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Financial Economics and Pension Plans

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The pension actuarial community is engaged in an ongoing and vigorous debate about our valuation paradigms. Some—often described as representing "financial economics" or "FE"—believe that actuarial practice has been built on a flawed foundation. They argue that traditional actuarial analysis is at odds with the valuation practices of economists, and pension valuations do not properly reflect risk. The security of plan participants' benefits has been severely jeopardized as a result. Others disagree. They assert that fundamental characteristics of pension plans render these criticisms inapplicable. Very long time frames, severe limitations on the ability to trade or settle pension obligations, and other important factors are not properly considered by the detractors' arguments.

As those with jaded views of human nature might have predicted, a healthy exchange of views has sometimes devolved into an unproductive quarrel. Ironically, the two sides often seem unaware of what they are really arguing about. The FE model is uncontroversial as a theoretical construct. The disagreement relates to how these conclusions apply to pension plans in the real world and how they should therefore be reflected in actuarial practice.

The discussion recently reignited in the context of public pension plans, and that exchange catalyzed the creation of this essay. It addresses an important yet seldom-discussed underlying issue: the relationship between models and reality.

MODELS

The uneasy relationship between theory and practice is not specifically actuarial. Similar issues exist throughout the physical and social sciences. The topic is essentially philosophical in nature, and many of these thoughts have been motivated by entries in the online *Stanford Encyclopedia of Philosophy*. Even my clumsy and untrained attempts to consider these resources have been very rewarding, and interested readers are encouraged to consult them and the primary sources that they cite.

Models in their various forms have been used for millennia. These include physical objects (such as architectural models), analogies (such as relating atoms to billiard balls), and mathematical constructs (such as the capital asset pricing model). They share the following elements:

- A model is used to represent a *target system*, the aspect of the real world under study. The target system of the FE models asserted in our actuarial exchanges is retirement systems.
- A model contains *idealizations*. These intentional simplifications of the target system allow for tractable analysis without the full complexity of the target system itself. Many of the idealizations in the FE-based actuarial models have been described as principles of economics, financial economics and public finance.
- A model is used for *surrogative reasoning* when conclusions developed within the model are applied to the target system itself. In our case, surrogative reasoning might lead a plan sponsor to fully fund the plan and allocate investments to liability-matching assets.

IDEALIZATIONS

There are at least two distinct kinds of idealizations. The first, sometimes called Aristotelian idealization, or isolation, simply strips out complexity that is considered irrelevant to the phenomenon of interest. An actuarial example might be disregarding participants' favorite color when we perform valuations. Although a characteristic of the plan population, it doesn't affect the benefit obligation. A second type is called Galilean idealization. This knowingly introduces distortions of the target system to the model. These could include simplifications about decrement timing, selection of optional forms, or the many other messy complexities that exist in the real world but are difficult to represent analytically.

Several objectives drive the idealizations in a model, including:

- Reasonably representing the phenomena of interest in the target system
- Constructing a model in which important conclusions can be derived
- Creating understandable dynamics that will advance the intuition of model users

Model users must assess how closely the idealizations correspond to the dynamics of the target system. This assessment is often subjective. After all, if there were a clear and universally agreed-upon understanding of how the target system worked, building the model may not have been necessary. Users must also understand how the idealizations were relied upon. Only then can they understand the extent to which different idealizations might have altered the model's conclusions.

UNREALISTIC MODELS

Franco Modigliani and Merton H. Miller's 1958 article, "The Cost of Capital, Corporation Finance and the Theory

of Investment," asserted, among other things, that the capital structure of a firm does not affect its value. The model in which this was demonstrated is highly idealized; both the premises and this conclusion can be criticized as unrealistic. So how can this work represent such an important contribution? Miller reflected on this in his 1988 article, "The Modigliani-Miller Propositions After Thirty Years":

> Skepticism about the practical force of our invariance proposition was understandable. . . . But the view that capital structure is literally irrelevant or that "nothing matters" in corporate finance, though still sometimes attributed to us (and tracing perhaps to the very provocative way we made our point), is far from what we ever actually said about the real-world applications of our theoretical propositions. Looking back now, perhaps we should have put more emphasis on the other, upbeat side of the "nothing matters" coin: showing what *doesn't* matter can also show, by implication, what *does*.
>
> This more constructive approach to our invariance proposition and its central assumption of perfect capital markets has now become the standard one in teaching corporate finance.

In other words, Miller's suggested use of the model does not assert that the conclusion is realistic. But if readers object to it, they must take issue with the model's idealizations. Then the focus can shift to the idealized aspects that are considered implausible, what dynamic is believed to exist in the real world, and how this discrepancy would alter the model conclusions to inform appropriate real-world actions.

Highly idealized models in the physical sciences, sometimes called thought experiments or gedankenexperiments, have also been used extensively to explain important principles. Schrödinger's cat is a famous example in quantum physics. Here, too, a model does not need to closely resemble reality to be valuable. The appropriate use of such models is not direct surrogative reasoning. These models can be of great pedagogical value by establishing relatively simple base cases. They can identify the considerations that are most critical to formulating real-world conclusions. And they can inspire extensions of the initial work that de-idealize the initial model.

EMPIRICAL EVIDENCE

Gathering empirical evidence in support of a model's conclusions can provide confidence in its use for surrogative reasoning. According to the scientific method, scientists are to establish predictions from a model and then conduct corresponding experiments in the real world. The model should be rejected if the experiments and observations are inconsistent with the assertions of the model. On the other hand, an ongoing failure to demonstrate a theory's falsity provides it additional credibility. Although this approach may be common in the physical sciences, it is problematic in economics. The interplay of many complicating factors makes it difficult to experimentally isolate specific phenomena. Many economic models lead to statements such as "everything else being equal," and everything else is never equal. Moreover, economic models often involve extensive idealizations. These considerations have led to specific criticism of economic models by philosophers of science.

And it is difficult to invent experiments that relate to applying financial economics principles to pension plans. The plans' obligations are not traded on the capital markets and their valuations are not prepared according to FE principles. Such experiments would be extremely valuable to the actuarial community, should they be feasible.

Consider one common assertion from FE proponents. It takes various forms, but fundamentally states that trillions of dollars are exchanged based on the same FE model. This appears to provide promising support. Here is empirical evidence that the model can be successfully applied. Unfortunately, it does not stand up to more careful scrutiny.

Successful surrogative reasoning with a model does not make its idealizations true. They are false by definition. This even applies to the bedrock no-arbitrage principle that is so fundamental in financial modeling. As Emanuel Derman wrote in "Metaphors, Models & Theories":

> The law of one price is not a law of nature. It's a general reflection on the practices of human beings, who, when they have enough time and enough information, will grab a bargain when they see one. The law usually holds in the long run, in well-oiled markets with enough savvy participants, but there are always short- or even longer-term exceptions that persist.

This is not necessarily a problem, as the relevant issue is the usefulness of the model rather than the independent and absolute truth of its idealizations.

Consider the simple mental model that I use to navigate when driving. It presumes that the earth is flat. This is false, yet the model has been exceptionally successful. Of the many times that I have gotten lost, none can be fairly attributed to the curvature of the earth. Yet my model's success does not prove that the earth is flat; it only demonstrates that the model can be a basis for surrogative reasoning.

Furthermore, the evidence cited must relate to the target system under consideration. The success of my model when driving does not make it advisable to use this model for a SpaceX flight. Evidence that a model can be successfully used for surrogative reasoning about financial instruments does not in itself prove it valid for application to public pension plans.

MULTIPLE MODELS

Scientists often use several models simultaneously, and philosophers of science generally agree that this is not problematic. For example, the National Weather Service uses three different models for its predictions. Wave-particle duality suggests that sometimes light behaves like a wave, while at other times it exhibits properties of particles. Notable instances of multiple models are used in chemistry, physics and other fields.

Peter Diamond's 2010 lecture for the Nobel Memorial Prize in Economic Sciences endorsed this practice. He said:

> Too many economists take the findings of individual studies literally as a basis for policy thinking, rather than drawing inferences from an individual study, combining them with inferences from other studies that consider other aspects of a policy question, as well as with intuitions about aspects of policy that have not been formally modeled. Assumptions that are satisfactory for basic research, for clarifying an issue by isolating it from other effects, should not play a central role in policy recommendations if those assumptions do not apply to the world. To me, taking a model literally is not taking a model seriously. It is worth remembering that models are incomplete—indeed, that is what it means to be a model.

Our goal need not be to crown a single champion in competition among models. We should consider the implications of each approach, identifying and acknowledging their strengths and weaknesses.

CONCLUDING REMARKS

A greater appreciation of the nature of models and how they relate to the world will enable a more constructive exchange of views. Labeling financial economics "right" or "wrong" does not properly reflect the essence of models. The following practices would help to make the discussion both more civil and more productive:

- Advocates of applying a model based on financial economics should freely acknowledge its idealized nature. They should be prepared to discuss the validity of conclusions when the idealizations are not perfectly upheld. They should not claim that effective surrogative reasoning with similar models in financial markets proves it valid for pension systems.
- Opponents of applying this model should not criticize it simply because it is idealized. That is not a fault. In fact, heavily idealized models may still provide great insight. Such actuaries should also recognize that the current paradigm is itself based on a model; its many idealizations should also be explicitly discussed.
- All actuaries should renounce the polarization that now contaminates our consideration of financial economics. Recognizing the validity of a model for one purpose does not necessarily require discarding all other models for other purposes. The retirement system is far too complex to be fully and faithfully represented by any single model. ■

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