Analysis of "What Goes Up … Ontario's Soaring Electricity Prices and How to Get Them Down"

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1 Introduction

On October 30, the Fraser Institute released a report by Ross McKitrick and Tom Adams entitled "What Goes Up … Ontario's Soaring Electricity Prices and How to Get Them Down."[1] The Fraser Institute is a Canadian think-tank that has been described as conservative and libertarian. Ross McKitrick is a professor of Economics at Guelph University. Tom Adams' website describes him as "an independent energy and environmental advisor and blogger." He has frequently criticized wind power and advocated the retention of Ontario's coal plants.

The heart of McKitrick and Adams' report is an econometric analysis of the Global Adjustment (GA), which is one of many components of Ontario's electricity rates. They attribute the increase in the GA over the last ten years to wind, solar and new hydro generation; with increases in exports and gas capacity and generation, and decreases in imports and coal generation also being significant. On the basis of this analysis, they recommend a moratorium on new wind, solar and hydro development, tearing up existing Feed-In Tariff contracts, and restarting Ontario's coal plants, as well as investigating imports from Quebec, and subjecting nuclear refurbishment to a cost-benefit test (pp. 24-28).

2 Global Adjustment vs. Total Electricity Bill

McKitrick and Adams focus on one component of the electricity bill: the GA. The GA is one of two components of the wholesale supply cost, with the other being the market price of electricity (the Hourly Ontario Energy Price, or HOEP). The GA varies inversely with HOEP because of the way that nuclear, hydro, wind, solar, gas and other plants are paid: when HOEP is low and generating plants earn less from the market, they are topped up out of the GA. As a result, any change in HOEP is approximately offset by an inverse change in the GA, with virtually no net change in consumers' bills.

Given the inverse relationship between the GA and HOEP, it is more useful to analyze and forecast the wholesale supply cost, which is the sum of the two, rather than each separately, because consumers pay the sum. But even this is not the full picture because consumers' bills include a number of other components, including transmission, distribution and regulated charges. The Debt Recovery Charge of 0.7¢/kWh ($7/MWh), for example, is largely due to Ontario's nuclear plants and their stranded debt, but is not included in the wholesale supply cost. Power Advisory estimates that wind and solar each contribute approximately 7% of the wholesale supply cost, and 4% of a typical consumers' total electricity bill.

3 Second-Order Impact of Wind on the Global Adjustment

McKitrick and Adams support their claim that wind generation has increased the GA (and by implication, consumers' electricity bills) in two ways: based on their econometric model (discussed in detail below) and by claiming that, in addition to its primary impact on the GA through its contract costs, wind has an additional second-order impact on the Global Adjustment:

> But there are interaction effects between generators that influence overall consumer cost and must also be taken into account. For instance, wind turbine operators can bid into the market

[1] http://www.fraserinstitute.org/research-news/display.aspx?id=21912

> at low (and even negative) prices because of their revenue guarantee, which drives down the wholesale price across the market, increasing the gap between what other generators are paid and the revenues they were guaranteed by the province. The addition of new wind capacity exacerbates this distortion, creating a second-order effect on the GA. (p. 2)

Any low-variable-cost generation – wind, nuclear, coal, etc. – tends to reduce HOEP because it is set to balance supply and demand. However, the effect is minor: for example, Power Advisory estimates that if Ontario had had no wind generation in 2014, and had not replaced this missing wind capacity with any other type of generation, HOEP would have been approximately 0.2¢/kWh higher. Moreover, while the presence of wind generation did indeed push down HOEP, which increased the GA, this second-order effect had almost no impact on what consumers pay for electricity, as every change in HOEP is offset by an approximately equal change in the GA.

Wind has contributed to the increase in the GA over the last ten years, as wind contract costs are paid in part out of the GA. As discussed above, this amounts to approximately 4% of the total electricity bill of a typical consumer. Contrary to McKitrick and Adams' claim, there is no secondary impact.

4 Modeling Issues

The final version of McKitrick and Adams' econometric model includes one dependent variable – the GA – and twelve independent variables. Its most notable feature, however, is what it doesn't include: the twelve independent variables do not include HOEP, the price of natural gas or even a time trend.

One of the fundamental realities of Ontario's electricity pricing system is that the GA varies inversely with HOEP. The statistical relationship is very strong: $R^2 = 0.87$.[2] As discussed above, this is a common-sense relationship, based on how the GA is determined. Another fundamental reality about Ontario's electricity pricing system is that HOEP in turn is largely a function of the price of natural gas: when the gas price goes down (as it has over the last decade), HOEP goes down. McKitrick and Adams acknowledge that the price of natural gas "strongly influences the HOEP (correlation = 0.86)" (p. 12).McKitrick and Adams' econometric model leaves out both these realities: HOEP is omitted from the regression model, and only the change in the price of gas from the previous month is included, which obscures the fundamental relationship. HOEP is omitted because McKitrick and Adam claim "it may introduce a problem of endogeneity bias" (p. 11) without providing any basis for this claim[3]; rather than further investigating this issue, or using an alternate form of the variable, they simply leave out the single most important factor affecting the GA. The price of natural gas is not used because "this variable appears to have a unit root" (p. 12)[4]. McKitrick and Adams use the first difference in the price of natural gas (i.e., the change in the price of gas since the previous period), which obscures the fundamental reality that the price of natural gas fell by over 60% during the study period (from

[2] The coefficient of determination, denoted "R^2" and pronounced "R squared", is a measure of how well a regression model fits the data. R^2 =1 means a perfect fit. The relationship was calculated based on month GA and monthly average HOEP for January 2005 through December 2013, with both expressed in real 2013 Canadian dollars.

[3] The word "endogeneity" do not appear elsewhere in the report.

[4] In simplified terms, a variable has a unit root if it follows a random walk, rather than tending to revert to an underlying value. Economic theory suggests that natural gas prices should in the long term revert to approximately the cost of supply rather than following a random walk.

approximately C$10.50/MMBtu at the Dawn gas hub in 2005 to approximately C$4/MMBtu in 2013); that the fall in natural gas prices was largely responsible for HOEP decreasing by more than 60% (from C$68/MWh in 2005 to $25/MWh in 2013); and that the decline in HOEP played a large role in the increase in the GA.

Using econometric analysis to tease out the factors contributing to change in the GA is challenging, even with a well-specified model, because the GA has increased steadily over time. Regression analysis for 2005 through 2013, with time as the only independent variable, gives $R^2 = 0.84$, virtually indistinguishable from McKitrick and Adams' final result of Adjusted $R^2 = 0.86$ (p. 17)[5], even though it uses only one independent variable instead of twelve. McKitrick and Adams chose not to include a time trend in their model, even though it would not suffer from endogeneity or have a unit root.

Figure 1: Monthly Global Adjustment With a Time Trendline

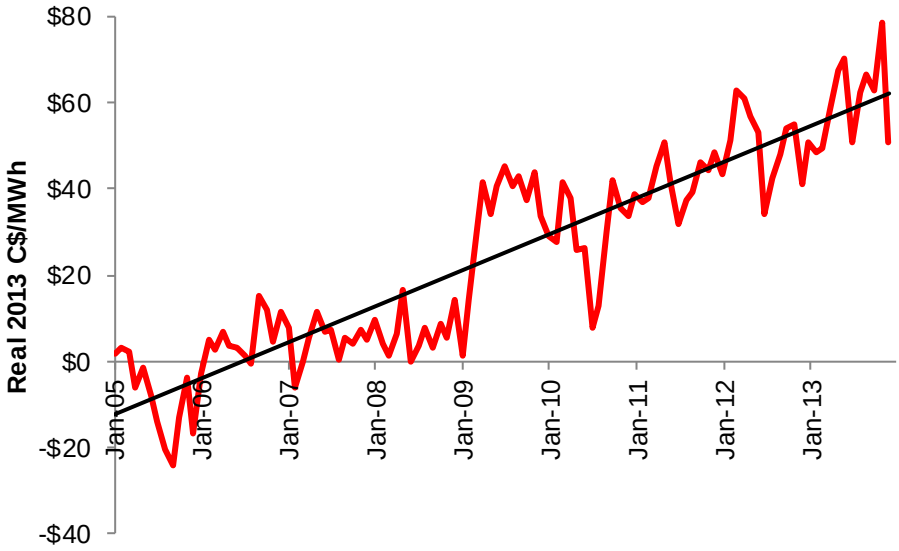

Table 4 on page 17 of McKitrick and Adams' report shows the results of their econometric model. Having left out HOEP, the price of natural gas, and even a time trend, the only two conclusions that can reasonably be drawn from their results are:

- A variable that has tended to increase over time, such as the GA, is positively correlated with other variables that have increased over time, such as wind generation and wind capacity, solar generation, new hydro capacity and exports, and negatively correlated with variables that have decreased over time, such as coal generation and imports.
- Regression equations with large numbers of independent variables can, after sufficient iterations, result in high R^2.

As every first-year student of statistics is taught, correlation is not causation. The fact that wind capacity, for example, is correlated with the GA does not mean the increase in wind capacity caused the

[5] Adjusted R^2 is used when there is more than one independent variable.

increase in the GA (any more than it means that the increase in the GA caused the increase in wind capacity); it merely means that both increased over time.

Another truism is that "the absence of evidence is not evidence of absence." While McKitrick and Adams' analysis proves nothing about why the GA has increased, it is nonetheless true that wind and solar have contributed to this increase – though far less than what McKitrick and Adams estimated. Power Advisory estimates that wind is now responsible for approximately 8% of the GA, and solar for 9%, up from zero in 2005 when there was virtually no wind or solar generation in Ontario. Of more relevance to consumers, both wind and solar contribute approximately 4% to a typical consumer's total electricity bill.

5 Estimating the Impact of Wind and Solar on Electricity Bills

Ontario's electricity system is complicated, and in Power Advisory's opinion cannot be captured in a simplistic linear regression model. Power Advisory uses multiple models to analyze and forecast HOEP, but these use what McKitrick and Adams refer to as "an accounting methodology", in that they explicitly track the fundamental factors and the relationships between them. In fact, the accounting methodology which we use to estimate the GA is essentially the same methodology that is used to set electricity rates for most low-volume customers in Ontario.

Power Advisory's analysis indicates that the increase in wind and gas generation is one of a number of factors that have contributed to increases in the cost of electricity in Ontario. Any new source of supply is likely to be more expensive than Ontario's existing nuclear and hydro plants which have been in service for decades and have largely been depreciated. Whether consumers' bills would have been lower if Ontario had followed some other path that excluded wind and solar is a complex question that cannot be answered with a simplistic regression model.