Finding Energy Efficiency in an Unexpected Place – The Cockpit

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Catherine Wolfram June 27, 2016

I suspect that most energy economists think there are more unexploited opportunities for energy efficiency in homes than in firms. Firms are cost-minimizers, after all – they're in the business of making things with the fewest possible inputs. And, energy is an important input for many firms, particularly airlines. So, not even McKinsey – in their exhaustive catalog of potential energy efficiency measures – identify improved fuel efficiency from airlines.

Surprisingly, a new NBER working paper finds a significant opportunity for fuel savings in the airline industry. In a research coup that makes people like me drool with envy, Greer Gosnell, John List, and Rob Metcalfe convinced Virgin Atlantic Airways to let them run an experiment. And, not just any experiment – one that involved their captains, the head honchos, as in, "This is your captain speaking."

The cockpit of a Virgin Atlantic Airbus A340

The researchers sent three randomly selected groups of Virgin Atlantic captains either (a) information about average fuel efficiency on the flights the captain made in the previous month, (b) the same personalized information as group (a) plus personalized targets for the coming month, or (c) personalized information and targets, plus an offer to donate 10 GBP

(which was worth more pre-Brexit…) to a charity for each target achieved. A fourth set of captains was in the control group and knew the experiment was going on, but didn't receive a monthly mailing.

Pilots who only received information – group (a) – significantly improved their fuel efficiency, while pilots who received personalized targets improved their fuel efficiency even more, achieving about the same gains as the pilots who could donate savings bonuses to charity.

Perhaps most surprisingly, even pilots in the control group improved their fuel efficiency considerably relative to the months before the study began. The authors speculate that this is an example of the so-called Hawthorne Effect, which suggests that people behave differently when they know they're being studied.

The adjustments yielded substantial savings, netting the airline more than $5.4 million in fuel savings over the 8-month pilot period. Presumably, this would scale up to about $8 million over a year – not too shabby considering that the company's profits (before taxes and exceptional items) were around $20 million in the year the study took place. And, since the costs of running the experiment were very low – less than $3,000 to send a couple hundred letters a month – this appears to be an example of a negative cost abatement strategy. The authors calculate approximately -$250 per ton of CO2 (yes, negative, since the company saved money on net).

In my mental model, pilots are super-humans. They're better than super-computers, and could probably even beat Gary Kasparov at chess. In other words, they always, always make the right decisions. This might be what my psyche requires to get on a plane, plus a function of being a teenager when the movie Top Gun came out.

So, what adjustments did these super-humans make to save fuel? And, do we really want them to be thinking about fuel efficiency and not **MY SAFETY**? As it turns out, most of the improvements involved simply – ahem – following the rules.

For example, when they're taxiing, pilots are usually supposed to turn off half of the engines (e.g., one on a two-engine plane and two on a four-engine plane). Before the experiment, pilots did this on 35% of the flights, and after they knew they were being observed, this increased to 51%. Other adjustments involved following advice from air traffic control about more efficient routes or using real-time information about the baggage onboard to adjust fuel levels.

So, if even super-human pilots can be nudged into saving fuel, can we expect to find lots of similar opportunities across other industries? Think of the energy inputs controlled by power plant operators, truck drivers, or building supervisors. I'm personally optimistic, but two points temper my enthusiasm:

> Nudging people to do things they weren't doing before likely imposes additional costs. (Hunt Allcott and Judd Kessler explore this point in more detail here.) So, even if the cost of sending letters to the pilots is low, there may be other, unobserved costs. For example, whatever extra time it takes the pilots to update the fuel calculations is time they were previously spending doing something else. And, even if it was just getting a cup of coffee at the airport, it was something they must have enjoyed, because they chose to do it.

Greer, List and Metcalfe thought about this, and surveyed pilots after the experiment. They found that if anything pilots reported higher job satisfaction, especially those who met their personal goals and donated to charity. While we can't rule out additional costs (unobserved

costs are notoriously hard to quantify…), that result at least suggests they are small and possibly negative.

> While the fuel savings are decent sized and statistically significant, they amount to small tweaks to the way an industry does business. But, climate scientists suggest that we need to reduce GHG emissions by around 80% to avoid dramatic disruptions, which we can't do with only small tweaks. Every little bit certainly helps, but we can't stop looking for more fundamental changes within sectors. (The Wall Street Journal had a recent piece on electric and hybrid planes, which still sound a bit futuristic, but you never know.)

As the researchers point out, providing feedback to the pilots involved large amounts of data (on over 40,000 flights), which were collected, quickly analyzed and sent to the pilots. At the most fundamental level, I see this experiment as an example of how using lots of personalized, high frequency data can give valuable feedback to decision-makers. Let's hope more companies take similar opportunities to find savings this way – it's in their best interest, as well as the climate's.

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Wolfram has published extensively on the economics of energy markets. Her work has analyzed rural electrification programs in the developing world, energy efficiency programs in the US, the effects of environmental regulation on energy markets and the impact of privatization and restructuring in the US and UK. She is currently implementing several randomized controlled trials to evaluate energy programs in the U.S., Ghana, and Kenya.

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