Aegent
ENERGY ADVISORS INC.

Deal or No Deal?

What can a TV game show tell us about how we buy energy?

Buying energy involves decision-making under conditions of uncertainty. Energy buyers face decisions about whether they prefer to enter into a transaction of certain value today – by fixing a price for their future energy -- or wait, expecting that something better will come along in the future. The art and the science of making these kinds of decisions are of interest to energy buyers…and to those who advise them.

The latest television game show phenomenon is called "Deal or No Deal". On the surface, it is simply another glossy prime time production, complete with big-dollar prizes, manufactured tension, and a bevy of glamorous models. But there is more to it than that. In fact, the show provides an interesting laboratory for examining the behaviour of people forced to make decisions under uncertainty with significant stakes on the line.

In fact, an international team of economists and behavioural scientists have done just that[1]. They concluded that neither the age, sex, education nor the economic status of a contestant had a significant effect on the contestant's aversion to risk. Not even high stakes or low stakes was a reliable predictor. The key factor affecting a contestant's degree of risk aversion was whether or not the contestant had suffered prior losses during the game. Contestants who had seen their chance to win big disappear early in the game were more willing to take big risks later in the game, even to the point of taking seemingly irrational bets.

Could the same be true of energy buyers? And if so, what are the implications?

About the game

Theories about how people make "risky choices" are important to many areas of economics. Consumers make these kinds of decisions when buying a house or a car, when investing, and when taking out a mortgage. However, economists have trouble researching this kind of decision-making behaviour in the real world, because it is so complex. Any research involves taking many "samples" of the same measurement under controlled conditions, and looking for patterns. But in the real world, it is almost impossible to find many independent examples of people having to make exactly the same decision in exactly the same circumstances. There are always factors from person to person that can't be controlled or eliminated, and the amount of information available can vary widely for each person faced with real life risky choices.

For this reason, it is quite common for researchers in this field to look at TV game shows as a source of research data. In a TV game show, the rules are set and are the same for all contestants, and each contestant brings to the game a similar level of knowledge about how the game works, and what the consequences could be of a good or bad decision.

Not surprisingly, the show "Deal or No Deal" has been the subject of some academic research, and the results tell us some things of interest to energy buyers.

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[1] Post, T., M. Vann den Assem, G. Baltussen, R. Thaler, (2006) *"Deal or No Deal? Decision making under risk in a large-payoff game show."*

First, let's describe the game for those who have not seen it.

The game began in the Netherlands in 2002, and versions of it have appeared on television in many countries. The American version is relatively new. The basic premise of the game is the same in most markets.

The game involves a single contestant who is faced in each round with having to make a choice between a certain outcome and an uncertain one. Contestants can win hundreds of thousands or even a million dollars, or could go home with just a penny. The contestants will never leave with less than they came with (it is not a casino).

In the U.S. version, the game begins with 26 numbered briefcases. Each briefcase notionally contains an amount of money, ranging from 1 cent to as much as $1,000,000. No two briefcases contain the same amount. A board displays to the contestant the 26 dollar amounts that are in play, but the contestant does not know which amount is in which brief case.

The contestant selects one briefcase to hold, and this briefcase will not be opened until the game is over. In the first round, the contestant chooses six of the remaining 25 briefcases to be opened, revealing the amount they contain. Once this is done, an unseen "banker" makes an offer to the contestant, a cash amount that the banker will pay the contestant to buy his briefcase. If the contestant accepts the offer, he takes the cash and surrenders his briefcase and the game is over. He is trading the unknown value in his case for the known amount of the offer. If he declines the offer, he will move on to the next round and open more brief cases. Deal or No Deal?

If he advances to the next round, the contestant opens 5 briefcases, and then receives another offer from the banker. If he chooses No Deal, then in the third round, he opens 4 cases, and so on, with the number of cases to open declining until the contestant is opening one case per round. It will take a maximum of nine rounds for the game to end.

After a set of briefcases is opened, the contestant can see what dollar values remain in play, and can in theory at least, calculate the expected value of the amount in his briefcase, or the probability that the value in his briefcase is greater than or less than the banker's offer.

Consider an example where the contestant has refused 5 offers from the bank. He is now faced with 5 unopened briefcases. The table below is an example of the information the contestant may have in front of him.

$0.01	$141,000	$10,000
$1.00		$25,000
$5		$50,000
$10		$75,000
$25		$100,000
$50		$150,000
$75		$200,000
$100		$250,000
$250		$300,000
$500		$375,000
$1,000		$500,000
$2,500		$750,000
$5,000		$1,000,000

The shaded values in the table are values that are no longer in play. The values in yellow are the values that are hidden in the remaining 5 cases. Let's say you are in this situation and the banker offers you $141,000 for your briefcase. Deal or No Deal? What factors figure in your decision?

Expected Value

One factor is that you can readily assess the "expected value" in your briefcase. Since each of the remaining dollar values could be in your case with equal probability, there is a one-in-five chance for each of the values to be the value in your case. The expected value of your case is the average of the remaining dollar values, or:

(1/5)*$0.01 + (1/5)*$50 + (1/5)*$250 + (1/5)*$200,000 + (1/5)*$500,000 = $140,060

In a sense, if you could play this situation several times, you would be indifferent to Deal or No Deal. At this point, the expected outcome of playing to the end or taking the current offer is pretty much the same. But of course, you only get to play this game once!

Looking at the odds in another way, there are two chances in five (40%) that your case holds a value greater than the offer, and a 60% chance that taking the offer is a significantly better choice.

Utility Theory

You may be influenced by how much you need the money. What if $141,000 was enough to pay off your mortgage? It would sure be nice to leave the game with $500,000 or even $200,000, but leaving with at least $141,000 would make a substantial difference to your life. Anything more, you may view as just a bonus. The lesser prizes aren't enough to make a difference. Does that make you more likely to take the deal?

The Value of the Next Round

There is another consideration. If you say No Deal, then you will have the opportunity to open another briefcase, and gain more information. If the case you choose to open reveals $500,000, then you can expect the banker's offer to be lower next time, as the expected value of your briefcase will decline to $50,075. But if you open one of the three low value briefcases, the offer will increase, likely by at least $35,000.

So, on the one hand, there is a 60% chance that this offer is better than the value in your brief case. However, there is a 60% chance that if you choose to go one more round, you will open a brief case containing less than the current offer, and the next offer will be higher.

So, what's your decision? Deal or No Deal?

The study

An international team of behavioural scientists and economists have studied Deal or No Deal, to examine what can be learned from the decisions that contestants make during the game, relative to economic theories about risky choices and rational decision-making.

The researchers examined 84 contestants from Dutch, Belgian, and German versions of the game. They categorized the contestants based on readily observable information (approximate age, sex) and on

information inferred from the introductory description of each contestant (for example, education and economic status, based on the contestant's occupation). The three countries were considered to provide contestants from similar cultural and socio-economic groups.

In Germany, there has been both a small-stakes (small prizes) and a large-stakes version of the game, with the other rules remaining the same. This allowed the researchers to examine whether the size of the stakes affected the decision-making of the contestants.

In total, the researchers examined games played by 84 different contestants. They applied various statistical and economic models, with exotic names such as "expected utility theory" and "cumulative prospect theory".

The models enabled the researchers to calculate a value for each contestant's "Relative Risk Aversion", an indicator of the degree to which that contestant was averse to taking risk (or conversely, willing to take risk). They could then correlate that value to other variables such as the age, sex, level of education, and economic status of the contestants, and the stakes of the game (whether the game involved large prizes or small ones). They also examined the degree to which a decision in one round was influenced by the outcome of earlier rounds.

Findings: Willingness to take risk increases after losses have been suffered

As explained, contestants in Deal or No Deal cannot "lose" in the sense that they will never go home with less than they came with. They will always win at least 1¢! However, they can lose an opportunity to win a big prize if they open a brief case containing a large amount, and eliminate that amount from the game. There is little chance of getting several rounds into the game without eliminating some of the big prizes. However, a contestant who has eliminated most of the big prizes early in the game may consider himself a loser.

One impact of these losses is that the banker's offer gets lower round by round. If a contestant eliminates a value that is greater than the banker's offer, the next offer will be less. Perhaps the contestant should have taken that last offer. However, what is done is done. He can't let that outcome affect his next decision. Or can he?

In Deal or No Deal, the odds of winning a certain prize are dependent only on the number of prizes remaining in the game, and on the value of those prizes. One would expect contestants to know this objectively. It is not unlike flipping coins – the odds of a heads on the next toss of a fair coin is 50% regardless of whether the last toss (or the last 10 tosses for that matter) were heads or tails.

Importantly, the researchers found that a contestant's willingness to take risk <u>increased</u> if he had been a loser in earlier rounds. This reduction in risk aversion was observed regardless of the amounts at stake, the age, sex, or education of the contestant.

They described these contestants as having made an incomplete adaptation to their previous loss. Their next decision was framed by reference to the unfavourable outcome of the earlier round, with the result that they viewed a greater number of the remaining possible outcomes as losing propositions and were unwilling to settle for them. Some contestants even accepted "unfair gambles" to avoid these perceived losses.

The researchers cite "Frank", a contestant in a Dutch edition of the show from January, 2005:

> *"In round 7, after several unlucky picks, Frank opens the briefcase with the last remaining large prize (€500,000) and he sees the expected prize tumble from €102,006 to €2,508. The banker then offers him €2,400, or 96 percent of the*

> *average of the remaining prizes. Frank rejects this offer and play continues. In the subsequent rounds, Frank deliberately chooses to enter unfair gambles, to finally end up with a briefcase worth only €10. Specifically, in round 8, he rejects an offer of 105 percent of the expected prize and in round 9 he rejects a certain €6,000 in favour of a 50/50 gamble between €10 and €10,000."*

The researchers suggest that in round 9, Frank is not comparing a guaranteed €6,000 against a 50/50 bet between €10 and €10,000 (expected value = €5,005). Instead, he is focused on the €10,000 prize. He sees the €6,000 offer as a sure loss of €4,000 and he is comparing that to a 50/50 chance of losing €9,900 (€10,000 - €10) or breaking even. In other words, if he takes the Deal, he cannot possibly win €10,000. If he says No Deal, he still has a 50/50 chance!

The researchers conclude that "risk aversion generally decreases after prior expectations have been shattered…Contestants facing a large reduction in the expected prize during the game may even become risk-seeking; they reject bank offers that exceed the expected prize and thus enter "unfair gambles". This path-dependent pattern occurs in all editions of the game, despite sizeable differences in the initial stakes across the editions. Thus, "losers" seem less risk averse than "winners", irrespective of the amounts at stake".

What does this mean to me?

There are compelling parallels between the situations of Deal or No Deal contestants and energy buyers. Buyers are faced with decisions each day on whether to take the Deal – a currently available fixed price for future energy requirements – or No Deal, and wait for another offer tomorrow. In the meantime, new information comes available that will affect the value of that next offer. By the time that information is known, it is too late to go back.

Sometimes, buyers are losers in early rounds. The market is moving against them, and new offers are less and less attractive than the offers that came before. Some buyers are able to evaluate the new information and make informed choices that are consistent with their organizations' business objectives and tolerance for price risk. Other buyers, frankly, may become less risk averse, and may take inappropriate chances. The knowledge that they have missed out on an attractive price makes them less willing to take the new Deal, and therefore more willing to accept a risk that the deals will continue to deteriorate. Like Frank, they focus on what they could win…and other potential outcomes are discounted. "If I fix my price now, I can never get back to my budget price. If I let my price float, there is still a chance I can get back to budget". These buyers are throwing good money after bad.

The best approach to risk management is one that minimizes emotion, and eliminates perceptions of winning and losing. The objective of price hedging is to control the predictability of energy prices, not to achieve winning hedges.

On the surface, Deal or No Deal is just a game show. But from another perspective, it provides an interesting study in decision making under conditions of uncertainty, something energy buyers wrestle with every day. While few of us are likely to be Jeopardy champions or winners on Who Wants to be a Millionaire?, we can hope that, given the chance to participate in Deal or No Deal, playing rationally and effectively would just be like another day at the office.

Another take on "Deal or No Deal" is provided in the May 30, 2006 issue of the National Post. View this article on-line.