiality reasons.\textsuperscript{133} Even when data are available, their method of collection may be inconsistent across time, making their use in an empirical model problematic.\textsuperscript{134} Another empirical tractability concern is unobservability, which is often the case when theoretical constructs in economics have no corresponding real-world data.\textsuperscript{135} As such, both theoretical and empirical models frequently incorporate these assumptions in order to reduce the number of unknown variables and make models more tractable.\textsuperscript{136}

\textmd{\textsc{Methodology} 383, 399 (2005) (asserting that despite their potentially “distorting effects,” the imposition of tractability assumptions is “usually unavoidable”).}
\textsuperscript{128} Hindriks, supra note 98, at 413.
\textsuperscript{129} Id.
\textsuperscript{130} Id. at 414.
\textsuperscript{131} Id.
\textsuperscript{132} Id.
\textsuperscript{133} Id.
\textsuperscript{134} Id.
\textsuperscript{135} Hindriks, supra note 127, at 399 (2005) (providing an example: “The value of marginal cost cannot easily be computed from cost data that are reported. Economists often assume that the relation between marginal cost and the number of products produced is nonlinear. This means that marginal cost is not the same as average cost”).
\textsuperscript{136} Id. at 392 (emphasizing that “tractability is a matter of solubility or of the efficiency of a solution.”).
Both Musgrave and Mäki recognize that the content of an assumption and its purpose constitute two separate concepts whose “truth values . . . behave differently.”

While Musgrave and Mäki hint at the dual identity of assumptions, Frank Hindriks articulates this distinction by introducing first-order and second-order assumptions. The first-order assumption is an idealization statement concerning factor X – whether it is absent, constant, or infinite in the model. The second-order assumption is a meta-statement that identifies the purpose of imposing the first-order assumption. While the first-order assumption concerns only the model-world, the second-order assumption is a statement about the real-world. For example, a negligibility assumption might take the following form:

[A] Factor F is absent or has no effect on the phenomenon under investigation.
[N] The factor F mentioned in first-order assumption A has a negligible effect on the phenomenon under investigation relative to the purpose for which the theory is used.

This formulation demarcates the instances in which the truth-value of an assumption is an important concern. First-order assumptions are often false or unrealistic, but this is unproblematic so long as the second-order assumption is approximately true relative to its purpose. For example, assuming that air resistance is absent is a descriptively false first-order assumption. The second-order assumption stating that air resistance has a

---

137 Mäki, supra note 98, at 325; Musgrave, supra note 98, at 380 (differentiating between the absence of a factor as a “descriptively false” statement versus the negligibility of that factor as a “descriptively realistic” statement).
138 Hindriks, supra note 98, at 406.
139 Id. at 407.
140 Id.
141 Id.
142 Id.
143 See id. at 421.
144 See id. at 410 (rephrasing Musgrave’s argument).
145 See Musgrave, supra note 98, at 378 n.2.
negligible effect may be approximately true, as in the case of a falling baseball.\textsuperscript{146} However, this negligibility assumption may be a false in other contexts, such as a falling feather.\textsuperscript{147}

The assumptions typology demonstrates how a lack of overt realism in face-value assumptions need not be in conflict with a realist approach to economics.\textsuperscript{148} The framework thus offers a sort of reconciliation between the realist and instrumentalist camps; on one hand, economists may use simplifying first-order assumptions as the tool that they are, and models will not be held to the impossible standard of being “photographic reproduction[s]” of reality.\textsuperscript{149} On the other hand, realistic second-order assumptions ensure that a model is still meaningfully connected to reality. The requirement that the second-order assumption be at least approximately true may allay Samuelson’s fears concerning the descent of economic science into empirical invalidity.\textsuperscript{150} It also prevents indiscriminate acceptance of unrealistic assumptions, a concern had by many following Friedman’s seminal essay.\textsuperscript{151} Most importantly, these methodologists approach the realisticness of assumptions as a dynamic phenomenon rather than a “dichotomous notion.”\textsuperscript{152} This analysis can be further developed by an

\textsuperscript{146} See id.
\textsuperscript{147} See Gibbard & Varian, supra note 69, at 671.
\textsuperscript{148} Tarja Knuuttila, \textit{Isolating Representations versus Credible Constructions? Economic Modelling in Theory and Practice}, 70 ERKENNTNIS 59, 61; see also Todd, supra note 28, at 269 (summarizing that “Although idealization involves some false assumptions, that does not undermine the truth of the model”).
\textsuperscript{149} Friedman, supra note 88, at 35 (contrasting the instrumentalist and realist approaches); Mäki, supra note 52, at 308 (emphasizing that “Unrealistic assumptions are the indispensable tools of the experimental theorist.”).
\textsuperscript{150} See, e.g., Mäki, supra note 98, at 332 (clarifying that paraphrased assumptions must involve factual claims about economic reality).
\textsuperscript{151} See Hindriks, supra note 98, at 410-411 (noting how the truth of second-order assumptions is important for a theory’s validity).
\textsuperscript{152} E.g., Mäki, supra note 36, at 324.
awareness of the various interpretations that the terms “realistic” and “unrealistic” may take.

Mäki sees the debate about realism of assumptions as “plagued by multiple ambiguity.” The culprits of this ambiguity, he says, are binary thinking and lack of specificity in language. As a remedy, he catalogs different kinds of realisticness which include truth, confirmability, plausibility and partiality, among others.

As a remedy, he catalogs different kinds of realisticness which include truth, confirmability, plausibility and partiality, among others.

Perhaps the most obvious conception of realisticness is truth; truth is self-evident and its antithesis is falsehood. In this sense, a statement is realistic if true and unrealistic if false. However, the truth is not always observable and may be difficult to ascertain after-the-fact. Empirical evidence can provide hints about this truth, but belongs to a different type of realisticness, which is confirmation and disconfirmation.

This type concerns matters that are not only observable, but testable and confirmed by empirical evidence. Confirmability is often conflated with truth but the two are not synonymous: evidence can speak for a false statement (confirmable but not true) and not all truths are supported by observable evidence (true but not confirmable). A third type of realisticness is plausibility, which is a matter of being believed by people. The criterion for realisticness here is not evidence but instead human logic and reasoning, so a representation may be realistic if plausible and unrealistic if implausible.

---

153 Id. at 320.
154 Mäki, supra note 82, at 239.
155 Id. at 241-43.
156 Id. at 241-42.
157 Id.
158 Id. at 242.
159 Id.
160 Id.
161 Id.
162 Id.
163 Id.
The final class of realisticness concerns partiality, of which there are a few sub-types. Partiality may refer to isolation, which “focuses on the influence of only one factor . . . to the exclusion of others.”\textsuperscript{164} Another subset of partiality is abstraction, where a universal or quasi-universal concept is stripped from its particularities.\textsuperscript{165} Partiality can relate to realisticness in two opposite ways. In one sense, a partial representation may be deemed unrealistic because it is not comprehensive (in the case of isolation)\textsuperscript{166} or concrete (in the case of abstraction).\textsuperscript{167} Alternatively, partiality may help a modeler “attain the truth about the essential features” of economic phenomena, and thus be more “realistic” than a model weighed down by innumerable and irrelevant details.\textsuperscript{168} “An isolating theory or statement is true if it correctly represents the isolated essence of the object; otherwise it is false.”\textsuperscript{169} Similarly, abstraction can help “facilitate the attainment of truth” by permitting greater scope.\textsuperscript{170}

Mäki’s enumeration of various types of realisticness provides yet another dimension to the previously superficial controversy surrounding the realism of assumptions. For one, an assumption may be simultaneously realistic in one sense and unrealistic in another, such as a false assumption that may still be plausible.\textsuperscript{171} Furthermore, realisticness does not always have to be binary as in the case of truth and

\textsuperscript{164} Id. at 243.
\textsuperscript{165} Mäki, supra note 36, at 322 (referencing the example of a production function, where an ‘L’ represents the aggregate labor input without any reference to “spatio-temporally specified instances of labor.”).
\textsuperscript{166} Id. at 321.
\textsuperscript{167} Id. at 323.
\textsuperscript{168} Mäki, supra note 83, at 311.
\textsuperscript{169} Mäki, supra note 36, at 344.
\textsuperscript{170} Jack Melitz, Friedman and Machlup on the Significance of Testing Economic Assumptions, 73 J. POL. ECON. 37, 41 (1965).
\textsuperscript{171} See Mäki, supra note 82, at 241-43; see also Mäki, supra note 36, at 346 (describing how a theory can also be simultaneously realistic (it shows nothing-but-the-truth) and unrealistic (it does not show the whole truth)); Todd, supra note 28, at 263, 275, 278-79.
falsehood or confirmation and disconfirmation, as plausibility and partiality can exhibit differences of degree.\textsuperscript{172}

These various conceptions of realism are also present in the context of litigation. In the “quest for truth,” juries make plausibility judgments on competing testimony and parse evidence that may confirm or disconfirm certain statements.\textsuperscript{173}

**II. ECONOMIC MODELS IN LITIGATION**

**A. The Critical Role of Economics Expert Testimony in Complex Litigation**

Economics experts are frequently called upon to certify a class, prove causation, and estimate damages.\textsuperscript{174} Their model-based testimony is prevalent in various types of cases involving employment discrimination, business torts, fraud, antitrust violations, and property damage.\textsuperscript{175} Proving causation is no straightforward task given the myriad confounding variables that can affect an employment decision or a firm’s share price and profits.\textsuperscript{176} Because economists do not have the benefit of controlled experiments,\textsuperscript{177} they must use econometrics—the application of statistics to analyze economic data—to study phenomena like correlation and causation.\textsuperscript{178} These econometric models therefore help the jury make sense of vast amounts of disorderly data.\textsuperscript{179}

\textsuperscript{172} Mäki, supra note 36, at 321.
\textsuperscript{173} Casey & Simon-Kerr, supra note 11, at 1184.
\textsuperscript{174} Allensworth, supra note 9, at 835; Hersch & Bullock, supra note 26, at 2373-76.
\textsuperscript{175} Allensworth, supra note 9, at 835.
\textsuperscript{176} Todd & Jewell, supra note 40, at 286-87.
\textsuperscript{178} Alan O. Sykes, An Introduction to Regression Analysis (COASE-SANDOR INST. FOR LAW & ECON., WORKING PAPER NO. 20, 1993).
\textsuperscript{179} Todd, supra note 28, at 243; Todd & Jewell, supra note 40, at 286-87 (describing how experts must sort through “voluminous data, such as market information showing prices and sales, or financial records showing revenues and expenses” as well as account for the variable of time).
Statistical techniques such as regression analysis can establish and isolate the causal link between an independent variable—the defendant's alleged wrongful conduct—and a dependent variable, the plaintiff’s injury.\textsuperscript{180} Experts also perform complex valuation of assets and corporations for cases involving business torts.\textsuperscript{181} Additionally, they use empirical models to construct a counterfactual past that estimates what a plaintiff’s position would have been but-for the defendant's wrongful conduct.\textsuperscript{182} These estimations provide a basis for calculating the amount of damages, which is the difference between the plaintiff’s current position and their but-for position.\textsuperscript{183}

In sum, economics experts use their knowledge and technical expertise to “fill[] that evidentiary void” between complex, raw data and actionable information that the jury can understand and evaluate.\textsuperscript{184} Econometric models frequently comprise the only proof of causation and damages, so the outcomes of many cases are contingent on the jury seeing this testimony.\textsuperscript{185}

**B. The Jury’s Role in Assessing the Credibility of an Expert’s Story**

As factfinders, juries are tasked with determining the facts in issue of a case given the available evidence.\textsuperscript{186} By assessing witness credibility and weighing competing evidence, juries decide whether the defendant is liable and if so, the amount of

\textsuperscript{180} Lopatka & Page, \textit{supra} note 10, at 687 (stating that economic models help determine whether “the alleged harm bears the necessary causal link” in antitrust inquiries).
\textsuperscript{181} Casey & Simon-Kerr, \textit{supra} note 11, at 1178.
\textsuperscript{182} Allensworth, \textit{supra} note 9, at 837.
\textsuperscript{184} \textit{Fed. R. Evid.} 702(a) (“the expert’s scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue”); Casey & Simon Kerr, \textit{supra} note 11, at 1179.
\textsuperscript{185} Blair & Herndon, \textit{supra} note 17, at 802.
\textsuperscript{186} See Casey & Simon-Kerr, \textit{supra} note 11, at 1185.
damages. However, jurors do not approach evidence with a blank state. Instead, they filter the evidence through the lens of their past experiences. These experiences engender a common sense and intuition about how the world works. With the advantage of numerosity, juries are the entity best equipped to make common-sense judgments regarding “credibility and choice among competing inferences.”

Furthermore, juries evaluate evidence holistically rather than in isolation, searching for continuity among the various elements presented to them. With these evidentiary fragments, the jury constructs “alternative interpretations, or ‘stories,’ about the events that led to the dispute now on trial.” Each party also has a story about these events supported by their respective evidence. The parties present these opposing narratives to the jury, and use rhetoric and persuasion to convince this audience to share their respective conceptualizations of reality, essentially, whether or not the defendant caused harm to the plaintiff.

This model of jury factfinding is no different for expert testimony. Economics experts present their models to the jury and aim to persuade this audience of their model’s credibility. Juries use their past experiences as “buyers and sellers, parties to contracts, and business owners” to gauge the plausibility of the expert’s testimony.

---

187 Faigman et al., supra note 13, at 884.
189 Id. at 1138; Mnookin, supra note 14, at 1540-41.
190 Allensworth, supra note 9, at 848-49; Faigman et al., supra note 13, at 884 (specifying the jury’s role as the “assessors of witness credibility”).
192 Mnookin, supra note 14, at 1540; see also Griffin, supra note 190, at 286 (discussing how different pieces of evidence “interact in ways that alter their individual significance”).
193 Vidmar & Diamond, supra note 188, at 1138.
195 Id. at 622.
196 Todd, supra note 12, at 1018-22.
197 Id. at 1034.
Because the jury is a lay audience, experts rely on qualitative explanations and natural language to communicate the model’s results. The role of economists as storytellers becomes especially prominent in the context of litigation. In isolation, models are but “skeletal representations” whose substantive contributions are revealed only when they are accompanied by the modeler’s story. The expert must explain his idealizations and omissions, and aims to convince the audience that the model bears sufficient resemblance to relevant aspects of the real world. If the expert is successful in his storytelling role the jury will accept the conclusions of his model, such as the causal link between the defendant’s conduct and the plaintiff’s injury, or a given damages estimate.

Rhetoric and persuasion are particularly important when juries are confronted with dueling experts, as parties aim to dissuade the jury from accepting the opposing expert’s model and conclusions. The jury may or may not agree with these attacks, so each expert must defend his modelling choices in order to maintain his story’s credibility in the eyes of the factfinder.

While expert testimony is a critical piece of evidence in many lawsuits, it is but one element embedded in a greater narrative that each party constructs. Econometric

198 See supra text accompanying notes 78-79.
199 See Todd, supra note 12, at 1018-20.
201 Id.
202 Gilboa et al., supra note 80, at F518.
203 See supra text accompanying notes 180-83.
204 See Hill et al., supra note 15, at 342 (referencing the “battle of experts”); see id. at 358-64 (describing courts’ struggles with expert partisanship).
205 See Todd & Jewell, supra note 40, at 313 (writing that the plausibility of assumptions partly rests on the “persuasiveness of the [expert’s] reasoning”).
206 Hill et al., supra note 15, at 334.
models showing causation and damages are thus evaluated in relation to other evidence and lay witness testimony.\textsuperscript{207}

C. The Ill-Defined Gatekeeper Role for Judges Ruling on Admissibility

Before a jury can assess the weight of expert testimony, the judge must first act as a “gatekeeper” and evaluate the evidence for admissibility.\textsuperscript{208} This division of responsibility aims to prevent scientifically invalid expert testimony from reaching the jury and skewing verdicts.\textsuperscript{209} Admissibility determinations thus require weighing the relative competency of the jury in evaluating complex scientific evidence.\textsuperscript{210}

In the case of model-based testimony, delineating the separate domains of judge and jury is both important and troublesome. If the admissibility threshold is too low, judges may admit “junk science” testimony that misleads or “bamboozles” the jury.\textsuperscript{211} Conversely, a high admissibility threshold may cause a court to “substitute its judgment for the jury” in deciding issues of credibility.\textsuperscript{212}

Furthermore, admissibility rulings are increasingly frequent and high-stakes decisions.\textsuperscript{213} Given the vital role of economic models in showing causation, establishing injury, and estimating damages, the absence of such evidence can be outcome-determinative.\textsuperscript{214} One possible outcome is the case never makes it to a jury. An excluded model may mean the plaintiff is unable to establish causation between alleged

\textsuperscript{207} Mnookin, supra note 14, at 1577; Vidmar & Diamond, supra note 188, at 1138.
\textsuperscript{208} Fagman et al., supra note 13, at 861.
\textsuperscript{209} Id. at 862.
\textsuperscript{210} Id. at 884.
\textsuperscript{211} Lloyd, supra note 31, at 423.
\textsuperscript{212} Mnookin, supra note 14, at 1570.
\textsuperscript{213} Id. at 1569.
\textsuperscript{214} Blair & Herndon, supra note 17, at 802 (describing how a plaintiff’s case may “evaporate” without expert testimony that shows injury from anticompetitive behavior or provides damages estimates); Mnookin, supra note 14, at 1569 (noting that admissibility determinations are often case dispositive).
misconduct and personal or financial harm.\textsuperscript{215} Without sufficient proof of causation, the judge may grant summary judgment to the defendant.\textsuperscript{216} Even when a suit does make it to the jury, excluded expert testimony constitutes a significant missing “thread” in the party’s case.\textsuperscript{217} Admissibility rulings allow a judge to control the “evidentiary landscape” that a jury may use in constructing a coherent narrative of what happened.\textsuperscript{218} Even partial exclusion can mean that the relative weight between opposing expert testimony becomes lopsided, which can result in a party losing its case.\textsuperscript{219}

Admissibility versus weight is clearly a critical distinction, but the boundary between the two remains fuzzy for model-based testimony.\textsuperscript{220} An overview of the existing rules and precedents will illuminate how current standards are lacking.

1. Shortcomings of Current Evidence Law and Case Law on Admissibility

The first element a judge considers when evaluating evidence is relevance, that is, whether it “has any tendency to make a fact more or less probable than it would be without the evidence.”\textsuperscript{221} If relevant, FRE 402 follows a principle of “general admissibility”\textsuperscript{222} where evidence should only be excluded if it is “unfairly prejudicial, misleading, a waste of time, deceptive, redundant, or unreliable.”\textsuperscript{223} Expert testimony in

\textsuperscript{215} Mnookin, supra note 14, at 1569.
\textsuperscript{216} Id.
\textsuperscript{217} Hill et al., supra note 15, at 334.
\textsuperscript{218} Lopatka & Page, supra note 10, at 619 (explaining that “a jury’s evaluation of conflicting economic opinions rarely decides cases because federal judges’ choices limit the scope and force of expert testimony.”); Mnookin, supra note 14, at 1542.
\textsuperscript{219} Todd, supra note 12, at 997.
\textsuperscript{220} Faigman et al., supra note 13, at 884.
\textsuperscript{221} FED. R. EVID. 401.
\textsuperscript{222} FED. R. EVID. 402.
\textsuperscript{223} Faigman et al., supra note 13, at 875.
particular has its own set of parameters in evidence law.\textsuperscript{224} FRE 702 states that expert testimony may be admitted if:

(a) the expert’s scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
(b) the testimony is based on sufficient facts or data;
(c) the testimony is the product of reliable principles and methods; and
(d) the expert has reliably applied the principles and methods to the facts of the case.\textsuperscript{225}

This rule was amended in 2000 to incorporate a trilogy of Supreme Court cases that has culminated in the \textit{Daubert} standard.\textsuperscript{226} \textit{Daubert v. Merrell Dow Pharmaceuticals, Inc.} was the first of these cases, and involved a mother’s allegations that a prescription drug had caused her child to have birth defects.\textsuperscript{227} The plaintiff’s expert offered testimony that suggested causation, but the evidence was declined because it was based on methods that were not accepted by the general scientific community.\textsuperscript{228} The \textit{Daubert} ruling thus established that expert testimony must adhere to the principles, methods, and procedures of the scientific method.\textsuperscript{229} The Court also issued a series of flexible and non-exhaustive “\textit{Daubert factors}” that a judge may consider in evaluating expert testimony.\textsuperscript{230} Importantly, this ruling restricted the judge’s gatekeeping function to an expert’s principles and methodology, reserving the conclusions for the jury to evaluate.\textsuperscript{231}

\begin{itemize}
\item[\textsuperscript{224}] See \textit{FED. R. EVID.} 702–705.
\item[\textsuperscript{225}] \textit{FED. R. EVID.} 702.
\item[\textsuperscript{226}] \textit{FED. R. EVID.} 702 Committee Notes on Rules—2000 Amendment.
\item[\textsuperscript{227}] 509 U.S. 579 (1993).
\item[\textsuperscript{228}] \textit{Id} at 579.
\item[\textsuperscript{229}] \textit{Id.} at 589-90.
\item[\textsuperscript{230}] \textit{Id.} at 593-94 (listing these factors: 1. Whether the theory or technique in question can be and has been tested; 2. Whether it has been subjected to peer review and publication; 3. Its known or potential error rate; 4. The existence and maintenance of standards controlling its operation; 5. Whether it has attracted widespread acceptance within a relevant scientific community).
\item[\textsuperscript{231}] \textit{Id.} at 595.
\end{itemize}
The second case in the *Daubert* trilogy, *General Electric Co. v. Joiner*, involved allegations that chemical exposure at the workplace had accelerated the onset of the plaintiff’s lung cancer. While the reliance on animal studies was an accepted methodology, the Court still excluded the testimony because the studies were insufficient grounds for the expert’s conclusion. The *Joiner* ruling consequently expanded the judge’s range of discretion by allowing the perceived gap between methodology and conclusions to be a basis for exclusion.

The final *Daubert* case reinforced and supplemented this finding. A judge declined to admit expert testimony in *Kumho Tire Co. v. Carmichael*, where an engineer inspected an allegedly defective tire and concluded that the defect had caused the tire to explode. While visual and tactile examination was an acceptable method, there was too great of an analytical gap between the method and the conclusion that the defect caused the blow out. *Kumho* thus reinforced that an expert’s methods should not only be reliable in the abstract, but must also be reliable in context and application.

While the purpose of the *Daubert* standard was to protect juries from scientifically invalid evidence, some legal commentators fear that it set the admissibility threshold too high. In evaluating the “reliability” of an expert’s conclusions, courts may inadvertently encroach upon the jury’s domain, which is to make credibility

---

233 Id. at 136.
234 Id. at 146 (holding that “conclusions and methodology are not entirely distinct from one another” and that a “court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.”).
236 Id. at 139.
237 Faigman et al., *supra* note 13, at 872-73 (citing FED. R. EVID. 702(d)).
judgments amid competing testimony. The Daubert standard has garnered several other critiques, most notable of which are vagueness and lack of consistency in application.

Furthermore, all three cases in the Daubert trilogy concerned expert testimony from the “hard” sciences. Consequently, the guidelines derived from these cases are couched in terminology regarding the scientific method and objective scientific validity. But economic models are not a hard science, making these guidelines a poor fit for model-based testimony.

The next section illuminates why model-based testimony should be treated differently from the “hard” sciences in litigation. This discussion will also inform why courts struggle to distinguish between issues of admissibility versus weight with regards to economics experts and their models.

2. Common Challenges to Economic Models in Litigation

The conversation surrounding econometric models suggests a highly rigorous and straightforward scientific inquiry. However, though the methods themselves (regression analysis, for example) are mathematically sophisticated, their construction is

239 Mnookin, supra note 14, at 1570-71.
240 Hersch & Bullock, supra note 26, at 2777.
241 Andrew I. Gavil, Defining Reliable Forensic Economics in the Post-Daubert/Kumho Tire Era: Case Studies from Antitrust, 57 WASH. & LEE L. REV. 831, 874 (2000); Todd & Jewell, supra note 40, at 311 (observing that “some courts pay only lip service to Rule 702 and the Daubert trilogy and focus their analysis on pre-Daubert authority rejecting expert testimony that is too speculative”).
242 See Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 590 (1993) (“The adjective ‘scientific’ implies a grounding in the methods and procedures of science. Similarly, the word ‘knowledge’ connotes more than subjective belief or unsupported speculation. . . in order to qualify as ‘scientific knowledge,’ an inference or assertion must be derived by the scientific method.”).
243 Allensworth, supra note 9, at 829 (holding that “models are not scientific in the Popperian sense of being falsifiable; as inventions designed to perform a task, they are purposive rather than positive.”).
244 Todd, supra note 28, at 252 (explaining that “the relative clarity of the Daubert factors for the hard sciences become muddied when applied to the non-scientific choices of the modeler).”
245 Kaye & Freedman, supra note 82, at 272 (noting the general perception of statistical models as “marvel[s] of mathematical rigor”).
not an exact science.\textsuperscript{246} Models exhibit an “illusion of objectivity” that masks the integral role of the modeler’s subjective judgments,\textsuperscript{247} as pure theory and data alone cannot create a model.\textsuperscript{248} The combination of statistical techniques with human discretion thus makes modelling both a science and an art.\textsuperscript{249}

Perhaps the first choice a modeler makes is the methodology he wishes to use to achieve a given purpose, such as asset valuation.\textsuperscript{250} Multiple regression analysis is particularly popular for showing causation due to the method’s power in isolating the effects of independent variables on a target variable.\textsuperscript{251} However, established methodologies such as these do not guarantee admissibility\textsuperscript{252} and there are alternative methodologies that can achieve the same purpose.\textsuperscript{253}

Though they are not explicitly phrased as assumptions, model construction decisions regarding type of methodology, data, and variables are tacit assumptions.\textsuperscript{254} Choice of methodology implicitly assumes the appropriateness of that method for the task at hand,\textsuperscript{255} whereas choice of data assumes the similarity between a firm or market in a

\textsuperscript{246} Allensworth, \textit{supra} note 9, at 841 (describing how “scientifically acceptable choices are neither unique . . . nor objective”).

\textsuperscript{247} Hill et al., \textit{supra} note 15, at 334.

\textsuperscript{248} Morrison & Morgan, \textit{supra} note 72, at 15.

\textsuperscript{249} Allensworth, \textit{supra} note 9, at 829 (holding that the art of modeling exists where experts do not agree); Klock, \textit{supra} note 22, at 198 (stating that “The art of good model-building lies in the ability to assume well”); Morrison & Morgan, \textit{supra} note 72, at 31 (noting that good model-building, like an art or craft, involves “acquired skills in choosing parts and fitting them together”).

\textsuperscript{250} See Allensworth, \textit{supra} note 9, at 841; Hill et al., \textit{supra} note 15, at 338-39 (enumerating the various and “frequently subjective” choices involved in valuation methodologies).

\textsuperscript{251} Hill et al., \textit{supra} note 15, at 352.

\textsuperscript{252} Lopatka & Page, \textit{supra} note 10, at 690.

\textsuperscript{253} Allensworth, \textit{supra} note 9, at 841 (noting how modeling goals can be achieved through more than one method).

\textsuperscript{254} See Todd & Jewell, \textit{supra} note 40, at 302, 318.

\textsuperscript{255} Gavil, \textit{supra} note 241, at 876 (emphasizing the need for “fit” between a methodology and the facts of a case); Todd, \textit{supra} note 12, at 990 (stating that “the type of math to perform and the applicable valuation method are themselves artistic choices.”).
past study and those involved in the present case.\textsuperscript{256} These types of assumptions often only become apparent in their negation, that is, whenever opponents attack the modeler’s choices in methodology, data, or variables. Judges’ treatment of these challenges has historically been inconsistent: some courts have required that experts use a certain methodology (such as regression analysis)\textsuperscript{257} while other courts have held that choice of methodology is an issue of weight.\textsuperscript{258}

Another implicit assumption is a modeler’s choice in variables, which presumes the relevance of those included and the irrelevance of those excluded.\textsuperscript{259} Again, courts do not approach these challenges with consistency.\textsuperscript{260} In some cases, courts determined that omitted variable were issues of weight; in others, the omission of relevant variables caused the testimony to be excluded.\textsuperscript{261}

In addition to choosing appropriate methodology, data, and variables, modelers make a series of explicit simplifying assumptions.\textsuperscript{262} In litigation, these assumptions often involve similarity judgments between products and markets, as well as constructing alternate pasts where the defendant’s misconduct did not occur.\textsuperscript{263} Other types of

\textsuperscript{256} Todd & Jewell, supra note 40, at 298 (describing the underlying assumption in yardstick approaches to damages that “but for the anticompetitive behavior, plaintiff’s business would have performed like the comparator”); id. at 318 (noting a court’s rejection of growth projections based on tacit comparisons between TV markets).

\textsuperscript{257} Lopatka & Page, supra note 10, at 689.

\textsuperscript{258} Hill et al., supra note 15, at 313 (citing Popham v. Popham, 607 S.E.2d. 575, 576 (Ga. 2005)).

\textsuperscript{259} Mäki, supra note 82, at 248; Todd & Jewell, supra note 40, at 302 (describing how unfounded omissions involve a “tacit assumption [] that some important and relevant factor is unimportant and irrelevant.”).

\textsuperscript{260} Hill et al., supra note 15, at 353.

\textsuperscript{261} Id. (citing the court’s holding in Bazemore v. Friday, 478 U.S. 385 (1986) that omitted variables go to weight, not admissibility); Lopatka & Page, supra note 10, at 691 n.479 (citing, inter alia, Blue Dane Simmental Corp. v. Am. Simmental Ass’n, 178 F.3d 1035, 1040–41 (8th Cir. 1999) (finding an expert’s before-and-after model too “simplistic” to be admissible because it failed to account for other independent variables).

\textsuperscript{262} See generally, Mäki, supra note 36, at 328-29 (describing idealizing assumptions).

\textsuperscript{263} Todd & Jewell, supra note 40, at 298.
simplifying assumptions are needed to distill patterns or abstract salient features from a “chaotic reality.” These assumptions typically involve tradeoffs between accuracy, simplicity, and usefulness. These simplifying assumptions are those described by the assumptions typology, where certain factors are idealized or omitted for a second-order purpose that may be negligibility, applicability, or tractability.

Due to their subjective nature, simplifying assumptions are the elements most likely to be scrutinized in Daubert motions. Litigants often attack these simplifying assumptions as speculative or unrealistic, which prompts a highly ambiguous determination that appears to be guided primarily by “the predilections of the individual judge.”

Many simplifying assumptions cannot be falsified, such as whether a product or market is similar enough to the ones in the underlying studies and data. Speculating on what a plaintiff’s position would have been but-for the defendant’s wrongful conduct is also an exercise in reasoning rather than a verifiable fact. These types of assumptions regarding the plaintiff’s position in a counterfactual past also see mixed results from

264 Allensworth, supra note 9, at 862; Klock, supra note 22, at 196 (stating that “the goal is to abstract the salient features of reality without becoming mired in minutiae”).
265 Allensworth, supra note 9, at 832-833, 840; Klock, supra note 22, at 196 (noting that, like the construction of roadmaps, assumptions involve “aesthetically pleasing trade-off[s] between reality and abstraction”).
266 See supra Part II.B. (Musgrave-Mäki-Hindriks typology).
267 Hill et al., supra note 15, at 331-32 n.253 (claiming that these assumptions are the most understandable for non-expert counsel).
268 Lloyd, supra note 31, at 408.
269 Allensworth, supra note 9, at 840.
270 Todd & Jewell, supra note 40, at 298-300 (observing that unreasonable comparisons are a major category of assumptions that opponents frequently challenge).
271 Blair & Page, supra note 183, at 435-36 (emphasizing that due to the “multitude of potential influences on business conditions, a plaintiff cannot prove what would have happened with the same degree of certainty that it can prove what did occur”); Hill et al., supra note 15, at 335 (citing Gross v. Comm’r, 272 F.3d 333, 356 (6th Cir. 2001)) (calling the damages estimation process a “fiction”).
courts.\textsuperscript{272} Justifying these assumptions requires subjective judgments regarding “similarity,” “salience” and “credibility,” which, by their nature, cannot be expressed in mathematical or logical terms.\textsuperscript{273} The modeler should accordingly be able to articulate these justifications and defend his choice of assumptions.\textsuperscript{274}

Aside from these simplifying assumptions, there are also statistical assumptions that are not subject to a modeler’s “idiosyncrasies.”\textsuperscript{275} Regression, for example, assumes a linear relationship between the variables, as well as normally distributed and random error terms.\textsuperscript{276} Todd and Jewell note the importance of this distinction between statistical assumptions and artistic assumptions made by the econometrician in the construction of his model.\textsuperscript{277} For example, they observe the often overlooked distinction between omitted variable bias as a statistical issue and the omission of relevant variables as a fundamental flaw in model construction.\textsuperscript{278} The former limits the precision of a model and may skew the coefficient estimates, but can often be resolved with other statistical procedures.\textsuperscript{279} A violation of a statistical assumption is therefore “not likely to be fatal on its own.”\textsuperscript{280} The latter, however, is an artistic choice.\textsuperscript{281} An appropriately omitted variable may serve the

\textsuperscript{272} Todd, \textit{supra} note 28, at 236 (comparing the conflicting rulings about whether the “likelihood and extent” of business expansion (Polymer Dynamics, Inc. v. Bayer Corp. 2005 WL 1041197 (E.D.)) or consumer behavior (Nebraska Plastics, Inc. v. Holland Colors America, Inc., 408 F.3d 410, 416 (8th Cir. 2008)) are issues for the judge or jury to decide.).

\textsuperscript{273} Sugden, \textit{supra} note 61, at 4.

\textsuperscript{274} Todd, \textit{supra} note 28, at 239-40.

\textsuperscript{275} Allensworth, \textit{supra} note 9, at 839-40.

\textsuperscript{276} Sykes, \textit{supra} note 178, at 5-6.

\textsuperscript{277} Todd & Jewell, \textit{supra} note 40, at 290.

\textsuperscript{278} Id. at 290-93.


\textsuperscript{280} Todd & Jewell, \textit{supra} note 40, at 292.

\textsuperscript{281} Rubinfeld, \textit{supra} note 279, at 281 (describing how omitted variables involve “assumptions made going into the analysis, rather than conclusions that come out of the data.”).
purposes of isolation, since models cannot capture the vast complexity of the world.\textsuperscript{282} An inappropriate omission, however, can “easily invalidate any statistical results,” if a factor that the record suggests is relevant is excluded from the model.\textsuperscript{283}

Todd and Jewell also note that while opponents purport to attack the purely scientific or statistical elements of a model, most arguments invoke the lack of foundation or reasoning an expert has for his modeling choices.\textsuperscript{284} Essentially, opponents attack the artistic rather than the scientific elements of a model.\textsuperscript{285} As a result, the application of the \textit{Daubert} standard to these artistic choices is improper.\textsuperscript{286} The inconsistency arising from this improper application of standards is consequential, as the outcome of a case is frequently contingent on the admission or exclusion of expert testimony.\textsuperscript{287} Furthermore, large class actions and antitrust suits often involve eight- or nine-figure damages: estimates in \textit{Dover v. British Airways} ranged between $143 and $161 million.\textsuperscript{288}

3. \textbf{Proposed Solutions in Legal Scholarship}

Some legal commentators have attempted to illuminate this issue through various paradigms that center around the distinction between the judge’s domain of law, and the jury’s domain of facts. Allensworth states that models do not meet the criteria to be categorized as “facts,” and thus advocates that judges—ideally those with some basic

\begin{thebibliography}{9}
\item 283 Todd & Jewell, \textit{supra} note 40, at 292 (describing how poor choices in model construction cannot be fixed by statistical tools); \textit{see id.} at 312 (stating that failure to include a clearly relevant variable can make the entire model irrelevant).
\item 284 \textit{Id.} at 316, 319; \textit{see also} Hill et al., \textit{supra} note 15, at 352-53 (observing that the inclusion or exclusion of variables in regression models is a frequent point of contention).
\item 285 Todd & Jewell, \textit{supra} note 40, at 293.
\item 286 \textit{See} Todd, \textit{supra} note 28, at 252.
\item 287 Mnookin, \textit{supra} note 14, at 1569; Todd & Jewell, \textit{supra} note 40, at 282-83.
\item 288 321 F.R.D. 49, 57 (E.D.N.Y. 2017).
\end{thebibliography}
quantitative training—are best equipped to deal with model-based testimony.\textsuperscript{289} Casey and Simon-Kerr stand on the opposite end of the spectrum, equating expert testimony with that of lay witnesses, the evaluation of which requires no more than “run-of-the-mill fact-finding.”\textsuperscript{290} Some legal scholars see model-based testimony as a mixed issue of law and fact. For example, Kaye distinguishes between “legislative” and “adjudicative” considerations.\textsuperscript{291} The former involves facts that are external to the case such as the general acceptability of a certain methodology; these issues should be addressed by the judge.\textsuperscript{292} "Adjudicative” considerations such as failure to account for outliers, by contrast, are internal to the case and can be resolved by the jury.\textsuperscript{293}

Other legal scholars, however, reject this law-fact debate entirely. Allen and Pardo assert that the law-fact distinction has no epistemological or ontological grounding, and that in order to protect the domains of judge and jury, pragmatic conventions should take the place of abstract dichotomies.\textsuperscript{294} In order to be truly useful, these conventions should “import criteria and methods from the relevant scientific community” rather than pigeonhole disparate scientific disciplines into the existing legal framework.\textsuperscript{295}

\textbf{IV. A POTENTIAL SOLUTION BACKED BY ECONOMICS METHODOLOGY}

Recognizing this need for practical conventions, Todd proposes a functional framework that is based in economics methodology.\textsuperscript{296} This approach is in line with evidence law, since comments to FRE 702 instruct judges to look to the standards of the

\textsuperscript{289} Allensworth, \textit{supra} note 9, at 852.
\textsuperscript{290} Casey & Simon-Kerr, \textit{supra} note 11, at 1182.
\textsuperscript{291} Kaye, \textit{supra} note 31, at 1975.
\textsuperscript{292} \textit{Id.} at 1983-85.
\textsuperscript{293} \textit{Id.} at 2012-13.
\textsuperscript{294} Allen & Pardo, \textit{supra} note 31, at 1806-7.
\textsuperscript{295} Allensworth, \textit{supra} note 9, at 829.
\textsuperscript{296} Todd, \textit{supra} note 28, at 239, 282-90.
field in evaluating expert testimony.\textsuperscript{297} The Musgrave-Mäki-Hindriks typology of assumptions describes how assumptions should be evaluated relative to their second-order purpose, since all models have false first-order assumptions.\textsuperscript{298} Mäki’s types of realism illuminate how assumptions that are unrealistic in one sense (\textit{e.g.}, false) can still be valid if they are realistic in another sense (\textit{e.g.}, plausible).\textsuperscript{299}

Todd synthesizes and adapts these typologies for use in the context of litigation.\textsuperscript{300} Perhaps most importantly, judges should evaluate assumptions according to their purpose and context, rather than in isolation.\textsuperscript{301} The second-order assumption clarifies this purpose, which may be negligibility, tractability, or applicability.\textsuperscript{302} It is crucial that modelers be specific about the second-order purpose of their assumptions,\textsuperscript{303} as well as be willing to defend these choices in the event they are challenged.\textsuperscript{304} Judges should focus their admissibility decisions on whether the second-order assumption is appropriately realistic, rather than exclude models with unrealistic first-order assumptions.\textsuperscript{305} If the second-order assumption is materially disconfirmed by the evidence, the judge can exclude the testimony or require the expert to fix the assumption.\textsuperscript{306} For example, the judge may exercise his gatekeeping function when an expert excludes a variable for negligibility purposes, but the record shows that the factor

\begin{itemize}
\item \textsuperscript{297} Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 593-94 (1993) (listing general acceptance by the relevant field as one factor judges may consider in their admissibility rulings); Todd, supra note 28, at 237 (citing FED. R. EVID. 702 Committee Notes on Rules—2000 Amendment).
\item \textsuperscript{298} Todd, supra note 28, at 282; see supra Part II.B.
\item \textsuperscript{299} Todd, supra note 28, at 284; see supra Part II.B.
\item \textsuperscript{300} Todd, supra note 28, at 282-91.
\item \textsuperscript{301} Id. at 290.
\item \textsuperscript{302} Id. at 282.
\item \textsuperscript{303} Id. at 287.
\item \textsuperscript{304} Id. at 282.
\item \textsuperscript{305} Id. at 292.
\item \textsuperscript{306} Id.
\end{itemize}
is actually non-negligible.\textsuperscript{307} Lack of evidence, as opposed to disconfirmation by evidence, is not necessarily fatal to an assumption’s validity.\textsuperscript{308} After all, modelers must grapple with multiple “unknowns and unobservables” in constructing models that simplify a complex reality.\textsuperscript{309} Assumptions therefore may be justified for tractability purposes, in order to handle this lack of evidence or data.\textsuperscript{310}

If a modeler has no explanation for an assumption, the judge may exclude the testimony.\textsuperscript{311} In cases where the modeler can both articulate the purpose for his assumptions, and the stated purpose is not disconfirmed by evidence, the judge can admit the model to the jury.\textsuperscript{312} Jurors will then use their collective common sense and experience to assess realismness as plausibility, as well as the coherence of the model with the rest of the evidence.\textsuperscript{313}

Todd’s synthesis between the two typologies arms judges with the vocabulary to approach a model’s assumptions with a degree of clarity that has historically been lacking.\textsuperscript{314} The mechanics of the framework also help sketch a reasonable boundary between admissibility and weight with a threshold that does not tend to either extreme.\textsuperscript{315} The requirement that second-order assumptions be meaningfully connected to reality prevents indiscriminate acceptance of invalid models.\textsuperscript{316} Otherwise, judges need not

\begin{footnotesize}
\begin{itemize}
  \item\textsuperscript{307} Id. at 286-87 (citing \textit{in re} Live Concert Antitrust Litig., 863 F. Supp. 2d 966, 971-81) (an expert did not account for the effects that the advent of downloadable music might have on concert ticket prices. If the exclusion of this variable was a negligibility assumption, it would be invalid because evidence showed that downloadable music significantly affected ticket prices).
  \item\textsuperscript{308} Todd, \textit{supra} note 28, at 257 (arguing that scenarios projecting a counterfactual past (and thus lacking explicit evidentiary support) are issues of plausibility that the jury can evaluate).
  \item\textsuperscript{309} Id. at 287.
  \item\textsuperscript{310} Id. at 297.
  \item\textsuperscript{311} Id. at 282.
  \item\textsuperscript{312} Id.
  \item\textsuperscript{313} Id. at 284.
  \item\textsuperscript{314} Id. at 292.
  \item\textsuperscript{315} Id. at 284.
  \item\textsuperscript{316} Id.
\end{itemize}
\end{footnotesize}
exclude model-based testimony where the only realism issue is the question of plausibility, which can be decided by a jury.\textsuperscript{317}

Although the framework theoretically provides clarity to admissibility rulings, it is unclear whether the framework holds in practice. Todd samples contentious assumptions from several different cases but does not go into depth on any one case.\textsuperscript{318} *Dover v. British Airways* presents an appropriate opportunity to test the framework’s utility on an entire case. First, the case involves dueling experts, a dynamic that has not previously been explored by Todd in his application of the framework. The presence of two experts who reached opposite conclusions regarding the correlation between fuel prices and YQ charges places increased pressure on the judge to confront alternate choices of methodology.\textsuperscript{319} A “battle of the experts” also raises unique questions about the interaction between objective scientific requirements on which experts agree versus artistic choices that may be up for debate.\textsuperscript{320} Moreover, Judge Dearie’s Expert Ruling provides ample detail about the individual challenges to each expert’s testimony;\textsuperscript{321} this detail yields a more in-depth analysis than would otherwise be permitted. Finally, a high-profile defendant—and the concomitant massive damages estimates—helps illustrate the relevance and importance of these admissibility determinations. Judge Dearie’s Expert Ruling details the challenges to expert testimony and explains the rationale behind his admissibility decisions; this document provides the basis for this analysis.

**A. Dover v. British Airways: Background**

\textsuperscript{317} *Id.* at 292.
\textsuperscript{318} Todd, *supra* note 28, at 282-91.
\textsuperscript{319} See *infra* Part IV.B., C.
\textsuperscript{320} See *infra* Part V.
British Airways had a frequent flyer program called the Executive Club, in which members could accumulate points ("Avios") by flying with British Airways, renting cars, and staying in certain hotels. These points could then be redeemed for reward flights with British Airways. The Executive Club contract explicitly granted the airline the right to impose fuel surcharges; in exercising this right, the airline’s fuel surcharge committee used its cost of fuel in 2003-2004 as the baseline for these charges (internally referred to as "YQ charges"). Frequent flyer members alleged that this baseline was arbitrary and yielded YQ charges that were not “substantively or temporally relevant to the actual cost or price of fuel.” As a result, frequent fliers claimed that British Airways breached the Executive Club contract, and moved for class certification of all members who paid the YQ charges for Avios-redeemed flights between November 9, 2006 and April 17, 2013. Among this class were four representative plaintiffs: Russell Dover, Suzette Perry, Cody Rank, and Henry Horsey. Each party enlisted testimony from economics experts to testify regarding the correlation between YQ charges and the cost of fuel. Plaintiff’s expert Jonathan Arnold was an economist from the Chicago Economics Corporation, and Andrew Hildreth was an econometrician retained by the defendant, British Airways. Plaintiffs also provided testimony from Robert Kokonis, an expert in the airline industry who provided relevant input to the challenges against Arnold’s damages models.

323 Id.
324 Id. at 52-53.
325 Id. at 53.
326 Id.
328 Id. at 460, 463.
329 Id. at 459, 462.
B. Plaintiff’s Expert Testimony

Plaintiff’s expert Jonathan Arnold asserted in his reports that the level of YQ charges bore “no close relationship” with the price of fuel over time.\textsuperscript{330} British Airways attacked this opinion as unreliable because it was not based on a regression “or some other peer-review or published studies.”\textsuperscript{331} Instead, his methodology involved a quarter-by-quarter comparison of YQ charges and fuel prices, as well as a comparison of the relative growth of the two figures across time.\textsuperscript{332} Judge Dearie accepted Arnold’s methodology as “reasonable and sufficiently reliable,” and references three cases in succession as self-evident support for this decision:

\begin{quote}
Zeraga Ave. Realty Corp. v. Hornbeck Offshore Transp., LLC, 571 F.3d 206, 213–14 (2d Cir. 2009) (“[A] trial judge should exclude expert testimony if it is speculative or conjectural or based on assumptions that are ‘so unrealistic and contradictory as to suggest bad faith’ or to be in essence ‘an apples and oranges comparison.’” (quoting Boucher v. U.S. Suzuki Motor Corp., 73 F.3d 18, 21 (2d Cir. 1996)). Any arguable weakness in this methodology, or the possibility that relevant factors were omitted, goes to weight, not admissibility. See id. at 214 (“[C]ontentions that the assumptions [of an expert witness] are unfounded go to the weight, not the admissibility, of the testimony.”) (alteration omitted) (quoting Boucher, 73 F.3d at 21)).\textsuperscript{333}
\end{quote}

The inherent contradiction of current admissibility precedent becomes clear here. Judges may pull in quotes ad hoc to support whichever conclusion they decide, since support for either outcome can be found in previous rulings. Referencing Boucher, Judge Dearie notes that any arguable weakness and any contention that assumptions are unfounded are issues of weight, not admissibility.\textsuperscript{334} Such statements seem to advocate for a threshold

\textsuperscript{330} Id. at 460.
\textsuperscript{331} Id. at 461.
\textsuperscript{332} Id.
\textsuperscript{333} Id.
\textsuperscript{334} Boucher v. U.S. Suzuki Motor Corp., 73 F.3d 18, 21 (2d Cir. 1996).
that is so small as to be effectively non-existent. On the other hand, Zeraga describes a situation in which a judge may exercise his gatekeeping function, which involves instances where testimony is “speculative or conjectural.”

Ambiguity is also pervasive: it is unclear at what point “unfounded” assumptions become too “unrealistic” to be admissible. Furthermore, essentially synonymous terms are used to justify opposite conclusions: assumptions that are “unfounded” are issues of weight, but those that are “conjectural” raise admissibility concerns. A critical look at Judge Dearie's rationale thus demonstrates just how nebulous the basis for admissibility rulings can be.

While the framework does not explicitly provide guidelines on challenges to choice of methodology, the methodological literature would likely support admission of the testimony. So long as Arnold can justify the appropriateness of his method, Arnold’s testimony should be admitted so that his story may reach its intended audience, the jury.

British Airways raised similar challenges in regards to Arnold’s damages model. Party experts agreed that, assuming breach of contract, “the amount of damages to the class would equal the difference between the amount class members paid in YQ charges and the amount they would have paid had British Airways adopted an alternative, commercially reasonable course of conduct in compliance with the Contract.” Arnold proposed two alternatives for how British Airways could have behaved in this fictional past: either the airline could have adjusted its fuel surcharge on a quarterly basis

336 See Todd, supra note 28, at 1039-40 (concluding that if an economist’s story adequately explains their artistic choices, the “gatekeeper should [...] step aside so that the factfinder can hear the story.”).
or it could have operated without a fuel surcharge at all. British Airways criticized the models as presenting an “unrealistic ex post view” with assumptions that are “speculative.” Judge Dearie offered a brief response to these challenges, referencing the same quote as before:

This objection alone is not grounds for excluding his testimony. See Zeraga, 571 F.3d at 214 (explaining that exclusion is warranted “where an expert’s opinion is speculative or conjectural or based on assumptions that are ‘so unrealistic and contradictory as to suggest bad faith .... ’ ” (quoting Boucher, 73 F.3d at 21))

Both the defendant and the court see an overly unrealistic assumption as grounds for exclusion. However, the judge’s dismissal of the airline’s challenges indicates that the two disagree regarding what is unrealistic, if it is binary, or, if it is a continuum, when an assumption passes the threshold into being too unrealistic. An exploration of Mäki’s different types of realisticness may illuminate this issue.

If by “unrealistic ex post view” defendants mean unrealistic in the sense of implausible, then the testimony should be admitted because the jury can make credibility judgements based on their common sense and collective experiences.

British Airways also argues that these proposals are inadmissible because they lack foundation . . . Kokonis, however offers a basis for Arnold’s view . . . (stating, based on his experience in the airline industry, that “it is not commercially unreasonable to manage fuel costs without a YQ charge.”)

One may presume the defendants mean lacking evidentiary foundation, and thus view realisticness in the sense of empirical confirmation. A lack of evidence, however,

338 Id.
339 Id.
340 Id.
341 See supra text accompanying notes 187-91, 312-17 (issues of plausibility can and should be weighed by the jury).
342 Dover, 254 F. Supp. 3d at 462 (citing Kokonis’ May report).
343 See supra text accompanying notes 156-63 (describing Mäki’s types of realisticness).
is not equivalent to disconfirmation by evidence.\textsuperscript{344} Because it is not disconfirmed, one may not say that Arnold’s assumption is unrealistic in this sense.\textsuperscript{345} To the contrary, evidence does exist to corroborate the statement in the form of Kokonis’ expert testimony.\textsuperscript{346}

Absent this supporting testimony, the lack of evidence would still be unproblematic because it is the very reason why the assumptions were imposed in the first place.\textsuperscript{347} In this case, Arnold’s assumptions were imposed for the purposes of empirical tractability. One can infer this second-order purpose because the data needed to calculate damages are unobservable;\textsuperscript{348} they exist only in a counterfactual past where British Airways complied with the contract.\textsuperscript{349} To make the analysis tractable, therefore, Arnold must incorporate a hypothetical but-for condition in order to have a basis for comparison with the plaintiff’s current position.\textsuperscript{350} He accomplishes this through the idealization (quarterly adjustment) and omission of YQ charges.\textsuperscript{351} Thus, the formulation becomes:

First-order assumption: Commercially reasonable alternatives include British Airways adjusting its fuel surcharges on a quarterly basis, or operating without fuel surcharges entirely.

Second-order assumption: These assumptions were imposed for empirical tractability purposes because the data needed to calculate damages are unobservable.

\textsuperscript{344} See supra text accompanying notes 308-10.
\textsuperscript{345} Id.
\textsuperscript{346} Dover, 254 F. Supp. 3d at 462.
\textsuperscript{347} See supra text accompanying notes 308-10 (modelers frequently need to incorporate factors for which they lack evidence).
\textsuperscript{348} See supra text accompanying notes 132-36 (listing the data conditions that may justify empirical tractability assumptions).
\textsuperscript{349} Blair & Page, supra note 183, at 435-36 (describing how plaintiffs must “construct and support a scenario of events in the but-for world.”).
\textsuperscript{350} See supra notes 182-83, 271 (experts necessarily craft hypothetical scenarios in damages estimations).
The framework dictates that judges evaluate assumptions relative to their second-order purpose, rather than assess their realism at face-value.\textsuperscript{352} The proper question for Judge Dearie to consider, therefore, is not whether the proposed alternatives are commercially reasonable, but whether the model was actually intractable without these first-order assumptions.\textsuperscript{353} The answer is relatively clear in this case because, by definition, damages estimates hypothesize about what the plaintiff’s position would have been but-for the defendant’s wrongful conduct.\textsuperscript{354}

Since there is no evidence that controverts the second-order tractability assumption, Arnold’s model is admissible.\textsuperscript{355} The jury can then assess realismness as plausibility of the first-order assumptions, that is, decide whether quarterly adjustment or operating without fuel surcharges are reasonable alternatives given the expert’s need for tractability.\textsuperscript{356} This decision will be informed by their experiences as business-owners and consumers, as well as their common sense and knowledge of how the world works.\textsuperscript{357}

Judge Dearie ultimately made the proper decision in admitting the damages model, but his rationale conflated admissibility with weight. By citing Kokonis’ testimony as support for Arnold’s assumptions, Judge Dearie muddles the basis for the model’s admissibility: the model is acceptable not because evidence supports the assumption, but because the question of the reasonability of a first-order assumption is for the jury to answer, not the judge.\textsuperscript{358} Supporting evidence in the form of Kokonis’

\textsuperscript{352} See supra text accompanying notes 301-8 (the judge should limit his analysis to whether the second-order assumption is disconfirmed by evidence).
\textsuperscript{353} Id.
\textsuperscript{354} See supra text accompanying notes 182-83, 271.
\textsuperscript{355} See supra text accompanying notes 312-13.
\textsuperscript{356} Id.
\textsuperscript{357} See supra text accompanying notes 189-91, 197.
\textsuperscript{358} See supra text accompanying notes 301-10 (judges should focus their analyses on the realismness of second-order assumptions, not first-order assumptions).
testimony may strengthen the plausibility of the model in the juror’s eyes, but evidentiary support for first-order assumptions is not a precondition to admissibility.\textsuperscript{359}

Fortunately, the recognition of this distinction becomes clearer as Judge Dearie continues. Judge Dearie cites the \textit{Daubert} case in recognizing that the “presentation of contrary evidence” in conjunction with “vigorous cross-examination” are generally sufficient means for the jury to evaluate models critically.\textsuperscript{360} British Airways will likely raise the same arguments to the jury during cross-examination and Arnold will be forced to defend his choice of assumptions.\textsuperscript{361}

\textbf{C. Defendant’s Expert Testimony}

Defendant British Airways enlisted the testimony of econometrician Andrew Hildreth. The expert proffered several regression analyses that supposedly showed a “high degree of correlation (over 70 percent)” between the airline’s YQ charges and the price of fuel over time.\textsuperscript{362} The results of his model would suggest that British Airways had in fact complied with the contract, since their surcharges were reasonably related to fuel prices. However, plaintiffs challenged the reliability of Hildreth’s testimony, alleging that his failure to account for the non-stationarity of the underlying data rendered the model’s results “spurious.”\textsuperscript{363} Non-stationarity is a property of some time-series data, in which statistical parameters such as mean and variance change over time.\textsuperscript{364} “Colloquially, non-stationary data is said to exhibit a ‘random walk,’ such that knowing

\begin{footnotesize}
\begin{itemize}
\item\textsuperscript{359} See \textit{supra} text accompanying notes 132-36, 308-10 (one purpose of tractability assumptions is to account for variables that lack data).
\item\textsuperscript{360} Dover v. British Airways, 254 F. Supp. 3d 455, 462 (E.D.N.Y. 2017) (citing Daubert, 509 U.S. at 596, 113 S.Ct. 2786).
\item\textsuperscript{361} See \textit{supra} text accompanying notes 204-5.
\item\textsuperscript{362} Dover, 254 F. Supp. 3d at 462.
\item\textsuperscript{363} Id. at 463.
\item\textsuperscript{364} Id. (citing reports from both Arnold and Hildreth).
\end{itemize}
\end{footnotesize}
its value today tells us little or nothing about its value tomorrow.”365 Experts from both sides agreed that performing regression analysis on non-stationary data can yield spurious results, such as showing false correlation between unrelated variables.366

In response to these critiques, Hildreth claimed that non-stationary data may still be valid for use in a regression if the data are cointegrated.367 Cointegration refers to two variables in a time-series (YQ charges and fuel prices, for example) that exhibit a long-run equilibrium.368 Hildreth claimed to have tested the data for cointegration using the Engle-Granger method.369 However, plaintiffs presented evidence of the contrary: Engle himself rejected the expert’s finding that the variables were cointegrated, even stating that Hildreth used another method entirely.370 As a result, Engle concurred with Arnold that the results of Hildreth’s regression are “statistically meaningless.”371

While these challenges concern alleged statistical errors rather than competing notions of realism, the framework may still be useful for analysis. The element of Hildreth’s model under scrutiny may be phrased as an applicability assumption:

First order assumption: Regression analysis is a valid method for demonstrating the correlation between fuel prices and YQ charges.

Second order assumption: If the data are cointegrated, then regression analysis of non-stationary data (such as fuel prices and YQ charges) yields valid results.

According to the framework’s specifications, Judge Dearie was proper in evaluating the realism of the second-order assumption rather than that of the first-order

365 Id. at 464.
366 Id. at 463-64.
367 Id. at 464.
368 Id.
369 Id.
370 Id. at 464-65.
371 Id.
assumption.\textsuperscript{372} He did not call into question whether the choice of method (regression analysis) was acceptable in a general sense, but instead considered how evidence controverted the \textit{applicability} of that method. Plaintiffs demonstrated that the domain condition was not satisfied, i.e., the data were not cointegrated. Thus, the second-order assumption is disconfirmed by evidence, which is grounds for exclusion because the use of regression analysis outside its applicable domain renders the model invalid.\textsuperscript{373}

Judge Dearie declined to make an admissibility decision based solely on the parties’ submissions and called for an evidentiary hearing to better evaluate the validity of Hildreth’s testimony.\textsuperscript{374} However, the defense withdrew the expert before an evidentiary hearing could be held.\textsuperscript{375} The case subsequently moved to settlement, with class members collectively receiving up to $63 million in compensatory damages.\textsuperscript{376} This result reinforces how the exclusion of expert testimony is outcome determinative: without a model that shows correlation between fuel prices and YQ charges, British Airways lacked a critical thread in their narrative of valid fuel surcharges.\textsuperscript{377} This, in conjunction with the admission of plaintiff expert testimony, would have led to a loss at trial, which potentially explains why the airline opted for a settlement.\textsuperscript{378}

\textbf{V. FRAMEWORK ASSESSMENT AND DISCUSSION}

The theoretical framework certainly provides greater analytical depth to the evaluation of plaintiff expert Arnold’s testimony. By approaching the assumptions of

\begin{itemize}
\item \textsuperscript{372} See supra text accompanying notes 301-6.
\item \textsuperscript{373} See supra text accompanying notes 306-11.
\item \textsuperscript{375} Dover v. British Airways, 2017 WL 4358726, at *2 (E.D.N.Y. Sept. 29, 2017).
\item \textsuperscript{376} Dover v. British Airways, 323 F.Supp.3d 338, 346 (E.D.N.Y. 2018).
\item \textsuperscript{377} See text accompanying notes 14-20.
\item \textsuperscript{378} Id. (describing how exclusion of one party’s expert can increase the relative weight of the opponent’s testimony).
\end{itemize}
quarterly adjustment and zero YQ charges at face-value, Judge Dearie risked making a credibility determination that usurped the jury’s role. The framework prevents this outcome by distinguishing between first- and second-order assumptions, as well as describing the various ways these assumptions may be realistic or unrealistic. An understanding of how these two typologies intersect would have allowed Judge Dearie to navigate his admissibility decision with consistency and clarity. Rather than evaluate whether the first-order assumption is realistic as plausible, Judge Dearie could have limited his analysis to whether the second-order purpose was unrealistic as disconfirmed by evidence.

Furthermore, the application of Mäki’s typology of realisticness clarifies the previously hazy conceptions of what is “realistic” versus “unrealistic.” If defendants had been required to articulate exactly what kind of realisticness Arnold failed to meet, the judge could have made a less ambiguous determination. If British Airways had attacked the assumptions about YQ charges as unrealistic in the sense of implausible, these challenges would clearly be issues for the jury, whose job is to discern credibility. Unrealistic in the sense of confirmation and disconfirmation is a stronger claim, but lack of evidentiary support for a first-order assumption is still not grounds for exclusion because all models involve unrealistic first-order assumptions to simplify the real-world.\(^{379}\) The presentation of contrary evidence regarding the second-order tractability assumption, however, may warrant exclusion.\(^{380}\) If the contract had stipulated a precise method British Airways must use to set fuel surcharges—perhaps automatically

\(^{379}\) See Klock, supra note 22, at 196.

\(^{380}\) Hindriks, supra note 98, at 410 (describing how the first-order assumptions are often false or unrealistic, but second-order assumptions must be realistic).
calculated and directly related to the cost of fuel—the data concerning plaintiffs’ but-for position might be observable and the empirical tractability assumption would no longer be valid.\textsuperscript{381} Plaintiff’s expert Arnold could have looked at past fuel prices and applied the method mentioned in the contract to calculate what plaintiffs should have paid but-for the breach of contract. The availability of data in this hypothetical scenario would have invalidated the empirical tractability assumptions, since the damages model would actually be tractable without them. In reality, the contract did not specify how fuel surcharges were to be calculated, so Arnold had to impose tractability assumptions regarding how British Airways should have acted in the counterfactual past.

Application to defendant’s expert Hildreth was not as straightforward, but highlights an important distinction. Judge Dearie’s decision to hold an evidentiary hearing for Hildreth’s regression was due to a perceived fundamental difference between the challenges to each expert’s testimony. “Unlike the parties’ arguments respecting the other experts, the possibility that Hildreth’s analysis may be spurious and statistically meaningless goes to the heart of the Supreme Court’s concerns in \textit{Daubert} and \textit{Kumho Tire}.”\textsuperscript{382} This comment indicates Judge Dearie’s subtle awareness that economic modeling is both science and art.\textsuperscript{383} The recognition that Arnold’s simplifying assumptions were subjective and artistic choices was fairly unambiguous. Recall that constructing a “but-for” world is an exercise in reasoning rather than a factual

\textsuperscript{381} See \textit{supra} text accompanying notes 132-36; see also Todd, \textit{supra} note 28, at 297 (citing Neb. Plastics, Inc. v. Holland Colors Americas, Inc., 408 F.3d 410, 416, 416 n.2 (8th Cir. 2005)) (describing a case where an expert imposed an assumption under the guise of tractability, namely that all siding panels would fade and thus be subject to warranty claims. However, historical data for this factor existed that the expert could have used, thus disconfirming the tractability assumption).


\textsuperscript{383} See \textit{supra} Part III.C.
The science of statistics does not prescribe how Arnold may simplify reality or project a counterfactual past. Further, the use of natural language makes the jury capable of assessing the plausibility of the expert’s propositions. Aided by their collective common sense and experience, jurors can decide whether Arnold’s model depicts a world that could be real. The expert, of course, will have to convince his audience of the similarity between his model and reality and persuade them to make the “inductive leap” required to accept his conclusions. Though Judge Dearie did not articulate this distinction in these terms, his ultimate decision suggests an understanding that the plausibility of artistic assumptions are issues of weight for the jury.

By contrast, challenges to Hildreth’s testimony prompted a separate kind of inquiry. Judge Dearie reasoned that the technical nature of these challenges—as opposed to challenges based on logic and reasoning—warranted a more in-depth treatment. The question becomes whether this assessment was correct, and consequently, to what extent the theoretical framework can apply.

Recall Todd & Jewell’s distinction between omitted variable bias as a statistical issue versus omitted variables as flaws in model construction. The former involves a violation of a linear regression assumption that the error term is random. This is

---

384 See supra text accompanying notes 269-73.
385 See supra text accompanying notes 245-49, 269-74.
386 See supra text accompanying notes 196-203 (experts use stories to communicate a model and its assumptions to a lay audience).
387 See supra Part III.B.; see also Sugden, supra note 59, at 25, 28 (describing models as credible counterfactual worlds that could conceivably be true, given a general understanding of how the world works).
388 See supra text accompanying notes 77-81.
389 See supra Part IV.A.
390 Dover v. British Airways, 254 F. Supp. 3d 455, 465 (E.D.N.Y. 2017) (noting how evidentiary hearings are “highly desirable” and “commonly held in cases like this one that involve expert testimony on complex scientific or economic topics.”).
391 Todd & Jewell, supra note 40, at 290-93.
392 Sykes, supra note 178, at 23-24.
because the influence of an independent variable on a dependent variable becomes reflected in the error term, making these errors systematic rather than random.\textsuperscript{393} Similarly, omitted variable bias results in overestimated coefficient estimates.\textsuperscript{394} Though these problems are “scientific” in nature, they do not necessarily ruin a model’s utility, and may only decrease the model’s goodness of fit.\textsuperscript{395} The latter conception of omitted variables, by contrast, constitutes an artistic choice that may be a “fatal flaw[] in the model’s construction.”\textsuperscript{396} Omitting a variable that the record suggests is relevant can make the entire model irrelevant for its purpose.\textsuperscript{397}

It is not immediately clear under which conception Hildreth’s testimony should be placed. One on hand, plaintiff’s challenges may concern purely statistical issues, akin to the former conception of omitted variable bias that often can be fixed and may only weaken precision. Alternatively, Hildreth may have made poor choices in model construction that rendered the entire model invalid.

Plaintiff’s challenges to the expert’s model concerned his choice of methodology in relation to the type of data he used. Those challenges hinged on whether the data exhibited certain properties (stationarity at first, then cointegration) that would allow a regression analysis to yield valid results.\textsuperscript{398} The technical complexity of these challenges may suggest that Hildreth’s model exhibits statistical and thus purely “scientific” flaws, those which \textit{Daubert} aims to prevent and which are distinct from the framework’s

\textsuperscript{393} Sykes, supra note 178, at 24-27; see also Todd & Jewell, supra note 40, at 291.
\textsuperscript{394} Sykes, supra note 178, at 25-27.
\textsuperscript{395} Id.; Todd & Jewell, supra note 40, at 290-92.
\textsuperscript{396} Todd & Jewell, supra note 40, at 291.
\textsuperscript{397} Id. at 312.
\textsuperscript{398} See supra Part IV.C.
intended use.\textsuperscript{399} Since the alleged flaws concerned certain data properties, Hildreth’s assumptions perhaps should be treated more like statistical assumptions, which often concern data properties such as linearity and normally distributed error terms.\textsuperscript{400} Sometimes, the violation of these statistical assumptions may be fairly innocuous. After all, “owing to the nature of economic relationships and the lack of controlled experimentation, these (statistical) assumptions are seldom met.”\textsuperscript{401} One can still accept the general conclusions of the model to help answer, although with less confidence than if all statistical assumptions had been met.\textsuperscript{402} Thus, the model may still be useful in helping the trier of fact answer a certain question.

In Hildreth’s case, however, the alleged error was material to the purposes for which the model was designed. Regression analysis applied to non-stationary and non-cointegrated data may yield “spurious” results such as false correlation.\textsuperscript{403} When the purpose of the model is to establish correlation between fuel surcharges and the price of jet fuel, and false correlation is a potential consequence of the statistical error, the model fails at achieving its purpose. In this case, the judge would be proper in exercising his gatekeeping function, either by requiring that Hildreth fix the issue or excluding his testimony altogether.

Alternatively, Hildreth’s errors may be construed as poor artistic choices to which the framework can be applied. Recall that model construction decisions regarding type of

\textsuperscript{399} See Todd, \textit{supra} note 28, at 249-52 (noting how statistical assumptions can be tested empirically for validity but artistic assumptions cannot, thus creating confusion among courts).

\textsuperscript{400} Allensworth, \textit{supra} note 9, at 844.

\textsuperscript{401} \textsc{Peter Kennedy}, \textit{A Guide to Econometrics} 25, 1 (6th ed. 2008).

\textsuperscript{402} Rubinfeld, \textit{supra} note 279, at 322.

\textsuperscript{403} Clive Granger & Peter Newbold, \textit{Spurious Regressions in Econometrics}, 2 \textit{J. Econometrics} 111, 112–14 (1974) (explaining the phenomenon of “spurious” regressions in time series data, that is, regressions that show a false correlation between unrelated variables).
methodology, data, and variables are tacit assumptions. This alternative framing would more clearly fit within the assumptions typology.

Hildreth’s use of regression analysis involved an implicit assumption regarding the appropriateness of that method for showing correlation between fuel surcharges and the cost of jet fuel. The second-order assumption restricted the application of that method to instances where the nonstationary data are cointegrated. Plaintiffs alleged that his combination of regression and non-stationary data could yield spurious results that were “meaningless as a matter of statistics.” Lacking the technical knowledge to make a decision based on the parties’ submissions alone, Judge Dearie called for an evidentiary hearing. This decision stemmed from a fear about the jury’s incapacity to parse the statistical merits of Hildreth’s model.

Had the theoretical framework been applied, the evidentiary hearing may not have been necessary. If Hildreth had been unable to defend his choice of methodology, this lack of a “story” would be grounds for exclusion. While experts have discretion in the construction of their models, their choices must be grounded by a second-order purpose that connects their model to reality in a meaningful way. Hildreth initially justified his choices through an applicability assumption that would have made regression analysis a valid method. The presentation of evidence showing that Hildreth violated the domain

---

404 See supra text accompanying notes 254-61.
406 Id. at 465 (considering whether Hildreth’s testimony is the very kind of “unsound science” that should trigger the judge’s gatekeeping role).
407 Todd, supra note 28, at 285-86 (stating that an economist’s story necessarily involves explanations for their assumptions, therefore “courts need only admit expert testimony if the modeler has a story for the jury.”).
408 Id. at 270; see supra Part II.B.
409 See supra Part IV.C.
of applicability means that the second-order assumption is unrealistic in the sense of disconfirmation, making his model invalid and excludable.\textsuperscript{410}

Therefore, without having to know whether regression analysis can actually yield valid results with non-stationary and non-cointegrated data, the judge could have looked to how Hildreth’s applicability assumption was supported or contradicted by the record and made his decision on this basis. Approaching Hildreth’s issues as poor choices in model construction—as opposed to strictly scientific flaws—permits an evaluation of expert testimony that does not require perfect knowledge of statistical requirements and conventions. This type of approach comprises the most frequent basis for exclusion of expert testimony.\textsuperscript{411} Rather than attack purely statistical problems, opponents and courts have instead seized upon the lack of justification or support for the expert’s artistic choices.\textsuperscript{412}

The framework thus aligns with how courts have historically approached challenges to expert testimony. Though Todd and Jewell only make claim to a positive rather than normative analysis,\textsuperscript{413} it is a strength of the framework that it would not fundamentally change how courts address contentious issues. After all, the goal is to give judges (a “lay audience” with regards to econometric principles) a set of guidelines that do not require them to be experts in statistics themselves. Though the framework’s appropriateness for Hildreth’s testimony is initially ambiguous, a closer look reveals that it can help resolve challenges that straddle the scientific and artistic aspects of model-

\textsuperscript{410} See supra Part IV.C.
\textsuperscript{411} Todd & Jewell, supra note 40, at 318 (noting that “though courts cite to problems arising from the violation of regression assumptions like omitted variable bias, those courts excluded expert testimony not because of statistical problems but because of poor choices in model construction.”).
\textsuperscript{412} Todd & Jewell, supra note 40, at 314-15.
\textsuperscript{413} Id. at 319.
building. Therefore, the framework affords judges the vocabulary needed to address a variety of complex issues from a standpoint that is familiar to litigation: justification for assumptions (specifying second-order purpose), argumentation in defending these choices (both implicit and explicit), and an eye to how the record supports or controverts these arguments.  

VI. CONCLUDING THOUGHTS

While the framework has wide applicability, it could benefit from additional guidelines that help courts distinguish between attacks to statistical issues versus attacks to choices in model construction. An awareness of the dual-identity of models as both art and science would be the first step to making this distinction. Increased specificity from opponents regarding the precise objects of their attack (e.g., omitted variable bias vs. omission of relevant variables) could also prevent future conflation of the two types of issues. Finally, understanding that models involve many tacit assumptions—such as choice of methodology, data, and variables—can expand the framework’s applicability to more general issues. Application to Arnold’s damages models confirmed the framework’s utility for evaluating internal and explicit assumptions whose realisticness is at issue. Hildreth’s case demonstrated that the framework is also useful when applied to choices that are external to a model’s construction, such as type of methodology and variables. Once these tacit assumptions are phrased explicitly as a pair of first- and second-order assumptions, the judge may evaluate the second-order assumption in light of the available evidence. Therefore, the theoretical framework—in conjunction with a

414 See id. at 283.
firm grasp on modeling as a science and art—can provide more precision and consistency to how courts currently approach admissibility rulings on economic models.
Bibliography

**PRIMARY SOURCES**

**Statutes**

FED. R. EVID. 401.

FED. R. EVID. 402.

FED. R. EVID. 403.


**Cases**


Blue Dane Simmental Corp. v. Am. Simmental Ass’n, 178 F.3d 1035 (8th Cir. 1999).


Gross v. Comm’r, 272 F.3d 333 (6th Cir. 2001).
Nebraska Plastics, Inc. v. Holland, 408 F.3d 410 (8th Cir. 2005).


SECONDARY SOURCES

Economics


Legal


