

Good morning.

The subject of this conference is Risk, but the organizers are not taking any chances with the title. The title they have chosen is "The (Ir)rationality of Risk", strategically placing "Ir" between brackets. Rationality or irrationality; they are hedging their bets, managing for both contingencies. Whether we will conclude today that taking risk is very rational or deeply irrational, in the end they can tell us, we told you so.

The language associated with risk is a very prominent part of everyday life; just in the previous sentence I used expressions like "taking chances" and "hedging bets". But our relationship with risk is has many different faces, and this makes the language of risk complicated and sometimes confusing. Notice for instance that the word "risk" nearly always indicates the possibility of something bad happening. Investors risk losing their money, not washing your hands increases your risk of disease, those kinds of things. When prospects are better we use other words: there is a possibility of making a profit, there is a chance that she will go out with me.

Another difference exists between risks that can be

known, and controlled, and more general "uncertainty", that is hard to quantify. This difference between risk and uncertainty is the idea of the American economist Frank H. Knight, and he wrote about it almost 90 years ago. But it is a surprisingly common notion, as I discovered the other day when I was watching a movie with my wife. It was her turn to pick, and so I was stuck watching the 2004 romantic comedy "Along came Polly" starring Ben Stiller and Jennifer Aniston. Stiller plays Reuben the insurance actuary, sort of a prototypical economist-kind of guy who somehow has found a female friend called Polly (who is played by Jennifer Aniston). The conceit of the movie is that Reuben uses a computer risk model to assess the probability of love with Polly. Whenever he notices some aspect of her behavior he enters it into a spreadsheet and the numbers change. Now those of you who watch these kinds of movies (or have to watch them with their girlfriend) know how this ends: Polly finds out about the spreadsheet and threatens to leave Reuben in disgust; he then throws out the computer realizing that he can never capture true love in a model and everything is alright again. The end.

Now the point is not that true love cannot be modelled (which in fact is not that hard) but that there is difference between statistical Risk, where there are well-defined probabilities of things happening, and human Uncertainty, where you just don't have a good model that captures everything. This is a distinction that people who go to the movies know everything about, but that economists and finance-people tend to forget. It is this distinction that was the topic of Frank Knight's book, and I would like to expand upon it a little bit more as I think it is important for understanding today's conference.

Risk and Uncertainty. Now Risk is what they talk about in statistics, it is to do with things that happen with a certain probability. I mean that we are not sure which if these things will happen, but we are certain of the probability with which they will happen. Think of things like throwing heads with a coin, winning the lottery or getting struck by lightning. They are statistical occurrences and we can figure out their probabilities. Either by first principles, such as with the lottery, or by using a historical sample when the event repeats itself; such as with lightning.

The fact that these probabilities are known is the basis

of insurance, and one Dutch insurer even tells us this by placing huge billboards by the side of the road that read something like "there is a 0.16% chance that you will crash your car today." (If you stare at these huge, green, billboards for too long the chance actually goes up.) And the nice thing about insurance is that it makes risks go away. This has made insurance very popular, especially among the Dutch who spend close to 17% of their income on it. This is more than 2 months' income per year.

But what Frank Knight recognized is that not all events are statistical, and that we must recognize a second class of events that are just Uncertain. For these events, we do not have the means to find a probability of their occurrence, not from first principles and not from statistics.

We can think about what kind of events would fall in this Uncertain class. Suppose for instance that I wanted to start a company. I would be very interested in the probability that it will succeed, but how would I find that probability? The process is much too complicated to model from first principles. And for a statistical average I would have to start the company, say, 100 times in a row and record the number of

times it succeeds. This is not a practical approach, and so I am stuck with Knightian Uncertainty.

Why is it not practical to simulate the life of my company beforehand? I could use data on the life of Dutch companies in the past, for instance. But surely *my* company is different from all the other ones. And surely the present is nothing like the past. It is tempting to quote here the former secretary of defense of the US, Donald Rumsfeld, about known unknowns and unknown unknowns. For many events (especially, one may note, the occupation of a country), there are very many unknown unknowns: things that we do not know, and we do not even know that we need to know them. If that is the case we just cannot find the probabilities of the events' outcome, at least not by systematic means. We are left with our personal assessment, and hopefully a gut feeling. Not everybody feels this way. In 2004, US Judge and legal scholar Richard Posner argued that preventive war was sometimes justified (this was the time of the war against of Iraq) if the probability of future wars was high enough. He even performed some computations to show this, where he said things like "suppose there is a probability of 0.5 that the

adversary will attack at some future time". Many people objected that this probability cannot possibly be known in advance, but Posner was not persuaded. He replied "we frequently have to act under conditions of profound uncertainty. It would be paralyzing to suggest that we should never act unless we can quantify the expected benefits and costs of our acts (there would be very few marriages under this approach)". But this is exactly the point; presumably, in these cases of profound uncertainty, you have to have some other decision mechanism. One possible mechanism is to just *assume* probabilities or to use a flawed method to approximate them. I believe that this leads to bad consequences.

To illustrate my point, I think that part, or maybe I should say a large part, of the current crisis is caused by people who have confused uncertainty with risk. The uncertainty in question concerned events that affected the value of financial assets: will IBM go bankrupt, will Google beat Microsoft, will mister Jones make his mortgage payments. These are uncertain events and their probabilities certainly cannot be known from first principles. But financial firms were not deterred and figured that they could

assign probabilities anyway by looking at past behavior. With several decades of data they estimated models of different parts of the economy and thus started treating uncertainty as risk. When that happened, the logical next step was to insure the risk and make it go away, diversifying until it disappeared. And so large banks, companies and town councils started pouring their money into projects that just could not go wrong. We all know how that ended.

The crisis certainly took the people who had caused it by surprise. Early on, in 2007, so-called "quants" at large banks said that their models were fine- it was just that there had been a 25-standard-deviation shock. An event with a probability on the order of 10 to the power minus 138 had occurred (this kind of probability makes "not in a million years" look like a regular event). That sure was bad luck, but it got worse when several other such events happened in the next few months. Obviously, the probability distribution that underlied the model was not entirely correct.

The current crisis is causing lots of people to redraw the lines that divide risk from uncertainty. This means

that some things that were, in the past, done by models and computers will once again be done by people. People with gut feelings, and models, and computers. This is probably a good thing. It certainly increases the demand for economists, which is certainly a good thing.

And there are other good consequences. The events of the past years have caused us to be together today, for instance, so that I can warn you about confusing risk and uncertainty. Something that I should of course have done earlier, but that's life. Other people are doing the same thing when they talk about the fat tails of black swans and other metaphors, and so hopefully we will all learn something.

And finally, the best thing about the renewed prominence of uncertainty is that we again realize what it is that makes the world interesting. Because a world with only risk is a boring world, in which predictable people lead predictable lives and all surprises insured. I believe it is not too much to say that uncertainty captures everything that makes this life worth living.

Now the idea that uncertainty is something to cherish may sound overly romantic - and it probably is, being

the subject of a romantic comedy and all. So before you go out and rent (or download) that movie tonight, let's give some good hard thought to uncertainty's more predictable brother, Risk. We have a good opportunity to do just that today.