Antitrust Models in the Courtroom
A Methodological Appraisal[*]

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Abstract

The paper deals with the difference between what makes a successful model in the economics literature and what makes it so in the real world. In particular, I focus on the troubled relationship between industrial organization (IO) models and U.S. antitrust enforcement. I show how some contributions from contemporary philosophy of science can clarify the ongoing debate on the role of economics expert witnesses.

1 Introduction

When it comes to finding whether a firm has engaged in anti-competitive behavior and violated antitrust law, economists are often called upon as expert witnesses by both the plaintiff and the defendant. Testimonies by expert witnesses in US federal courts are governed by the so-called "Daubert criteria" which state, in essence, that expert testimonies are admissible as long as they are based on a theory which is both reliable – that is, capable of being falsified – and relevant to the specific case at hand (Werden, Froeb, and Scheffman 2004; Werden 2008). The standard tool used by economists appearing as expert witnesses in antitrust litigations comprises a family of game-theoretic models which form modern industrial organization theory ("IO" for short) – a field of economics dealing with the strategic behavior of firms, regulatory policy, antitrust policy and market competition. Daubert criteria caused

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many problems for antitrust economists using IO theory. Solely in the period 2012–2018, 584 Daubert challenges – i.e. special motions raised before or during trial to exclude the presentation of unqualified evidence to the jury – have been raised against economists appearing as expert witnesses in antitrust cases. Interestingly, roughly half of them have been successful in obtaining the total or partial exclusion of the counterpart's expert witness (Giocoli 2020, p. 213).

The poor performance of economics expert witnesses has been explained mostly by the existence of crucial weaknesses within the models that are currently used by antitrust economists – that is, game-theoretic models of strategic behaviour. Following the 1980s game theory revolution in the industrial organization literature, these models have gained wide acceptance by academic scholars and nowadays represent the bulk of standard IO textbooks (Shy 1995; Martin 2010; Belleflamme and Peitz 2015). Academic consensus notwithstanding, game-theoretic models are recognized to be highly sensitive to variations in the underlying assumptions and hard to test empirically (cf. Fisher 1989; Peltzman 1991; Sutton 2001). For this reason, some scholars recently argued that models used by economists in antitrust cases are more likely to fail to meet the Daubert criteria and be rejected in the courts (Coate and Fischer 2012; Giocoli 2015, 2020). This answer contains more than a grain of truth, yet I believe that some contributions from the philosophy of science may help in clarifying the debate.

Philosophers devoted much effort in analyzing some crucial concepts commonly used by both natural and social scientists in reasoning about their theories, methods, and practices. Two of these concepts are that of "model application" and "model pluralism". It is often said, for instance, that game-theoretic IO models fails to apply to the specific industry under scrutiny. Or that the legal world requires a method to choose between competing scientific theories. However, what does it mean to apply a theoretical model and how it can be chosen among competing models to address a legal case? In the following I shall focus on these key concepts and discuss their relevance for the understanding of the case study.

I proceed as follows. In section 2, I briefly survey the role of scientific experts in the US legal system and the relative performance of economists as expert witnesses. Section 3 examines some tentative understandings of the relation between US admissibility criteria and economics as a science. From this discussion, it turns out that the models used in IO are alleged to be non-robust, irrelevant and overabundant. According to some scholars, these three features put together can partly explain the unremarkable performance of antitrust economists as expert witnesses. Section 4, which constitutes the bulk of the paper, consider these criticisms from the perspective of contemporary philosophy of science. Eventually, section 5 concludes the paper.

2   Case study: IO models in US courtrooms

Economists are called, like many other scientists, to appear as expert witnesses in the courtrooms. Economic analysis can be crucial in assisting the decision-making process of the court and, therefore, economists should use the best theories and models at their disposal. Courts, on the other hand, should be able to discriminate between admissible scientific theories and pseudoscience. The US legal system has two features that help to spell out the methodological properties of scientific theories and models used by scientific experts. First, it is an adversarial system, meaning that the trial is based on a pair-to-pair debate between the plaintiff and the defendant. Both the opponents propose, if necessary, the testimony of expert witnesses and these testimonies are subject to impeachment through cross examination. As the antitrust law scholar Hovenkamp (2005, p. 84) notes, "the traditional way judges respond to these technical disputes is to encourage the parties to engage in vigorous cross-examination of experts".[1]   Second, the US legal system has a well-defined role for scientific experts as regulated by a section of the Federal Rules of Evidence (FRE for short), namely FRE 702 – Testimony by Expert Witness. In the remaining part of this section, I discuss in detail this second and crucial aspect.

The admissibility of expert testimonies in US federal courts has been guided by the so-called Frye standard since 1923. Roughly speaking, the Frye standard relied on a criterion of general acceptance – that is, the expert testimony had to be admitted in the courtroom as long as it was grounded on a theory generally accepted by the relevant scientific community. This admittedly vague criterion has been revised in 2000 to reflect the standard articulated by the Supreme Court in *Daubert v. Merrell Dow Pharm. Inc.* and then refined in a series of decisions taken between 1993 and 1999. The so-called Daubert criteria are much more stringent than Frye because they are built on strict Popperian methodological premises. To be admitted in court, an expert testimony must provide a theory which is both reliable and relevant. A theory is reliable when it is possible, at least in principle, to test it against evidence – that is, when a theory is falsifiable in Popperian terms. Instead, a theory is relevant when it is sufficiently tied to the facts of the case debated or, in scientific jargon, when it applies to the phenomenon under examination (*Daubert* 509 US, pp. 590–91; see also Haack 2005, 2015).

The introduction of the Daubert criteria had immediate consequences on the way in which expert testimonies were delivered in courts and, more generally, on the role of judges. Since 1993, it is up to judges to ensure that the methodology underlying the expert testimony makes it both sufficiently tied to the facts of the case and capable of being falsified. In legal jargon,

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[1] As suggested by Werden and Froeb (2019, pp. 4–5), this aspect partly explains the difference in the chance of success of an antitrust action in the US and EU.

Daubert and the ensuing FRE 702 have assigned courts the role of "gate-keepers" for the admission of scientific experts – a role they must perform by identifying what is relevant evidence and, above all, what is scientifically valid, and thus reliable, testimony. Moreover, as Giocoli (2020, p. 205) notes, it has become customary to raise a so-called Daubert challenge, viz. to ask the court to assess the admissibility of the opposing party's expert witnesses with the goal of excluding them.

Here I focus on the role of economists as expert witnesses in antitrust litigations. To the best of my knowledge, the latest data analysis on Daubert challenges and antitrust cases has been done by Giocoli (2020), using the *Daubert Tracker* database – an online paid service providing litigants with the broadest database of Daubert challenges, divided by subjects. Giocoli's work updates an earlier analysis by Langenfeld and Alexander (2010) that stopped in 2010 and offers mainly descriptive statistics measures. Although a sound econometric analysis of the *Daubert Tracker* database is on my research agenda, for the time being I will dwell on Giocoli's valuable work.

Evidence from *Daubert Tracker* data calls into question the reputation of economists as trustworthy scientists. In the period from 2012 to 2018 there have been a total of 971 antitrust litigations in the US. Among them, 886 have been subject to a Daubert-related challenges against all areas of expertise (that is, about 91% of the total cases). An astonishing number of 584 challenges have been raised against economists appearing as expert witnesses. The distribution of the challenges is not homogeneous since one observes that roughly two-thirds of the time challenges attacked the plaintiff's scientific experts. More specifically, 391 challenges attacked plaintiff experts while 193 targeted experts from the defendant. Overall, one notices that roughly half of the time Daubert-related challenges were successful in excluding, totally or partially, the testimonies of economics expert witnesses. Of these, 155 (40%) succeeded against plaintiff experts and 114 (59%) against defendant experts.

Why do antitrust economists perform poorly as expert witnesses? In the following section, I will consider in detail some possible explanations suggested by a number of authors.

3 Economists and Daubert criteria: setting the stage

Although a rigorous empirical analysis on the data concerning Daubert-related challenges in US federal courts is still missing, the above descriptive statistics are sufficient to convey the impression of a troubled relation between antitrust economists and the admissibility standard in the courtroom. Different scholars studying the poor performance of economists against Daubert criteria have proposed different ways of understanding this phenomenon. Let us consider three main answers proposed by Werden

(2008), Coate and Fischer (2012) and Giocoli (2015, 2020), respectively.

Gregory Werden, a leading antitrust scholar, focuses on two main aspects of the relation between Daubert criteria and economics. First, he notices that determining whether a witness is qualified to provide expert testimony is not an easy task. As a matter of fact, antitrust cases are usually highly specific and they demand a detailed knowledge of the industry under scrutiny. For this reason, he claims that "even a highly respected academic industrial organization economist might be unqualified to offer an opinion on basic issues in a typical antitrust case" (Werden 2008, p. 804). Indeed, even some Nobel prize winners – such as Robert Lucas and Joseph Stiglitz – have seen their testimonies rejected as a result of a Daubert challenges (Giocoli 2020, p. 217).

Werden's first point is strictly related to a second one, namely the problem of making an economic theory or model fit the specific quantitative facts of an industry – a process known as "calibration". Model calibration concerns matching the model's assumptions (specification of demand curves, for example) and parameters (elasticity, cost assumptions) to market realities. For example, an oligopoly model used to predict the effects of the merger must be calibrated on the basis of pre-merger market shares and other parameters of the model, such as elasticities of demand (see section 4.2 for further details). Model calibration is crucial for the admissibility of economics expert witness because, as Werden underlines, "quantitative testimony based on an economic model is not admissible if the expert fails to calibrate the model properly and the model's predictions therefore are misleading" (Werden 2008, p. 811).

Despite these two potential issues, Werden's overall verdict on the implementation of Daubert criteria for economists is positive:

> By requiring that an economic expert demonstrate that testimony is grounded in economics, FRE 702 both screens out the ipse dixit of the expert and also clarifies the economic logic and formal analysis supporting opinions that go well beyond ipse dixit. And by requiring that expert testimony fit the facts of the case, FRE 702 compels that economic analysis be firmly grounded in real world industry characteristics and hard data. (Werden 2008, p. 817)

Werden suggests precisely that having high standards for the admissibility of scientific testimonies can be a driver for improving the intricate interplay between economic theory, empirical calibration, and reality. The Daubert criteria, Werden concludes, "are improving the quality and clarity of economic testimony in antitrust cases, and they are thereby increasing the sophistication of the discourse in antitrust litigation and the accuracy of judge and jury decisions" (Werden 2008, ibidem).

A different take on the Daubert criteria is expressed by Coate and Fischer (2012), who detach from the irenic view expressed by Werden and stress some reasons why modern game-theoretic IO models may fail to satisfy the new admissibility standards. Their paper addresses the challenge that game-theoretic merger analysis faces from the Daubert standard and suggests how game theoretic expert testimony can be structured to survive a Daubert challenge. Equipped with a peculiar kind of Popperian-Friedmanian methodology, they argue that the problem is not so much in the Daubert criteria but rather in the specific methodology adopted in modern IO. According to Coate and Fisher, all game-theoretic analyses depend on their underlying assumptions and minor changes in these assumptions are able to generate significant differences in their predictions. If this is case, then courts must be sure that economics expert testimony assists, rather than obscures, their decision-making process.

This is by no means a new critique to modern IO theory. In fact, even a quick glance at the the history of industrial organization will show that many prominent scholars have raised concerns about the way of building models adopted after the so-called "game theory revolution" (cf. Giocoli 2005, 2009, 2015). These criticisms arose primarily as a reaction to (or rather, review of) the *Handbook of Industrial Organization* (Schmalensee and Willig 1989), the *summa* of the reformulation of IO theory around the methodology of game theory occurred from the early 1970s to the early 1980s.

The MIT economist Franklin Fisher first intimated that the extensive use of game theory in industrial organization had not improved the matching between theory and empirical reality. In fact, he claimed the very opposite was true. The impression he drew from the contemporary *Handbook* was of a plethora of theoretical models that were extremely sensitive to underlying assumptions and the absence of empirical generalizations that could actually be used to intervene in economic reality.

> At present, oligopoly theory consists of a large number of stories, each one an anecdote describing what might happen in some particular situation. Such stories can be very interesting indeed. Elie Wiesel has said that 'God made man because He loves stories', and economists (not merely game theorists) are plainly made in the divine image in this respect. (Fisher 1989, p. 118)

His impression was reinforced by a well-known review written by the Chicago economist Sam Peltzman (1991). Peltzman's critique echoes Fisher's article to the extent that it focuses on the impossibility, for all game-theoretical models, of allowing any powerful empirical generalization. Notably, Peltzman argued that a theory deprived of empirical generalizations constitutes

simply a series of special cases – indeed, it is not a theory anymore.[2] As he puts it:

> By suitably permuting and combining the problems and assumptions, new models can be produced almost ad libitum. Indeed the production of new models and tidying up of old ones seem to be major goals of this research enterprise. The uninitiated observer faced with this long march of models soon begins groping for motivation to stay to the end of the parade. (Peltzman 1991, p. 207)

In line with these "traditional" concerns by Fisher and Peltzman, Coate and Fisher argue that something wrong exists in game-theoretic models that shape modern IO – this, in turn, would explain the poor performance of economists as expert witnesses in the courts. In their own words:

> [Game-theoretic] modeling structure has been used to define a general theory of firm behavior without any real empirical evidence. The evidence that exists is hardly supportive of a general relationship. Thus, we can only conclude that merger analysis with unilateral effects fails a fundamental test of admissibility. Applied to mergers, generic unilateral effects game theory is mathematics, not validated economic science. (Coate and Fischer 2012, p. 152)

A consonant position is advanced by Giocoli (2015, 2020). His work focuses on a couple of interesting phenomena within modern antitrust economics. First, he deals with the mysterious persistence of the Chicago approach as the main analytical engine driving antitrust enforcement in American courts. Second, he addresses possible explanations for the economists' troubles when facing a Daubert challenge in antitrust cases. The two topics are related. On the one hand, while IO economic theory is now entirely grounded on game theory, the practice of antitrust judges is still rooted in the old-fashioned Chicago-style price theory. Chicago arguments still permeate antitrust case law at all judicial levels and this may affect the performance of economists whose testimonies rely on game-theoretic models (Giocoli 2015, section 12). On the other hand, as suggested by Coate and Fisher, some structural features of theoretical models in IO exist that render them especially susceptible to the Daubert doctrine. That is, the problem is primarily methodological:

> The true difficulty of the Post-Chicago approach vis-à-vis Daubert is intrinsic to the way game-theoretic models are built.

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[2]A similar position is advanced by the LSE economist John Sutton (2001).

These models' empirical value is usually nil because their solutions can be determined only when the underlying assumptions are exactly met. In other words, the array of outcomes that in a game-theoretic model, depending on the model's specific assumptions, may possibly arise as equilibria make the model itself, and any expert testimony based on it, inevitably ad hoc. [...] Thus, Post-Chicago models, and the antitrust complaints based on them, can hardly achieve the status of 'relevant and reliable science' that could guarantee a pass under Daubert. (Giocoli 2020, p. 223)

In this connection, a more general remark is in order. All the preceding criticisms levelled at modern IO and, by extension, at the unremarkable performance of economists as expert witnesses are made mostly within the economics profession. For this reason, those scholars employed somewhat loosely certain concepts that attracted much attention from philosophers of science and economics. To give a more complete picture on the case study, I believe it is useful to examine these issues within the language and concepts of the contemporary philosophy of science. As a matter of fact, the troubled relation between Daubert standard and antitrust economics can be understood in terms of three traditional issues in the philosophy of scientific modeling, namely (i) robustness analysis, (ii) the problem of model applicability and (iii) the quest for model pluralism. In the next section, I will offer a preliminary discussion of the basic elements of these ideas and explore how they can shed light on our case study from antitrust economics.

4 Models and reality in antitrust cases: a philosophy of science perspective

Is there something special about models used in antitrust economics? The answer seems to be positive, at least according to scholars we have encountered so far. To sum up our previous discussion, one may argue that game-theoretic models of strategic behavior are charged with (i) lack of robustness, (ii) irrelevancy and (iii) overabundance. I shall consider these criticisms in order from the perspective of contemporary philosophy of science.

4.1 Robustness analysis

As we saw before, modern IO models are said to be non-robust, i.e. to be highly sensitive to slightly changes in their modeling assumptions. Broadly speaking, robustness analysis is performed to discover the minimal set of assumptions which is essential for deriving a given result within the model (cf. Kuorikoski, Lehtinen, and Marchionni 2010; Lehtinen 2018). A model is robust if it gives the *same* results from a different set of assumptions.

To illustrate this, let us consider a core model of IO theory, namely the so-called Bertrand model where the market contains just two firms that both produce one perfectly homogeneous good at constant marginal costs. Clearly, many assumptions of this model are highly idealized: to mention but a few, perfect homogeneity of goods, perfect information among consumers, no capacity constraints, constant marginal costs, profit maximisation and so forth. With such highly unrealistic assumptions, one is able to prove that the equilibrium price in the market equals the marginal cost — a result which is hardly ever supported by empirical evidence and, for this reason, is known as the "Bertrand paradox".[3]

The standard Bertand model, however, is strongly non-robust because a small variation in one of its assumptions makes the paradox disappear. Economists know this non-robustness very well and have exploited it by relaxing some strict assumptions to obtain results that differ from the paradox. For instance, antitrust economists mainly use a variation of the standard Bertand model which account for product differentiation in merger analysis to predict the post-merger equilibrium prices after being calibrated using data from a given industry (Werden, Froeb, and Scheffman 2004; Einav and Levin 2010).

As shown by this example, the lack of robustness *per se* is not a big deal as long as economists are able to identify idealized assumptions and replace them with more realistic ones in order to obtain better models from an explanatory and predictive point of view (a process sometimes called "de-idealization"). While the debate on the nature and role of (de-)idealizations in economics is not settled, it seems fair to say that only a careful analysis of specific case-studies can tell us whether, and to what extent, economists do employ de-idealization strategies in developing their models.[4] In any case, the absence of robustness does not seem to be a major problem with game-theoretic models used in IO compared to other branches of economic theory.

While several authors have pointed out the non-robustness of game-theoretic IO models, I believe they intended to emphasize a different problem for theoretical economic models, namely the problem of how to apply the model to reality. The following paragraph addresses this issue.

4.2   Three kinds of model application

As we saw in Section 2, to satisfy the Daubert criteria a scientific theory or model should be relevant to the case at hand. As to antitrust cases, this means that economics expert witnesses should employ a theoretical model

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[3]For a standard textbook treatment of the model, see Belleflamme and Peitz (2015, chapter 3).

[4]In Peruzzi and Cevolani (2021) we examine in detail a case study from IO theory to argue that de-idealization strategies are used in economics.

which applies to the specific market which is under scrutiny. Failure to fit the facts has been the principal basis for excluding economic expert testimonies in antitrust cases. For instance, the Stanford economist Robert Hall saw his testimony rejected in 2000 *Concord Boat Corp v. Brunswick*. The Eighth Circuit argued that the testimony had to be excluded because the Cournot model proposed to describe the market for sterndrive engines did not fit the economic reality – that is, it was not relevant to the facts of the case. More specifically, the court held that "a theory that might meet certain Daubert factors [...] should not be admitted if it does not apply to the facts of the case" and that, after the "thorough analysis of the expert's economic model" required by Daubert, the court found the model wanting in several respects (cf. Werden, Froeb, and Scheffman 2004, p. 89).

This episode is a prime example of a traditional issue in the methodology of economics concerning the conditions of a properly application of theoretical models to real-world situations.[5] The model application issue is here, if possible, even more significant: whenever the model presented fails to apply to the case at hand, the economist's testimony is considered unable to satisfy the minimum requirement for being admitted to the court. In the following I shall examine some philosophical accounts of what it means to apply a model and try to understand whether theoretical models used by antitrust economists have particular gaps in this respect.

In the philosophical literature, the word "application" has at least three different meanings. A first view construes model application as the logical interpretation of a theoretical model in terms of a real-world situation (cf. Gibbard and Varian 1978; Hausman 1992; Weisberg 2013). In this respect, to apply a game-theoretic model to a real-world scenario means to give its predicates particular extensions, its quantifiers particular domains, and the like-by, that is to provide an interpretation in the logicians' sense. For instance, to apply the Bertrand model would amount simply to interpret its variables (prices, quantities, costs, etc.) and its general terms (firms, consumers, etc.) in terms of, say, the Pepsi-Coca Cola market. A key feature of this view is that a theoretical model can potentially give rise to an infinite number of applications whose falsehood does not affect the mathematical truth of the theoretical model from which they are generated. As Hausman (1992, p. 72) argues, if the application of a theoretical model in real situations leads to statements about reality that prove to be false, one cannot say that the theoretical model is false, but that its application in a specific situation displays some false statements.

While admittedly narrow, this view of model application has some merit that should not be underestimated. Indeed, this view accounts for the fact that most of economic models are not directly aimed at the description and

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[5]Hausman (2018) provides an overview of the debate on how to apply economic models to reality.

explanation of real phenomena. Rather, it is often the case that economic models design has conceptual exploration as its main goal, i.e. economists aim to tell us how a phenomenon possibly *could have come about* when a certain set of assumptions is satisfied (cf. Schelling 2006; Weisberg 2007; Aydinonat 2018). Unfortunately, however, this account of model application is too vague to meet the stringent Daubert admissibility standards. As we know, FRE 702 requires that expert testimony be "based upon sufficient facts or data" and this proviso is often interpreted as requiring that the testimony be grounded in the facts of the given industry relevant for the given case. Finding a real-world situation through which one can interpret the model – while valuable for academic and educational purposes – is not enough to meet such standards.

A second and broader understanding of the notion of model application refers to the good match between theoretical predictions and observational and experimental data. Such interpretation can be traced to Popper's falsificationism, but it is also used by leading experimental economists (Smith 1989, 1994; Goodfellow and Plott 1990). These authors nicely convey the long-standing emphasis on predictive success – i.e. whether a model makes strong and robust predictions that are borne out by facts in the laboratory as well as in the field – present within economists' scientific practice.[6] Here, we don't need to take stock of the huge discussion about the influence of falsificationism on economics profession. What is worth noting, however, is that this interpretation of model application is more closely related to the Daubert reliability criterion – which explicitly refers to the falsifiability of scientific theories – than to the relevance one.

Finally, a third and crucial account of what it means to apply a model exists that refers to various strategies that are used to link assertions of an abstract model to the reality that is purported to be examined. This type of model application is sometimes known as model calibration of (families of) economic models (recall the discussion of Werden's criticism in the last section) or, mostly in the philosophical literature, empirical model building (cf. Cartwright 1989, 2009; Knuuttila and Morgan 2019).

Let us consider once again merger analysis. i.e. the study of whether mergers between direct competitors in concentrated industries are profitable and/or welfare enhancing. From an antitrust perspective, a merger assessment requires to trade off welfare-reducing price effects with welfare-increasing gains in productive efficiency using total or consumer surplus as the relevant criterion. The modern toolbox of merger assessment is the so-

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[6]The tendency of assessing economic models on the ground of their predictive success can be traced back to the well-known essay "The Methodology of Positive Economics" by Milton Friedman. However, Friedman has been only the first of a long series of economists who insist on the predictive properties of theoretical models. For instance, economist and game-theorist David Levine (2012, p. 3) has recently invoked predictive success as the main epistemic feature of mainstream economic theory.

called "merger simulation analysis" where a standard model of oligopoly is chosen, calibrated to match critical features of the industry (e.g., prices and market shares), and used it to compute the post-merger equilibrium prices (cf. Belleflamme and Peitz 2015, chapter 15).

Any merger simulation involves a myriad of modelling choices that the economist should make in order to connect the theoretical model to the real-world market. To mention but a few, the economics expert must choose whether firms maximise prices or quantities, the timing of the game (one-shot or multiple rounds), the degree of homogeneity of products, how to estimate price elasticities and marginal costs, etc. The set of these choices determines how the model is calibrated with respect to the market at hand and, hence, whether or not the economist's analysis can be considered relevant under Daubert.

It is an open problem, that I plan to investigate in the near future, whether game-theoretic models have specific deficiencies in this calibration process compared to (families of) models within other branches of economics. An appealing hypothesis to be explored is that the distinction among three meanings of model application may help to solve the apparent contradiction that exists whenever an economist says that her model applies to reality while the court does not. Indeed, the first two meanings of what it means to apply a model are highly popular among academic economists and usually serve as adequate characterization of a successful theoretical model. However, it is only the third and final meaning of model application that is actually pertinent to whether or not the Daubert relevance criterion is met. Still, one may investigate whether the poor performance of economics expert witnesses in antitrust cases could be partly explained by saying that economists understand application in its first two meanings – logical interpretation and predictive power –, while the court only in its third one – i.e. model calibration.

4.3   Pluralism and overabundance: choosing the right model

A third and final criticism of modern IO models concerns the proliferation of models and the absence of accepted rules for selecting the "right" model from those available. Among others, Sam Peltzman (1991, p. 208) pointed out speaking about oligopoly theory:

> Put aside the big questions such as 'What is science supposed to be about anyway?' And focus on the little one of 'How do industry analysts actually use this bag of tools?' The answer comes in the chapters on empirical research, and it is 'hardly at all'. The rosy view that model proliferation is necessary to understand an inevitably complex world fails this most basic test.

Peltzman's concerns raise further questions: how do economists choose a

single from a set of available models? Is this choice a necessary requirement for an economics expert witness? How can evidence be used to distinguish between competing models of the case? The answer to these questions, which affect the appearance of economists as expert witnesses, can benefit from contemporary insights from the philosophical literature on the virtues of pluralism in economic theorizing and practice.

In the aftermath of Rodrik's *Economic Rules* (Rodrik 2015), many scholars have strongly defended the advantages and desirability of a greater pluralism in the methods, the aims and the topics of current economic research. Among them, several philosophers of economics started focusing their attention on families of models, rather than on single models, in order to discuss interesting methodological issues (Aydinonat 2018; Grüne-Yanoff and Marchionni 2018; Veit 2019; Gräbner and Strunk 2020; Lisciandra and Korbmacher 2021). Despite their different views on economic modelling, the shared idea is that knowledge accumulation in economics mainly proceeds "horizontally", i.e., by developing many different and sometimes mutually inconsistent models of the same target, each of which is only partial and highly context-sensitive. Here, we don't need to take stock of this discussion. What is worth noting, however, is that some scholars identified a potential issue for model pluralism enthusiasts, namely the so-called overabundance problem or "embarrassment of riches". Against Rodrik's suggestion that progress in economics should be understood and measured horizontally, by a continuous expansion of new models, one may argue that this could lead to a rapid expansion of our model library to such an extent that we become unable to choose between the available models. As Grüne-Yanoff and Marchionni (2018, p. 9) put it:

> [Model pluralism] raises the threat of an embarrassment of riches: when progress would turn into the production of non-processable white noise. [...] An embarrassment of riches will arise if the menu of candidate models is not sufficiently constrained.

That is, despite the widespread enthusiasm about model pluralism, to have large set of alternative models to explain a certain phenomenon can be highly detrimental at the pragmatic level. The same antitrust case can be interpreted in terms of different theoretical models, each of whom may generate conflicting predictions. Economists in the courtroom must select, among competing models, the *right* one to interpret the given available evidence. As underlined by Werden (2008, p. 815) "economics typically has no well-established standards governing the selection and application of particular models and methods". Accordingly, in the absence of a suitable procedure for model selection, the multiplicity of models may undermine economists' testimonies in antitrust cases and explain their poor performance. Further

work is needed, however, to assess in detail the nature and role of model pluralism, model selection and conflicting evidence, with reference to economic models and IO theory in particular.

5 Concluding remarks and future work

The main claim advanced in this paper can be summarized as follows: the ongoing discussion on the role of economists as expert witnesses in antitrust cases, and especially the debate on the nature of game-theoretic models which form modern IO, may benefit from a philosophical analysis as based on the ideas of model application and model pluralism.

This paper is only a first take on this issue and further work is needed to fully substantiate this claim. Here I will focus solely on two topics that I consider critical for my argument. First, an interesting open issue for future work is to explore how the recent "empirical turn" that has taken place in many areas of economics affects our case study. Following the empirical turn, theoretical models seem to have lost their distinctive status in favour of other methods such as RCTs, field experiments, laboratory experiments, etc. Thus, a strong scepticism about the possibility of learning real-world features through economic models has spread among economists and philosophers (Angrist and Pischke 2010; Alexandrova and Northcott 2009; Duflo 2017). Industrial organization has not been untouched by this empirical turn, which has taken the form of the so-called New Empirical Industrial Organization (NEIO). Does the development of NEIO help antitrust economists in their performances as expert witnesses? What is the relationship between NEIO and the empirical turn that occurred in other areas of economics? These and many other questions deserve a separate study, that I have to leave to a future occasion.[7]

A second interesting question concerns the issue of how to reconcile stringent legal standards with scientific practices. As we saw in section 2, the FRE 702 are built on fairly strict methodological standards. In particular, the Daubert criteria are entirely based on the amount of empirical content present in a scientific model, i.e. how much the proposed model can *say* about the real world.[8] However, many other criteria exist in science that are relevant to define a successful model or choose among multiple models (formal elegance, simplicity, generality, etc.). Further work should be done to understand whether this conflict among different standards – that of le-

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[7]A intriguing starting point is provided by the exchange of ideas between Angrist and Pischke (2010) – the champions of the empirical turn – and Einav and Levin (2010) – two leading figures within NEIO – in the very same issue of the *Journal of Economic Perspectives*.

[8]As Giocoli (2020, pp. 225–226) notes, courts provide a "safe methodological heaven" where models are evaluated solely on the basis of their empirical content while leaving aside all other criteria.

gal system and scientific practice – may help to explain the high record of rejections among economics expert witnesses.

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