Switching Energy Suppliers: It's Not All About the Money

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In light of low levels of consumer switching in pursuit of cheaper deals, governments in the UK and Australia have reintroduced price caps for energy consumers, responding to concerns that many consumers are paying 'over the odds'. By apparently 'leaving money on the table' when spurning the chance to pay less for an apparently homogeneous product, such consumers do not sit easily with simple utility-maximising models of behaviour, particularly since energy costs constitute a significant proportion of household expenditure.

To address this phenomenon, we observe the responses of consumers to real offers made in an opt-in collective switch, called 'The Big Switch' (TBS), where participants had to exert only minimal effort to complete a switch once presented with an offer that would have reduced their annual energy bill. (The 'search' process of finding a better deal was performed by TBS process itself, and so we are able to identify pure determinants of consumer switching.) The offers made to more than 7,000 consumers, and a record of their decisions, are combined with survey data about their attitudes and circumstances.

We use a probit model to identify the factors associated with accepting an offer. These include the potential savings available, the presence of exit fees, non-price preferences (e.g. the environmental stance of suppliers), uncertainty, consumer preparedness, concerns with the switching process, time pressures and demographic details.

Only just over a quarter of those who were offered positive savings took the small step necessary to accept the offer. Even for savings of over £300 per year (around a third of the average bill), only around half of the consumers switched, despite the fact that these participants had already actively opted in to TBS, faced no additional search costs and often had characteristics usually associated with market engagement. We conclude a range of non-monetary factors limit switching in the retail energy market, even after all search costs are eliminated. The size of the potential saving *does* have a positive effect on the propensity to switch, but the prospect of substantial savings is by itself insufficient to induce a majority of participants to switch, despite the small additional effort required.

A range of non-price factors—uncertainty, the non-monetary characteristics of different offers, concerns about the switching process and time pressures when TBS occurred—are all associated with the switching decision. Some results, such as the seemingly disproportionate weight attached to exit fees, and the negative impact of seeing two offers rather than one, may suggest elements of behavioural bias. However, most of the factors we identify are consistent with consumers making a largely rational decision when choosing not to switch, even if this results in monetary savings being left on the table.

Our findings mean that the freedom to switch cannot be relied on to put most consumers on the cheapest deal for them. Indeed, our results suggest that some consumers consciously choose

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to remain with more expensive suppliers due to non-price preferences (e.g. regarding a supplier's ethical/environmental stance). These non-price preferences mean that consumers do not really regard energy as a homogeneous product.

Opt-in collective switching processes do not offer a panacea in terms of getting consumers to switch to cheap energy deals, since they still rely on consumer engagement, both to choose to take part and to accept the auction offer. Since financial savings are associated with switching, policies which restrict available savings are likely to reduce the switching rate. However, the proportion of TBS participants not switching suggests that relying on consumers to drive down firms' margins is likely to prove disappointing.

If the well-educated, highly-engaged, savings-seeking TBS participants did not behave like the model consumers envisaged in an idealized homogeneous product market, policymakers should lower their expectations about the power of consumer engagement to promote competition in retail energy markets.

The Price Impact of Energy Vouchers

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France and South Korea have implemented voucher programs in order to counter energy poverty. Energy poverty occurs when a household cannot afford the required energy expenditure for basic needs such as heating. Both countries consider as energy poor any household who spends more than 10% of income on energy. As 14% of the French households in 2018 and 11.6% of the South Korean households in 2011 are energy poor by this criterion, it is a large-scale phenomenon. Our paper investigates whether the increase of energy demand that a voucher program entails has an impact on the price of energy.

Although the use of vouchers to subsidize necessary goods has existed for a long time, they traditionally target goods supplied by private firms with relatively low market power at the national level (food, housing) or by non-profit organizations (education, health care). In contrast, the market structure that dominates energy supply is one of a national oligopolistic network industry. Firms of such an industry can have a strategic response to any policy that impacts it. Our main contribution is to take into account this strategic behavior in the formation of the energy price.

Our theoretical approach consists in modelling a game between energy suppliers and a regulator, where suppliers maximize profit while the regulator ensures that no consumer spends more than a given share of income on energy. From a benchmark case with no vouchers, we analyze the impact of their introduction in three settings: one where firms and the regulator make decisions simultaneously, one where firms move first and one where the regulator moves first. The first setting corresponds to a case where neither the industry nor the regulator has a commitment power that enables it to announce first its decision and stick to it. The two others correspond to cases where such commitment power exists for the firms or for the regulator, respectively.

We show that the implementation of the voucher program reduces the energy price under simultaneous decision-making or when the regulator moves first. However, the impact of vouchers on the energy price is ambiguous if firms move first. This scenario's price is above the price of the simultaneous decision scenario's price.

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The possibility of a price reduction can be at first surprising as increasing the household's demand of energy would seem to increase the market power of energy suppliers. This does not occur because the distribution of vouchers increases the price elasticity of demand of eligible consumers, so that it in fact decreases the market power of suppliers. This reduction of market power can however be partially or fully countered by firms when they move first.

We also suggest how the model can be extended to take into account other definitions of energy poverty than the one used in France and South Korea. Our results are robust to the extent that the voucher distribution increases the price elasticity of demand of eligible consumers.

Writing energy economics research for impact

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We highlight the importance of effective writing in energy economics for generating impact from research. Our study shows that 20 percent of the future impact of research, measured by subsequent citations to a research article, are derived from non-topic aspects of how research is structured and written.

Our working sample is all articles published in *The Energy Journal* between 1996 and 2013. For these articles we measure citations received after publication as an indicator of research impact. To determine non-topic drivers of this impact we include 19 features of how an article is written.

These features include the initial information that a potential reader sees when deciding what article to read. For this, we highlight the importance of title construction and abstract readability. We next examine the article itself and explore the importance of the readability and writing style of the article. An active voice in writing, use of visual aids, and writing towards the least sophisticated rather than the most sophisticated potential reader of the article, is highly recommended. We also show the importance of references within the article. These should be plentiful (with justification), recent, and include significant references drawn from peer journals, including *The Energy Journal*. Lastly, we show the importance of research teams with experienced authors who have generated research impact in the past.

Our article is written as a guide for future writers and is of benefit to those seeking to publish in energy economics journals, but also those engaged in wider writing in energy economics. Our writing approach blends statistical analysis with prior published advice on writing effectively in energy economics, to offer a refined and tailored approach for energy economics writing. The overall message of the article is that the normal drivers of impact matter - topic, research question, and testing - but also that how research is presented and structured makes a difference in how a research study will be perceived.

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Do Foreign Gifts Buy Corporate Political Action? Evidence from the Saudi Crude Discount Program

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From 1991 to 2003, Saudi Arabia maintained a position as the top supplier of foreign crude to U.S. refiners in order to support its political alliance with the United States. Although oil is often thought of as having one world price, Saudi Aramco supported this export strategy by selling the same crude at different prices in different geographic markets. Maintaining the pricing differentials required by its export targets appears to have been both politically strategic and quite expensive: between 1991 and 2003, Saudi Arabia spent approximately 8.5 billion dollars selling discounted crude to the United States. The per-barrel discount relative to the Asian price reached a high of 6.30 dollars, 30 percent of the U.S. crude price in 2001, and was worth 1.9 billion dollars that year alone.

In achieving its export target, Saudi Arabia therefore transferred substantial rents to the U.S. oil industry in the form of discounted crude supplies. In addition to determining the total value of this transfer through its export quotas and pricing policies, Saudi Arabia also controlled how these rents were distributed within the United States; discounted crude was targeted at specific refineries using highly restrictive sales contracts. The allocation of discounted crude may itself have served as a political tool: refiners who receive discounted crude would have had incentives to take political action in support of Saudi Arabia to protect their access to these rents. This policy is an empirically appealing example of Saudi strategic political behavior both because it had a clearly measurable cost and because it was effectively directed at specific recipients. This paper assesses the incidence of these discount rents in the U.S. market and yields the first empirical evidence for the use of oil as a tool of political leverage through transfers to American firms.

There are several main results. First, there was a great deal of heterogeneity in the value of the discount received by different companies and significant geographical dispersion in the destination of Saudi crude. There is also variation even among refineries of similar capacity and in similar locations as well as within a single refinery over time. This variation allows for an estimation of the impact of discount receipts on refiner profits, and I find that most of the discount rents were captured by refinery owners as profits rather than passed through to consumers as lower gasoline prices. The capture of rents appears to have been almost complete, supporting the idea that the discount was purposefully targeted at specific refiners. Receipts of imports from other countries do not appear to have a similar association with excess profits.

Finally, I examine the effect of discount receipts on one particular type of measurable corporate
political action: contributions to congressional campaigns. These results suggest that this gift was related to some amount of pro-Saudi political action on the part of recipients. Discounts were also associated with increases in refiners' overall political contributions as well as reallocations of these contributions. Recipients shifted contributions away from Members of Congress who received donations from pro-Israel interest groups, which may have been consistent with Saudi foreign policy objectives at the time. Politicians who received more contributions from discount recipients (relative to contributions from other refiners) were more likely to vote in favor of Saudi interests in a House vote at the end of the discount period.

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The results have implications in several different areas. First, the study adds to the small literature on the discount program, showing that the price differentials created rents for U.S. refiners. This paper also provides evidence on the incidence of heterogeneous cost changes in the oil refining industry, supporting the idea that certain types of cost changes may be captured as profits rather than passed through into product prices. This paper also adds a quantitative dimension to the literature on the political economy of global energy markets, providing empirical evidence for the use of Saudi oil not only directly as a tool of political leverage, but through transfers to American companies. This analysis contributes to the broader literature on the relationship between business and politics and the determinants of political giving by corporations. In particular, the Saudi crude discount program serves as an example of a non-standard lobbying channel that offers a window into how firm preferences over the amount and allocation of their political giving are affected by their other business relationships. This is the case whether the discount is passed through into contributions, contributions are used to solicit discount rents, or whether recipients' interests are simply more aligned with Saudi interests. This empirical evidence thus provides a window into the use of these channels of influence in forging economic and political ties through the global energy market.

All the DUCs in a Row: Natural Gas Production in U.S.

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Drilling activity, measured in terms of the count of actively drilling rigs, has been often used as the primary determinant of oil and gas production. However, in recent years natural gas output in the U.S. grew despite the decline in drilling activity. In this study, we use aggregate and well level data from seven major U.S. shale gas regions to examine the implications of the growth in DUC (drilled but uncompleted) well inventory for natural gas output. Our empirical strategy includes three components. First, we analyze natural gas production in terms of rig counts and completed wells using two-way fixed-effects models and vector autoregressive models. Second, we analyze the DUC inventory within and across regions using two-way fixed-effects regressions. Third, we examine the unconventional well DUC status duration using the survival analysis technique.

None of the previous studies examine the growth in DUC inventory and the relationships between gas production, drilling rig activity, and well completion in the unconventional oil and gas industry. This paper is the first empirical analysis of DUCs and their effects on natural gas production. We disentangle drilling activity from completion, which allows us to present a more nuanced account of gas production given the recent growth in the number of drilled but uncompleted wells.

We observe that in recent years, the explanatory power of drilling rig count has declined. On the other hand, the cumulative number of completed wells remains an important factor in explaining the variation in gas output. An increase in DUC inventory has a significant effect on natural gas output, while DUC inventory depends on drilling rig activity and futures prices of oil and natural gas. Results indicate that well completion decisions and the duration of DUC status depend on oil and gas futures prices, pipeline capacity, producing well type and well depth. Survival analysis shows that an increase in oil and natural gas futures prices motivates operators to complete existing drilled wells sooner. These results are consistent with producers hedging gas production to take ad-

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vantage of high initial well productivity. The results also confirm the effect of pipeline infrastructure bottlenecks in natural gas markets.

The Impact of Energy Production on Farmland Markets: Evidence from the 2008 New York Shale Gas Moratorium

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The U.S. is well on its way to becoming a net energy exporter. Most of the current or planned energy production, whether conventional or renewable, will take place on farmland. However, little is known about how energy production influences farmland markets. Further, there have been multiple debates on the impacts of shale gas development (SGD) on the economy, environment, and social welfare. This study contributes to these debates by quantifying a major economic benefit of energy production for rural landowners, through estimating the net valuation of future SGD as reflected in farmland values.

We employ a dataset of farmland transaction or sales information, matched with geographical information and soil characteristics. Given the large number of variables in our original dataset related to soil quality, we use machine learning techniques to trim down the number of variables entering our main model. This approach allows us to better control for the agricultural use value of farmland and strengthens our ability to isolate the impact a major, unexpected policy announcement. We exploit the discrete change in expectations caused by the 2008 New York State moratorium on hydraulic fracturing, to investigate the impact of the moratorium on farmland valuation. We recover the net valuation of shale gas development with a hedonic price model and a difference-in-differences empirical strategy. The treatment area is counties in New York's Southern Tier (fairway counties) that are suitable for shale gas extraction and the control is adjacent counties, which are likewise not suitable for shale gas extraction. We also use "North Country" counties as a control and find similar results. We consider farmland sales prices 9 months before and 9 months after the moratorium, although our results are robust to a longer study period. We also split our sample by urban proximity and find a larger impact of the moratorium in areas with less urban influence, suggesting that the concurrent recession does not explain our result.

We estimate that agricultural properties in New York's Southern Tier experienced an average decline of approximately $1,400/acre in value due to the shale gas moratorium. This is approximately 40 percent of farmland values in the region and comparable in magnitude with related studies. Our results suggest that energy production can lead to substantial returns for rural landowners and also influence farmland markets.

The major contribution of this paper is that we provide novel evidence of the impact of SGD on farmland values. This informs debates on the broader economic and societal impacts of energy production as well as provides insight into implications of energy development for the agricultural sector. To the best of our knowledge, this is the first study focused on the impact of the NYS shale gas moratorium on farmland values and one of the few studies on the impact of energy production on farmland. Further, our use of LASSO demonstrates how machine learning techniques are useful for variable selection in hedonic property valuation studies. In this study, LASSO leads to more robust controls for the agricultural use value of farmland.

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Our estimate of the impact of the moratorium on farmland values and total farmland acreage in New York's Southern Tier implies an approximate potential loss of over $1 billion for farmland owners. This estimate is comparable to the expected impact of state government programs targeting this region. Overall, we show that rural landowners anticipated large economic benefits from shale gas production. Given that farmland makes up over 80 percent of farm assets, the broader impacts of energy production on agriculture is an important area for future research.

Demand Response: Smart Market Designs for Smart Consumers

Nicolas Astier,[a] and Thomas-Olivier Léautier[b]

Although the marginal cost of producing electricity may vary significantly over time, electricity retailers have historically charged simple tariffs subject to infrequent updates. However, as smart metering technologies are being rolled out, more complex tariff structures are becoming implementable.

Peak-Time Rebate (PTR) pricing is one of the most popular of these new tariff structures. It consists in rewarding consumers financially if, during specific hours when wholesale prices are high, they decrease their consumption relative to a counterfactual called *baseline*. Because customers are likely to be better informed than their retailer about (some aspects of) their future consumption, computing this baseline raises a problem of asymmetric information.

This work explicitly takes asymmetric information into account to study Peak-Time-Rebate contracts in day-ahead electricity markets. We start by highlighting a structural flaw of these mechanisms: embedded arbitrage opportunities. Consumers are allowed to buy their baseline power at a constant (state-independent) price while this power is worth more by construction. Under asymmetric information, PTR tariffs thus incentivize strategic consumers to inflate their baseline. We then show that making PTR contracts incentive compatible is equivalent to implementing a variable Critical-Peak-Pricing mechanism (vCPP), in which customers have to purchase their peak consumption at the spot price.

Whenever asymmetric information is a significant concern, vCPP mechanisms should thus be preferred. The relevant economic issue then becomes to design vCPP contracts optimally in order to achieve high enrollment rates under voluntary opt-in. We argue that this problem has different solutions depending on the industry structure on the one hand, and on whether or not policy-makers choose to maintain historical cross-subsidies on the other hand. We suggest there may exist complementarities between both aspects. Indeed, if subsidies to non-switchers are not to be maintained, retailers under perfect competition will offer Real Time Pricing contracts, all consumers will enroll, and the most efficient outcome will be reached. If on the contrary subsidies are to be maintained, a monopoly retailer may be in a better position to reach the second-best outcome, due to its ability to monitor the level of public spending. Other combinations of retail industry structures and political choices regarding historical cross-subsidies face difficulties than may induce inferior outcomes.

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The Rebound Effect in Energy-Intensive Industries: A Factor Demand Model with Asymmetric Price Response

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In this paper the rebound effect from energy efficiency improvement in the Swedish energy intensive industry is empirically assessed. The rebound effect represents economic behavior that will offset energy savings from energy efficiency improvements.

The challenge of climate change, together with energy security concerns, has spurred an increased societal interest in energy efficiency improvements. In 2016 EU presented a package of measures, "Clean energy for all", in which one ambition is to prioritize improvements in energy efficiency. The EU Energy Efficiency Directive has been revised within this package and now includes updated and extended national energy savings requirements to 2030 (Article 7). The Commission declares that the most efficient energy is the one not being consumed, i.e., indicating an ambition of decreasing energy use. This addresses the importance of not implementing policy measures resulting in significant rebound effects.

The paper focuses on four sectors in Sweden during the period 2001-2012; pulp and paper, iron and steel, chemical, and mining. We apply a factor demand model to estimate energy own-price elasticities, which serve as approximations of the size of the direct rebound effect. The model allows for asymmetric price response, i.e., that firms may response differently to increasing versus decreasing energy prices. In that case own-price elasticities calculated on decreasing energy prices should serve as approximations of the size of the rebound effect.

The result shows considerable rebound effects in the studied industries. For electricity and non-fossil fuels, e.g., efficiency improvements could even result in 'backfire'. Regarding fossil fuels the results suggested a smaller, but still considerable, rebound.

The results have important policy implications, not the least in relation to so-called industry energy efficiency programs. In Sweden, such a policy gives industrial firms the opportunity to seek financial support if conducting investments in energy efficiency measures whilst meeting the minimum permitted energy tax rate within the EU. However, to mitigate rebound, such policies should instead be combined with a raise in energy taxes if the ambition is to reduce overall energy use.

The Impact of a Revenue-Neutral Carbon Tax on GDP Dynamics: The Case of British Columbia

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The effect of environmental taxes on GDP is a major policy concern and it continues to generate heated debates in public squares. One side argues that environmental taxes produce a negative effect on the economy since they increase costs and may also adversely affect competitiveness. The other contends that, not only can environmental taxes reduce negative externalities such as

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pollution and global warming, but they may also increase GDP via the double-dividend economic argument. This can notably happen when the new tax is designed to be revenue-neutral and it replaces less efficient duties, such as those applied to personal and business income.

We rely on a unique policy that was enacted by the government of the province of British Columbia (B.C.) of Canada to study the effects over time of a revenue-neutral-designed environmental tax on the province's GDP. This carbon tax was applied to a broad range of greenhouse gas (GHG) emissions originating from fossil fuel use in the province, and its coming into effect in mid-2008, and the subsequent rate hikes and their timings over the next five years, were all pre-announced. We also study the extent of tax pass-through over time into energy prices.

We apply time series methods to suitably-constructed aggregate energy price and aggregate carbon tax series, taking into account possible pre-announcements and tax saliency effects. Results from estimated impulse response functions, and from statistical comparisons of GDP changes over time in the presence and (counterfactual) absence of carbon taxes, lead to the same result: globally, revenue-neutral carbon taxation has no negative impacts on GDP. We thus conclude that implementing a pre-announced policy of revenue-neutral carbon taxation by a jurisdiction contributes to lowering harmful greenhouse gases into the atmosphere without hurting the overall economy of the associated region. We also conclude that our data span is currently too limited to inform us on whether there have been any long run positive effects on GDP. Finally, we find that pass-through of carbon tax changes into energy prices has been complete, with consumers incurring the full extent of the tax increase.

Are Carbon Prices Redundant in the 2030 Eu Climate and Energy Policy Package?

Finn Roar Aune and Rolf Golombek

In 2018, an agreement between the key EU institutions—the Commission, the European Parliament, and the European Council—was reached after a long-lasting discourse over the 2030 EU climate and energy policy package. While there had been disagreement over the types of energy targets and how ambitious the targets should be, the parties agreed to an EU-wide renewable share in final energy consumption of 32 percent, to improve EU energy efficiency by 32.5 percent (relative to 2005), and also to reduce greenhouse gas (GHG) emissions by (at least) 40 percent (relative to 1990). The aim of this paper is to offer a comprehensive assessment of the approved EU 2030 climate and energy package. As there have been intense debates on which targets the EU should reach, we also analyze the 2030 outcome if, hypothetically, alternative energy policy targets had been agreed upon (or the EU energy targets are changed in the future).

The motivation of this paper is that the EU 2030 policy package is probably the single most important factor with respect to the development of the European energy markets and it also has powerful implications for policy design. The package is complex as it contains three types of targets: GHG emissions, renewables, and energy efficiency. Each target will contribute to decreased GHG emissions. While standard economic theory predicts the main effects of reaching each of the targets in the EU 2030 package, the net effects of reaching all targets, as well as the magnitude of the effects, cannot be predicted from theory; a numerical model is needed. In this study, we use the numerical model LIBEMOD to find the equilibrium effects of the EU 2030 climate and energy package.

LIBEMOD is a multigood, multiperiod model covering the entire value chain in the energy markets in 30 European countries from investment, extraction, and production via trade to consumption. In LIBEMOD, emissions reductions in the electricity generation sector are accomplished

through a different mix and scale of electricity technologies; a higher price of emissions triggers less investment in, and production of, fossil fuel-based electricity. In the end-user sectors, emissions reductions require higher end-user prices. LIBEMOD determines all energy prices and quantities in the European energy markets. Because renewable electricity plays a critical role in reaching the 2030 EU targets, investment in hydro, bio, wind, and solar power is endogenous in LIBEMOD. The model finds the combination of policy instruments that is consistent with reaching all policy goals.

This paper makes three contributions to the literature. Whereas the 2030 EU climate and energy policy package was analyzed in a commissioned work by the EU Commission, see PRIMES (2019), the present paper is the first "external" study of the 2030 package. Our first contribution is to characterize the outcome when all EU climate and energy targets are required to be met. We find that the targets for renewables and improved energy efficiency have been set so high that the implied GHG emissions reduction is 50 percent, which is *higher* than the agreed-upon 40 percent target. This result is in line with the commissioned work by the EU Commission, which found that the 2030 package will lower GHG emissions by 46 percent.

We find that by achieving the renewable and energy efficiency targets, both the ETS and non-ETS emissions targets are met. Hence, there is no need for a climate policy. However, while an efficient emissions reduction is characterized by equal marginal cost of emissions reduction in the ETS and non-ETS sectors, there is no reason to believe that cost efficiency will be reached when the emissions reduction is obtained through achieving the renewable and energy efficiency targets. In fact, we demonstrate that if a 50 percent GHG emissions reduction is reached cost-efficiently, then annual welfare increases (relative to the Reference scenario above) by an amount corresponding to 0.6 percent of GDP in Europe.

For years there has been a heated debate in the EU on whether there should be policy targets for renewables and improvement in energy efficiency, and if so, how ambitious these should be. Our second contribution is to examine how a renewable share in final energy consumption other than 32 percent, as well as an improvement in energy efficiency other than 32.5 percent, will affect emissions in the ETS and non-ETS sectors. We also show how the policy instruments imposed to reach the two energy policy targets need to be adjusted when the energy targets take alternative values.

Our third contribution is to the energy modeling literature. Here, our main contribution is to offer a framework for endogenizing investment in intermittent power (wind and solar power) and to present a calibration strategy that quantifies structural wind and solar parameters.

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