

# IMPLICATIONS OF INDEPENDENCE: AN ANALYSIS OF THE RELATIONSHIP BETWEEN ENERGY INDEPENDENCE AND GLOBALIZATION IN OECD NATIONS

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## ABSTRACT

Dependence on foreign energy both constrains a state's ability to act independently in the international system and increases its vulnerability to other state and non-state actors. Moreover, one of the major oil-supplying regions, the Middle East, continues to be extremely politically unstable, further contributing to the vulnerability associated with dependence on foreign energy. Today, with many states refocusing political capital into the goal of energy independence, it is increasingly important for scholars to understand the consequences of energy independence upon state behavior. This study seeks to explain how differing levels of energy independence affect a state's level of global engagement. I have quantified energy independence for the Organization of Economic Cooperation and Development (OECD) countries in order to statistically analyze the possible relationship between energy independence and political and economic globalization. To the extent that global engagement provides states with some remedy to the vulnerability linked to their energy dependence, I hypothesize that as countries are increasingly energy independent, they are likely to be both increasingly politically and economically disengaged in the international arena. The statistical analysis supports these hypotheses.

## INTRODUCTION

*"Since the first price explosion of 1973, we have learned that the energy crisis is not a mere problem of transitional adjustment; it is a grave challenge to the political and economic structure of the free world." – Henry Kissinger*

Energy independence is defined as the sufficient production of energy domestically to meet domestic demand for each source of energy, freeing a state from relying on foreign sources of energy. It is increasingly clear that dependence on foreign energy both constrains a state's ability to act independently in the international system and increases its vulnerability to other state and non-state actors. Moreover, one of the major oil-supplying regions, the Middle East, is currently extremely politically unstable, further contributing to the vulnerability associated with critical-resource dependence. From a historical perspective, instability

in oil-producing regions has demonstrated the dangers of energy dependence most notably during the Organization of Petroleum Exporting Countries (OPEC) oil embargo of 1973. Today, many countries have made energy independence a national priority; however, very little is known about the consequences of this independence upon their behavior in the international system.

There are two main sides to this unresolved debate over the implications of energy independence. Some argue that as a country becomes increasingly independent, it is more likely to become more isolationist.<sup>1</sup> A state does not need to rely on the international marketplace and the international political arena to ensure access to this critical resource if it is able to meet domestic demand through domestic production. Thus, the country becomes more inward looking, and prioritizes domestic policy over international issues. Others argue that as a country becomes increasingly independent, it will become more globally engaged.<sup>2</sup> Such a state does not have

the limitations of acting in the international political and economic arena with the constraints of ensuring a reliable flow of energy, allowing the state free rein in conducting its foreign policy. Much of the debate, however, is focused on anecdotal literature appearing through mainstream media outlets.

This study seeks to examine this same puzzle – whether there is a relationship between differing levels of energy independence and level of global engagement – but in a new light. In particular, I offer an empirically-driven and quantitative test to study the nature of this relationship.

I hypothesize that as states become increasingly energy independent, they are more likely to be politically and economically disengaged in the international arena. I argue that countries are heavily engaged because the international arena and its institutions give them some protection against vulnerability stemmed from lower levels of energy *independence*. Thus, I expect to see a negative relationship between energy independence and political and economic globalization because I believe that states with higher levels of energy independence are less vulnerable, making them less inclined to engage.

## ENERGY AND GLOBALIZATION: LITERATURE REVIEW

To date, little scholarly work exists dedicated to the implications of energy independence. Moreover, because energy independence has never before been quantified on an international scale, all prior work on the subject has been speculation on the consequences of independence or analysis of the possibility that a state becomes independent. In spite of all of these speculations, no work has been devoted to empirical analysis of the relationship between energy independence and globalization. There has been much written on energy *dependence* and energy *security*. Much of the work on energy security and the dangers of dependence focuses on the United States' history of dependence and how each subsequent oil crisis demonstrates the dangers of relying on foreign sources for such a vital resource.

Daniel Yergin, a prominent scholar on energy history and security, has written two books on the subject. In *The Prize*, Yergin chronicles the emergence of oil as the lynchpin of a successful globalized economy and how all modern societies became reliant on

energy. This analysis is valuable because it provides the historical backing for the creation of the term “energy dependence.” Yergin describes the dependence of societies at first on coal and now petroleum, detailing the dangers associated with this reliance.<sup>3</sup> In *The Quest*, Yergin takes a more contemporary approach to energy security analyzing only the Cold War years. Yergin's most significant contribution is his analysis of major current global themes and conflicts through the lens of energy, demonstrating the magnitude of energy issues in dictating international affairs. He looks at the role of energy in the Gulf War of 1991 and the role of energy in the emergence of China as a contemporary global power. By establishing the crucial role of energy in these major international themes and conflicts, Yergin lays the foundation for future scholarship on the relationship between energy dependence and international affairs.<sup>4</sup>

James Hamilton argues that energy dependence compromises energy security. Hamilton uses the catastrophic 1973 and 1979 supply disruptions and their effect on the United States economy as examples to support his argument. Through his economic analysis, Hamilton argues that the doubling in oil prices and rise in the price of gasoline during both crises squeezed the supply for petroleum products, nearly halting the largest economy in the world. If one resource can have such a drastic effect, Hamilton argues, then it is dangerous to depend too greatly upon it.<sup>5</sup>

Cohen, Joutz, and Loungani (2011) argue that there is a relationship between energy *diversification* and energy security. Although their study focuses on trends in the diversification of petroleum and natural gas in the OECD, the conclusion of the study is a proposed relationship between diversification and energy security. The study quantifies energy diversification, but it does not include a measurement of energy security to accurately test this relationship. The importance of this study is in the proposed link between diversification and energy security and overall vulnerability. Although this proposed relationship is ancillary to the proposed relationship between energy independence, vulnerability, and globalization, it is a similar relationship that serves as a model and basis for the formation of this hypothesis.<sup>6</sup>

Similarly, Bengt Johansson (2013) argues that domestic renewable energy sources contribute to energy security. Johansson claims renewable energy

sources, "... do not suffer from the same long-term resource availability problems as finite fossil resources and their geographical location is less concentrated, but other issues such as dependence on variable flowing resources and competition for scarce land resources will grow in importance."<sup>7</sup> Both of these arguments claim that diversification of sources, especially those that are not imported and exported like renewables, contribute positively to energy security. There are however, limitations to these arguments. The main counterargument is rooted in the fact that alternative energy sources, mainly solar and wind, rely heavily on a finite set of natural resources that are known as rare earth metals (REMs); the supply of which is dominated by China. The reason this is significant, is because China has on numerous occasions demonstrated its willingness to cut the supply of these resources to the global market, thus limiting the contribution to energy security as Johansson argues. As recently as 2010, China abruptly cut exports by 40%, citing environmental concerns<sup>8</sup>.

Jonathan Chanis (2012) defines interdependence as mutuality or a reciprocal relation between interdependent entities. With this definition, he argues that full energy independence in the United States is unrealistic. He cites the interdependence between Saudi Arabia, one of the world's largest oil exporters, and the United States, the world's largest oil consumer. This relationship, Chanis argues, is a factor that cannot be ignored when determining the probability of the United States achieving energy independence, even if the United States can produce enough energy domestically to meet demand, due to the mutual reliance created by the purchase of oil by the United States. Chanis claims, "the essence of 'interdependence' involves reciprocal vulnerability—the inability of one side to damage the interests of the other without also damaging itself."<sup>9</sup> Although he uses interdependence to argue that the United States will never be energy independent, the link between energy independence and interdependence is an important relationship that he builds upon in his argument. He also presents the relationship between interdependence and vulnerability, which the argument in this study is based upon.

Most prominently, my study builds on Michael Ross's earlier research on the demand for international institutions (such as the UN, NATO, World Trade Organization and others). The term "demand for

international institutions," is best exemplified by Bernice Lee (2013). Lee argues that, "Keen to guarantee their access to resources in a time of scarcity, Middle Eastern importers of food and Asian importers of raw materials are building economic and trade relationships with the major producing regions."<sup>10</sup> To fulfill the desire to guarantee their access to resources, states are creating and/or joining international organizations that help them achieve these goals. Thus the term "demand for international institutions" refers to countries creating or joining international organizations that help them achieve their goals. International relations theories have suggested that an increase in the transnational flow of goods, services, capital, information, and people generates a demand for international institutions. In other words, interdependence fosters political globalization. As the transnational flow of these goods, services, capital information and people increase, increased cooperation is necessary in order to ensure the smooth and efficient transfer of these goods (Mitrany 1966, Haas 1964, Keohane 1982).<sup>11</sup>

Functionalist theory, introduced by David Mitrany (1966), states that international cooperation and integration through the presence of international institutions is necessary in the search for material efficiency.<sup>12</sup> In *A Working Peace System*, Mitrany (1966) argues that an "international organization must do the same things which national governments do in modern society, only with a difference in scale. It must do those things which cannot be done well, or without friction, except on an international scale."<sup>13</sup> He goes on to argue that the efficient administration of limited resources on a supranational scale is essential for cooperation and for the creation of his ideal "working peace system."<sup>14</sup>

In 1958, Ernst Haas introduced neo-functionalist theory building upon Mitrany. Neo-functionalist theory argues that international integration is the process "whereby political actors in several distinct national settings are persuaded to shift their loyalties and activities towards a new center, whose institutions possess or demand jurisdiction over the pre-existing national states."<sup>15</sup> Although similar to the functionalist argument, Haas argues his point on a regional scale, not on a broad international scale as Mitrany does.

Both Haas and Mitrany establish the relationship between interconnectedness and the demand for international institutions on both the national

and regional scale. Robert Keohane added to the debate in 1982 when he published “The Demand for International Regimes.” Keohane focuses on the demand for international regimes and was the first to suggest the causal link between *interdependence* and the demand for international regimes. Keohane argues, “increased issue density [when several issues are closely linked] will lead to greater demand for international regimes and to more extensive regimes. Since greater issue density is likely to be a feature of situations of high interdependence, this forges a link between interdependence and international regimes: increases in the former can be expected to lead increases in the demand for the later.”<sup>16</sup>

Keohane’s main contribution may be in articulating the difference between interconnectedness and interdependence. This difference is important in determining how the flow of certain types of goods and services spurs demand for international institutions. Interconnectedness refers to the flow of goods, services, and capital across international boundaries. Interdependence refers to the mutual dependence of the flow of such goods, services, and capital.<sup>17</sup> Keohane claims that “a country that imports all of its oil is likely to be more dependent on the continuing flow of petroleum than a country importing furs, jewelry, and perfume (even of equivalent monetary value) will be on uninterrupted access to these luxury goods. Where there are reciprocal (although not necessarily symmetrical) costly effects of transactions, there is interdependence. Where interactions do not have significant costly effects, there is simply interconnectedness.”<sup>18</sup>

In 2011, these theories were applied to the energy space, when Ross examined the unbalanced global engagement among oil exporting states. Ross demonstrates that states that export oil tend to be more politically disengaged and more economically engaged in the international arena. Ross states that “if they were economically influential but politically well-integrated, their status would be unremarkable. If they were both economically and politically marginalized, they would be of lesser concern.” Ross argues that “oil-exporting states have achieved high levels of economic integration, and economic influence, yet remain relatively unfettered by the network of treaties and intergovernmental organizations that typically accompany this level of influence.”<sup>19</sup> Ross defines this phenomenon as “unbalanced globalization.”

Ross shows empirically that oil wealth is associated with high levels of economic integration and low levels of political integration. Oil-rich countries seem to shun international institutions that have a political character and that require legally binding commitments. While he confirms the conventional argument that interdependence cultivates political integration, he shows that petroleum exports have the opposite effect.

Ross argues, “countries with abundant reserves of petroleum—the commodity on which virtually all modern economies depend—are freed from the incentives that lead other countries towards cooperation and reciprocity.” In other words, the dependence that spurs the demand for international institutions is removed as the oil exporters have limited dependence on goods from other nations while the international community is continually reliant on their oil.<sup>20</sup>

Ross’ work introduced the relationship between globalization and energy issues and examined a unique relationship between oil-exporting states and globalization that is contrary to existing literature and theory. However, Ross’ study focuses solely on oil-exporting states, or according to prior international relations theory, certain states that *increase* the transnational flow of goods (in this case oil). Given the debate, this study aims to test Ross’ finding in a broader way with a slightly different method and a different data set that includes the OECD countries and not exclusively oil-exporting states.

Thus, where this study adds to the existing literature is by analyzing what happens when energy independence, rather than energy interdependence, is used as the independent variable. I also believe Ross neglected the inclusion of political variables (such as political system, legislative districting, among others) to his analysis, which could be extremely important to this story. I argue that *energy independence* allows states to be less engaged, and energy dependence results in states being more engaged. Much work has been done analyzing the dangers of energy dependence, but where the study adds to the literature is by analyzing the implications of energy independence.

## ARGUMENT

The literature, as demonstrated above, suggests that interdependence, defined as mutuality or a reciprocal relation between entities, spurs demand

for international institutions. In other words, interdependence spurs political globalization. Those who are involved in international markets want to be engaged in the international institutions that regulate these markets. Ross adds to the existing literature by showing that interdependence spurred by oil wealth does have this effect, yet he does not fully explain why this is the case.

If everyone depends on one state, that state does not need to be engaged in these international institutions. Thus, weak countries that are reliant on others for critical resources must desire international engagement because the international arena and its institutions give those states protection against their own vulnerability. In my opinion, their decreased vulnerability explains why oil exporting states are less engaged. It is not about oil exporting, but about dependence and independence, which is precisely why I introduce the variable of *energy independence* instead.

A state achieves energy independence when the production of each major energy source meets that source's domestic demand. Energy independence, however, is not binary; it can be achieved to varying degrees. In this study, the focus is not on whether or not a country is *wholly* energy independent, but instead on the degree to which a country is energy independent. This study does not seek to test the relationship between wholly energy independent countries and globalization, but rather tests the relationship between varying levels of energy independence and globalization.

Ensuring a steady supply of energy is of critical importance to any state. For countries with higher degrees of energy independence, this is more apparent because a majority of the state's energy mix is produced by domestic producers. Guaranteeing a steady supply of energy becomes significantly more complicated for states that have very low levels of energy independence. These countries rely heavily on foreign sources of energy and need to devote significant time and effort to ensure a steady supply. This task is mostly in the hands of foreign producers and governments, often in volatile regions of the world. Thus, I believe there is a link between differing degrees of energy independence and a country's vulnerability. States that rely heavily on foreign sources of energy are more vulnerable because the steady flow of energy is only partially under each

country's control. These countries also have a greater risk of being exposed to global energy shocks or volatility in energy producing regions.

One of the best examples of this vulnerability can be seen in the United States during the 1973 OPEC Oil Embargo. Up until the late 1950s the United States was wholly energy independent. However, in the early 1960s, domestic consumption began to outpace domestic production.<sup>21</sup> This meant the United States could no longer produce enough energy to meet both domestic and global demand. At the same time, the epicenter of global petroleum production shifted to the Middle East.<sup>22</sup> Middle Eastern oil-producing states began ramping up production to meet increasing global demand. By 1973, the United States imported 6.3 million barrels of oil per day, 48 percent of which came from OPEC.<sup>23</sup> Thus, American energy dependence on foreign sources was born. Soon thereafter, the 1973 crisis caused dependence on foreign oil to become commonly recognized as dangerous and the term "oil weapon," was coined by David Yergin.<sup>24</sup> Before this crisis, reliance on foreign oil was never viewed as an issue or concern. Oil was simply a global commodity exchanged in a global marketplace that was never thought of as having the potential of becoming a political weapon. However, in October of 1973, Egypt and Syria together attacked Israel with the support of other Arab oil-producing countries and the Soviet Union. The same day, the United States supported Israel financially and militarily. On October 16, the member states of OPEC raised prices by 17 percent and announced cuts in oil production. The next day, the OPEC ministers agreed to enact an embargo on exports of oil to the United States as a consequence of the United States' support of Israel.<sup>25</sup> The embargo lasted until March 17, 1974 and had near-crippling effects on the United States economy, as domestic production of energy could not meet demand.<sup>26</sup> The price of oil quadrupled, and the price of retail gasoline increased by 40 percent in a matter of months amidst massive shortages throughout the country.<sup>27</sup> This 1973 embargo serves as a quintessential example of the connection between energy dependence and vulnerability.

The connection between energy independence and vulnerability brings international engagement into the equation. I hypothesize that states with low levels of energy independence are heavily engaged

because the international arena and its institutions give them some protection against vulnerability, whereas those higher levels of energy independence are less vulnerable, thus making them less inclined to engage. Thus, I expect to see a negative relationship between energy independence and both political and economic globalization. This conclusion leads me to formulate the two hypotheses that I intend to test in this research.

## METHODOLOGY

This study differs from prior literature by offering a quantitative observational approach. I have created a cross sectional time series data set consisting of the energy independence variable, political and economic globalization, and political variables over the years of 1980-2010. The sample consists of thirty countries in the OECD. I tested my hypotheses through a multivariate regression by creating eight fixed-effects models, four for each dependent variable. The first two models were basic fixed-effects models. Models 3-8 included a one-year lag (3,4), a three-year lag (5,6), and a five-year lag (7,8) of the dependent variable. The reasoning behind including a lagged dependent variable of differing degrees was to attempt to determine how long it takes the relationship to be reflected in the dependent variable if the relationship is not immediately evident. The lagging of the dependent variable proves to be significant to the results.

There are many motivations behind using a fixed-effects model for the study. A normal multivariate regression for a cross sectional time series dataset indicates that the effect should be consistent with no geographic difference. However, I contend that there exist significant political, economic, and cultural differences between the countries in the dataset. Thus, by employing a fixed effects model, the study controls for idiosyncratic cultural and geo-political characteristics of each country.

## DATA AND VARIABLES

I have created a cross-sectional time series data set to test the hypotheses. There are four types of variables in the data: energy independence, a binary political variable measuring whether or not the states uses a single member district system, political globalization, and economic globalization. Data for these variables

has been collected for each OECD country between the years of 1980 and 2010.

I have chosen to limit the analysis to these countries for several reasons. First and foremost, it is logistically simpler to assemble relevant data for OECD member-countries, as energy statistics for these countries are reliable and readily available. Through the Energy Information Administration, all data relating to these countries' energy production and consumption by each major energy source is available for easy and transparent access. The most important aspect of defining energy independence is having reliable data available by source. If all or one of the sources of energy used to calculate independence is unreliable, the results will be tainted. Thus, I found it to be extremely important to ensure the countries included in this study were providing reliable data to the EIA.

The study excluded four states in the OECD from the analysis: Israel, Luxembourg, South Korea, and Japan. The reason for omitting Israel and South Korea is because they are extreme outliers that result from the paramount security threats that skew the policies of these countries. Non-military security issues, such as energy policies, do not significantly influence policy-making in these countries. I reasoned that a different vulnerability means these countries would not approach energy policies in a similar manner to the other OECD countries. This was confirmed when the analysis showed that these countries were extreme outliers.

In the case of Luxembourg, I reasoned that the country was quantitatively different in the way it is globalized both politically and economically because of its miniscule size (population, area, resources) compared to other members of the OECD. This was supported by the fact that Luxembourg is approximately one-hundred percent energy dependent. Luxembourg also presents extreme outlying data in terms of political and economic globalization. Thus, I concluded it was necessary to exclude Luxembourg from this study because of its unique size and nature. Again, this was confirmed when the data showed it was an outlier.

Lastly, I excluded Japan post-hoc from the analysis primarily because it is an extreme outlier in terms of its levels of economic globalization (though the reason for this is not entirely clear). After a personal interview with Andrew Sobel, a recognized authority on the matter, I hypothesize that there may be a few possible

explanations. Japan has an incredibly high savings rate and consequently Japanese savers hold most of Japan's public debt, leading to lower levels of cross-border capital flows. Moreover, Japanese consumers tend to buy Japanese products when available in a consumption category for several reasons. Among these are hidden protectionism (versus explicit tariff barriers) due to health and safety regulations, content regulation, and forms of industrial policy. On top of this, social and cultural norms contribute to the lower exposure of the Japanese economy to globalization. While I acknowledge that this post-hoc exclusion of Japan might weaken the analyses, the fixed effects analysis strategy relies on the notion that there might be unique circumstances in a given country that might lead to different conclusions on its energy policies and its levels of political and economic globalization. Japan simply turned out to be an extreme case that required its exclusion from the analysis.

The study ultimately examines thirty OECD countries to better understand the interplay of factors important to energy independence and political and economic globalization in the majority of developed countries. I acknowledge that the results need to be approached with slight caution because the results are based on models including thirty of thirty-four countries. However, despite this, I still believe the results are valid because the thirty OECD countries included in the model, all of which have market economies and similar economic structures, exhibit a robust relationship.

The focus solely on OECD countries poses two limitations to this study. First, it leaves out Brazil, China, Russia, and India, four of the largest forces driving global energy production and consumption. Unfortunately, reliable and precise data from these countries is not presently available. The hope is that with time, the quality of the data coming from these and other emerging economies will improve, allowing for their inclusion in similar studies. Second, and along similar lines, the OECD is not necessarily wholly representative of the entire world and does omit many of the largest oil producers in the Middle East. One

must understand that this study and its conclusions are only representative of the thirty OECD countries included in the study. The reasons for this are rooted in the reliability of data from countries outside of the OECD and the desire to compare a group of countries with similar levels of economic development due to the outcome variable being economic and political globalization. The similarity of the economic structures of the countries included in the study allow for the relationship to be clearly exhibited while limiting the interference of dissimilarities between countries and other variables that could not be controlled for.

The main independent variable in the study is energy independence. This variable has never been precisely quantified, so I developed a method to do so. Energy independence, however, is not binary; it can be achieved to varying degrees. In this study, the term energy independent does not refer to whether or not a country is *wholly* energy independent but instead, to what *degree* a country is energy independent. I divided energy production and consumption into five major categories: petroleum, natural gas, coal, renewables, and other. The main reasoning behind using these five categories is the breakdown of data made available by the Energy Information Administration (EIA). I then took domestic production as a percentage of domestic consumption of each source of energy to determine what percentage of consumption of each source comes from domestic production. From there, I determined what percentage of total consumption comes from each source and created a weighted average of the states' independence of each source to get an aggregate energy independence measure from zero (wholly dependent) to one hundred (wholly independent). For example, the United States produced 20.79 British Thermal Units (BTUs) of petroleum in 2012 and consumed 34.69 BTUs. Thus, the United States is 59.93 percent independent for petroleum ( $20.79/34.69 = .5993$ ). Since petroleum accounts for 36 percent of the United

Table 1: An example computation of energy independence for the case of the U.S.

Source	Production	Consumption	% of total consumption	Independence	Weighted Independence
Petroleum	20.79	34.69	36%	59.93	21.86
Natural Gas	24.59	26.06	27%	94.36	25.86
Coal	20.60	17.37	18%	100.00	18.27
Renewables	5.10	5.10	5%	100.00	5.36
Other	8.06	11.88	12%	67.81	8.47

NET ENERGY INDEPENDENCE

79.8170347

States' total energy consumption, I multiplied 59.93, petroleum independence, by 36 percent to calculate a weighted independence of ~21.86. I did this for each category of energy sources and summed up the five measures of weighted independence to get a measure of energy independence on a scale of 0-100. Table 1 provides an example calculation for the United States in 2012.

This measure does have its imperfections. It is impossible at this point in time to accurately measure where every unit of energy consumed is produced. The global energy arena operates in an international marketplace, and ultimately market forces dictate where a country gets its energy. Even if the United States produces 100 hundred units of petroleum and consumes 100 units of petroleum, the global marketplace of imports and exports could lead domestically produced petroleum to be exported while foreign oil is imported. Despite the measure's imperfections, I believe it is a good indicator of states' energy independence. It shows the ability of a country to power its economy from domestically produced energy if necessary, thus serving as a measure of the country's vulnerability. If the United States is producing 100 units of petroleum and consuming 100 units of petroleum, the United States would still be producing enough petroleum to meet domestic demand even if another energy crisis arises or another embargo halts the global marketplace.

In considering the more indirect effects that the larger political structure has on the relationship between energy independence and political and economic globalization, I included a couple of political variables in the models. The political framework of a country impacts policy adoption, and the literature on the impact of political institutions is expansive. It is not the goal of this paper to replicate or attempt to refute any of the already existing works. This study simply draws expectations from well-established findings from that literature, as they relate to the potential impact of political institutions on the relationship between energy independence and political and economic globalization.<sup>28</sup>

The study includes a binary political variable in order to avoid variable-selection bias and control for domestic politics affecting the dependent variables. This variable measures whether or not a country's legislature consists of single-member districts (SMD) (1) or multi-member districts (0). I include this variable

primarily because a 2010 study by Costa, Christensen, and Sened demonstrated the significance of the role SMDs play in affecting a country's energy policy, and its alternative energy policy in particular.<sup>29</sup> There are a few main explanations of the role of SMDs in existing literature that make the inclusion of this variable so important. The first hypothesis I have based on the literature is of procedural nature. The literature shows that SMD systems tend to create two-party systems.<sup>30</sup> In two-party systems, one party usually receives a mandate, allowing for easy passage of uncontroversial legislation like international agreements and treaties. Thus, I believe there may exist a positive relationship between SMDs and globalization because of the ease of passage of international agreements in two-party systems. I also hypothesize that countries with two-party systems might possibly prioritize and execute the process of achieving energy independence differently. SMDs and subsequently two-party systems operate with what is generally conceived as a clear mandate to the majority, winning party to do as it sees fit. On the other hand, multi-member district countries (MMDs) and multiparty systems operate through coalition forming. I believe the coalition forming aspect of MMD and multi-party system countries leads to more creative policies to appease smaller, goal-oriented parties, and this might be a variable in influencing a country's level of energy independence. Although the fixed-effects model does control for country-specific variables, I believe it is important to include SMDs as an independent variable to further granulate whether or not this variable is significant in influencing energy independence or the dependent variable of globalization. As Costa et al. argue, citing Nobel Laureate Douglass North, "These macro level political institutions do not directly dictate how an economy functions, but they do affect the way in which actors function within an economy."<sup>31</sup>

In some initial runs, the study also included a variable that captured whether a system was parliamentary, presidential or 'hybrid.' The idea was similar to trying to capture the feature that the president has some degrees of freedom in conducting international relations policy in most presidential systems. This variable was later omitted as it never proved to be significant in the many models tested, a subset of which is reviewed below.

The dependent variables are political and economic globalization. The KOF Index of



Globalization is a well-accepted measure of political and economic globalization which “employs the number of embassies and high commissions in a country and, the number of international organizations to which the country is a member and the number of UN peace missions a country participated in. In addition, it includes the number of treaties signed between two or more states since 1945.”<sup>23, 32</sup> These inputs are indicative of a state’s level of political engagement in the international arena, as it measures diplomatic relations, involvement in international peacekeeping coalitions, as well as international treaties the country signs. The index then combines these inputs to produce a 1-100 measurement.

The index defines economic globalization as the “long distance flows of goods, capital and services as well as information and perceptions that accompany market exchanges.” Included in the measure of economic globalization are actual flows of goods, including “a sub-index on actual economic flows includes data on trade, FDI [Foreign Direct Investment] and portfolio investment,” as well as a second sub-index that “refers to restrictions on trade and capital using hidden import barriers, mean tariff rates, taxes on international trade (as a share of current revenue), and an index of capital controls. Given a certain level of trade, a country with higher revenues from tariffs is less globalized.”<sup>33</sup>

I ultimately decided to separate political and economic globalization and not use the KOF index of *overall* globalization for a few reasons. First, although I hypothesize that the relationship between energy independence and both political and economic globalization will be the same, I felt it was necessary to separate them because of the qualitative differences in the variables and the potential impact of energy independence on each. Much speculation exists regarding the impact of energy independence on geopolitics and economic involvement separately, so I strived to fine-tune the method to address theories pertaining to globalization as a whole, but also to those specifically related to politics and economics. Moreover, the aggregate index of globalization includes social globalization, which makes up a sizeable portion of the measurement. I felt that including social globalization would dilute the dependent variable and mask potential relationships by adding an ancillary factor and drifting away from the crux of the hypotheses.

The main shortcoming of using this index as the dependent variables in this study is the slow moving nature of the measurement. Energy independence can move extremely rapidly, and as a result, engagement in the international arena can as well. This measure of engagement, however, is slow moving and might take time to accurately indicate significant changes in involvement. This is the main reason why I lagged this dependent variable in models three through eight. With that said, this is a reliable, well-respected, and well-calculated measure of engagement and is the only measure available. Despite its slow-moving nature, I am still very confident in its ability to measure international engagement and its relationship with energy independence for this study.

## RESULTS AND ANALYSIS

The first pair of models analyzed the relationship between energy independence and political and economic globalization. The first model confirmed H1, demonstrating a significant negative relationship between energy independence and political globalization. The second model confirmed H2, demonstrating a significant negative relationship between energy independence and economic globalization. Models one and two also both indicated a significant positive relationship between SMDs and political and economic globalization.

I also hypothesized that the relationship might be more robust if I lagged the dependent variable. The thinking behind this decision was that if a relationship did exist between energy independence and globalization, the relationship with changing levels of energy independence might not be reflected in the globalization measures immediately. Thus, I tested the dataset by lagging globalization one, three, and five years in models three to eight to test this. I capped the lag at five years to limit the number of data points lost with each year of lag.

In models three and four, I tested the relationship between energy independence and political and economic globalization with a one year lag. Again, H1 and H2 were confirmed and the relationship between the variables was maintained; the coefficient of energy independence was negative and significant to the same degree as models one and two. SMDs were also equally as significant in affecting the outcome.

In models five and six (three-year lag) and

Table 2: Selected fixed-effects model results (P=Political Globalization, E=Economic Globalization)

	0 year lag		1 year lag		3 year lag		5 year lag	
	Model 1 (P)	Model 2 (E)	Model 3 (P)	Model 4 (E)	Model 5 (P)	Model 6 (E)	Model 7 (P)	Model 8 (E)
(Intercept)	<b>90.3*</b> (1.9)	<b>57.8*</b> (2.2)	<b>91.4*</b> (1.9)	<b>58.5*</b> (2.2)	<b>92.3*</b> (1.8)	<b>59.0*</b> (2.1)	<b>91.8*</b> (1.8)	<b>58.7*</b> (2.1)
Energy Independence	<b>-0.27*</b> (.03)	<b>-0.20*</b> (.04)	<b>-0.27*</b> (.03)	<b>-0.21*</b> (.04)	<b>-0.26*</b> (.03)	<b>-0.19*</b> (.04)	<b>-0.20*</b> (.03)	<b>-0.15*</b> (.04)
SMD	<b>21.9*</b> (2.7)	<b>27.2*</b> (3.1)	<b>21.9*</b> (2.6)	<b>27.5*</b> (3.1)	<b>19.5*</b> (2.5)	<b>26.6*</b> (3.0)	<b>15.2*</b> (2.5)	<b>24.7*</b> (2.9)
Canada	<b>6.0*</b> (2.0)	<b>9.1*</b> (2.3)	<b>6.0*</b> (1.9)	<b>8.7*</b> (2.2)	<b>5.8*</b> (1.8)	<b>7.7*</b> (2.2)	<b>5.4*</b> (1.8)	<b>6.7*</b> (2.1)
Denmark	<b>16.6*</b> (2.0)	<b>35.4*</b> (2.4)	<b>15.8*</b> (2.0)	<b>35.2*</b> (2.3)	<b>13.2*</b> (1.9)	<b>34.1*</b> (2.2)	<b>10.2*</b> (1.8)	<b>33.0*</b> (2.1)
France	<b>-4.0</b> (2.5)	<b>-11.5*</b> (3.0)	<b>-4.7</b> (2.5)	<b>-11.9*</b> (2.9)	<b>-4.1</b> (2.4)	<b>-11.5*</b> (2.9)	<b>-1.8</b> (2.4)	<b>-10.1*</b> (2.8)
Germany	<b>6.4*</b> (2.2)	<b>21.4*</b> (2.6)	<b>6.6*</b> (2.2)	<b>21.2*</b> (2.5)	<b>6.3*</b> (2.1)	<b>21.1*</b> (2.5)	<b>5.6*</b> (2.1)	<b>21.0*</b> (2.5)
Italy	<b>-13.8*</b> (3.2)	<b>-13.5*</b> (3.7)	<b>-14.6*</b> (3.1)	<b>-13.9*</b> (3.7)	<b>-13.4*</b> (3.0)	<b>-12.8*</b> (3.6)	<b>-9.5*</b> (3.1)	<b>-10.1*</b> (3.6)
Mexico	<b>-16.5*</b> (2.0)	<b>-11.1*</b> (2.3)	<b>-16.2*</b> (1.9)	<b>-11.2*</b> (2.2)	<b>-16.0*</b> (1.8)	<b>-11.7*</b> (2.2)	<b>-16.0*</b> (1.8)	<b>-12.4*</b> (2.1)
Norway	<b>25.7*</b> (2.8)	<b>38.2*</b> (3.3)	<b>25.7*</b> (2.8)	<b>38.2*</b> (3.3)	<b>22.8*</b> (2.7)	<b>36.3*</b> (3.2)	<b>17.5*</b> (2.7)	<b>33.3*</b> (3.1)
Poland	<b>16.7*</b> (2.3)	<b>9.7*</b> (2.7)	<b>16.6*</b> (2.3)	<b>9.8*</b> (2.7)	<b>14.8*</b> (2.2)	<b>9.1*</b> (2.6)	<b>11.3*</b> (2.2)	<b>7.7*</b> (2.5)
United Kingdom	<b>7.8*</b> (2.0)	<b>8.9*</b> (2.3)	<b>7.8*</b> (1.9)	<b>8.5*</b> (2.2)	<b>7.8*</b> (1.2)	<b>7.8*</b> (2.1)	<b>7.6*</b> (1.8)	<b>7.0*</b> (2.1)
United States	<b>-8.6</b> (2.0)	<b>-9.0*</b> (2.4)	<b>-1.0</b> (2.0)	<b>-9.5*</b> (2.3)	<b>-0.7</b> (1.9)	<b>-10.0*</b> (2.3)	<b>-1.9</b> (1.9)	<b>-10.1*</b> (2.2)
N	870	870	840	840	780	780	720	720
R <sup>2</sup>	<b>.65</b>	<b>.59</b>	<b>.66</b>	<b>.60</b>	<b>.67</b>	<b>.63</b>	<b>.67</b>	<b>.66</b>
Adj. R <sup>2</sup>	<b>.64</b>	<b>.57</b>	<b>.65</b>	<b>.59</b>	<b>.66</b>	<b>.62</b>	<b>.65</b>	<b>.64</b>

\* Indicates p-value <0.05, Standard error in parentheses

seven and eight (five-year lag), the results again confirmed H1 and H2 as these models maintained the negative, significant relationship between the variables. The energy independence coefficient was again virtually constant in models five and six compared to three and four, and subsequently, the coefficient was virtually constant in models seven and eight compared to five and six. SMDs also remained significant in all models, with a strong positive relationship as previously demonstrated.

## DISCUSSION

There are many key points derived from these results. First, it is clear that a robust relationship exists between energy independence and political and economic globalization, and the hypotheses were confirmed in all models. This relationship was maintained in strength and significance when I included the one, three, and five-year lags. Although the relationship remained virtually constant across

all models, it is impossible to perfectly pinpoint how long it takes changes in energy independence to be reflected in the relationship with political and economic globalization. However, it was clear that increases in lag maintained the strength of the relationship. This simply indicates that the impact of changes in energy independence may take time to be reflected in the relationship with the globalization measurement in certain cases, but the fact that the relationship was robust, negative, and significant with no lag and robust, negative, and significant with each increment of lag only further supports the validity of the relationship.

This negative relationship between energy independence and political and economic globalization corroborates the hypotheses. Countries that are increasingly energy independent are less inclined to be a part of the international institutions that protect states from said vulnerability, possibly because they are less vulnerable. The argument, however, is not one

of causal nature. There are countless variables that impact political and economic engagement. Whether it be the Cold War, Western interests in Israel, the fear of a nuclear Iran, or combatting terrorism, international engagement is not only about energy. I simply hypothesized, tested, and confirmed that a statistically significant negative relationship exists between energy independence and political and economic globalization.

In terms of the relationship between SMDs and political and economic globalization, the robust positive relationship in all models is no surprise. Although they were initially included as a control variable, I believe there is a straightforward possible explanation to the SMD results. Existing literature suggests that SMDs create two-party systems, and thus, legislatures in SMD countries usually have a clear mandate to act, as one of the two parties will always have a majority in the legislature. This mandate and clear majority indicates increased ease in committing to and passing legislation, which lead to treaties, international trade agreements, and other forms of international engagement. The United States has only recently become an anomaly. Closed primaries and safe seats most likely due to increased polarization cause this across the board that have both parties entrenched in their positions, resulting in gridlock.

Ultimately, I believe the fixed-effects model was the optimal way to test the hypotheses. With a cross-sectional time series data set spanning thirty years and thirty countries, I felt controlling for country-specific variables were important. Once I controlled for each country, the results were robust. A linear model would not have provided such compelling results.

## CONCLUSION

While many have speculated about the implications of energy independence but no empirical analysis has been performed to test the implications, thus making this study the first of its kind. By creating a method to quantify energy independence and test its relationship with political and economic globalization in the OECD countries, I hope I can provide a base study for others to build on.

One point that I referenced many times but never fully pursued is the global nature of energy prices and how the global market for energy fits into the story. The argument focuses on energy independence protecting a state from vulnerability

stemming from supply disruptions, but there exists a separate but related question of whether or not a country is truly “independent” if it is not protected from price shocks. Even if the United States produces sufficient amounts of each source of energy to meet consumption, a major conflict in the Middle East will still create a major price shock that the United States, despite its energy independence, will not be wholly protected from. It will be protected from the catastrophe of not having *enough* energy to meet demand, but it will not be protected from the cost of this energy. This is a topic I look forward to pursuing in the near future by arguing that renewable energy is the key to limiting energy-related vulnerability. True freedom from energy-related vulnerability assumes protection from both shortages and price hikes, and I hypothesize that renewables are that solution.

Future studies that build off of this one could be relevant to developing countries outside of the OECD, which are not included in this analysis. The majority of global energy consumption growth in the coming decades will come from the emerging markets of developing states. As consumption quickly outpaces production in these economies, these countries will be faced with a similar issue that developed states face today: ensuring a safe and steady supply of energy amidst consumption growth. As these countries become increasingly globalized, understanding the relationship between energy independence and global engagement will be critical to the formulation of future energy and foreign policies in these countries.

Appendix: Complete table of fixed-effects model results and Energy Independence / Globalization Data

	0 year lag		1 year lag		3 year lag		5 year lag	
	Model 1 (P)	Model 2 (E)	Model 3 (P)	Model 4 (E)	Model 5 (P)	Model 6 (E)	Model 7 (P)	Model 8 (E)
(Intercept)	<b>90.3*</b> (1.9)	<b>57.8*</b> (2.2)	<b>91.4*</b> (1.9)	<b>58.5*</b> (2.2)	<b>92.3*</b> (1.8)	<b>59.0*</b> (2.1)	<b>91.8*</b> (1.8)	<b>58.7*</b> (2.1)
Energy Independence	<b>-0.27*</b> (.03)	<b>-0.20*</b> (.04)	<b>-0.27*</b> (.03)	<b>-0.21*</b> (.04)	<b>-0.26*</b> (.03)	<b>-0.19*</b> (.04)	<b>-0.20*</b> (.03)	<b>-0.15*</b> (.04)
SMD	<b>21.9*</b> (2.7)	<b>27.2*</b> (3.1)	<b>21.9*</b> (2.6)	<b>27.5*</b> (3.1)	<b>19.5*</b> (2.5)	<b>26.6*</b> (3.0)	<b>15.2*</b> (2.5)	<b>24.7*</b> (2.9)
Austria	<b>13.6*</b> (1.9)	<b>25.3*</b> (2.3)	<b>13.1*</b> (1.9)	<b>25.4*</b> (2.2)	<b>11.8*</b> (1.8)	<b>25.4*</b> (2.2)	<b>10.4*</b> (1.8)	<b>25.6*</b> (2.1)
Belgium	<b>9.4*</b> (2.0)	<b>36.5*</b> (2.4)	<b>8.6*</b> (2.0)	<b>36.1*</b> (2.3)	<b>7.4*</b> (1.9)	<b>35.8*</b> (2.3)	<b>6.9*</b> (1.9)	<b>35.8*</b> (2.2)
Canada	<b>6.0*</b> (2.0)	<b>9.1*</b> (2.3)	<b>6.0*</b> (1.9)	<b>8.7*</b> (2.2)	<b>5.8*</b> (1.8)	<b>7.7*</b> (2.2)	<b>5.4*</b> (1.8)	<b>6.7*</b> (2.1)
Chile	<b>1.7</b> (2.0)	<b>19.2*</b> (2.3)	<b>1.5</b> (1.9)	<b>19.2*</b> (2.3)	<b>.52</b> (1.9)	<b>18.9*</b> (2.2)	<b>-1.1</b> (2.8)	<b>18.4*</b> (2.1)
Czech Republic	<b>9.9*</b> (2.4)	<b>32.2*</b> (2.8)	<b>10.0*</b> (2.4)	<b>32.8*</b> (2.8)	<b>8.6*</b> (2.3)	<b>33.1*</b> (2.7)	<b>6.6*</b> (2.3)	<b>32.8*</b> (2.7)
Denmark	<b>16.6*</b> (2.0)	<b>35.4*</b> (2.4)	<b>15.8*</b> (2.0)	<b>35.2*</b> (2.3)	<b>13.2*</b> (1.9)	<b>34.1*</b> (2.2)	<b>10.2*</b> (1.8)	<b>33.0*</b> (2.1)
Estonia	<b>-19.4*</b> (2.3)	<b>36.6*</b> (2.7)	<b>-17.9*</b> (2.3)	<b>37.1*</b> (2.6)	<b>-15.7*</b> (2.2)	<b>37.3*</b> (2.6)	<b>-16.1*</b> (2.2)	<b>37.3*</b> (2.6)
Finland	<b>8.1*</b> (2.0)	<b>23.2*</b> (2.3)	<b>7.4*</b> (1.9)	<b>23.3*</b> (2.2)	<b>5.8*</b> (1.8)	<b>23.5*</b> (2.2)	<b>4.4*</b> (1.8)	<b>24.0*</b> (2.1)
France	<b>-4.0</b> (2.5)	<b>-11.5*</b> (3.0)	<b>-4.7</b> (2.5)	<b>-11.9*</b> (2.9)	<b>-4.1</b> (2.4)	<b>-11.5*</b> (2.9)	<b>-1.8</b> (2.4)	<b>-10.1*</b> (2.8)
Germany	<b>6.4*</b> (2.2)	<b>21.4*</b> (2.6)	<b>6.6*</b> (2.2)	<b>21.2*</b> (2.5)	<b>6.3*</b> (2.1)	<b>21.1*</b> (2.5)	<b>5.6*</b> (2.1)	<b>21.0*</b> (2.5)
Greece	<b>-1.7</b> (2.0)	<b>15.3*</b> (2.3)	<b>-1.9</b> (1.9)	<b>15.0*</b> (2.2)	<b>-2.3</b> (1.8)	<b>14.6*</b> (2.2)	<b>-2.5</b> (1.8)	<b>14.3*</b> (2.1)
Hungary	<b>1.8</b> (2.0)	<b>18.0*</b> (2.3)	<b>1.8</b> (1.9)	<b>18.1*</b> (2.3)	<b>1.2</b> (1.8)	<b>18.4*</b> (2.2)	<b>-0.5</b> (1.8)	<b>18.8*</b> (2.1)
Iceland	<b>-16.3*</b> (2.1)	<b>19.4*</b> (2.5)	<b>-16.7*</b> (2.1)	<b>19.5*</b> (2.3)	<b>-18.7*</b> (2.0)	<b>19.0*</b> (2.3)	<b>-21.6*</b> (1.9)	<b>18.1*</b> (2.3)
Ireland	<b>-2.9</b> (2.1)	<b>36.4*</b> (2.4)	<b>-3.5</b> (2.0)	<b>36.0*</b> (2.4)	<b>-4.2*</b> (1.9)	<b>35.8*</b> (2.3)	<b>-4.2</b> (1.9)	<b>35.9*</b> (2.2)
Italy	<b>-13.8*</b> (3.2)	<b>-13.5*</b> (3.7)	<b>-14.6*</b> (3.1)	<b>-13.9*</b> (3.7)	<b>-13.4*</b> (3.0)	<b>-12.8*</b> (3.6)	<b>-9.5*</b> (3.1)	<b>-10.1*</b> (3.6)
Mexico	<b>-16.5*</b> (2.0)	<b>-11.1*</b> (2.3)	<b>-16.2*</b> (1.9)	<b>-11.2*</b> (2.2)	<b>-16.0*</b> (1.8)	<b>-11.7*</b> (2.2)	<b>-16.0*</b> (1.8)	<b>-12.4*</b> (2.1)
Netherlands	<b>14.9*</b> (2.0)	<b>41.6*</b> (2.3)	<b>14.3*</b> (1.9)	<b>41.3*</b> (2.3)	<b>12.5*</b> (1.8)	<b>40.5*</b> (2.2)	<b>10.3*</b> (2.1)	<b>39.5*</b> (2.1)
New Zealand	<b>-16.9*</b> (2.0)	<b>2.4</b> (2.3)	<b>-16.9*</b> (2.0)	<b>2.3</b> (2.3)	<b>-16.2*</b> (1.9)	<b>2.9</b> (2.2)	<b>-14.9*</b> (1.9)	<b>3.7</b> (2.2)
Norway	<b>25.7*</b> (2.8)	<b>38.2*</b> (3.3)	<b>25.7*</b> (2.8)	<b>38.2*</b> (3.3)	<b>22.8*</b> (2.7)	<b>36.3*</b> (3.2)	<b>17.5*</b> (2.7)	<b>33.3*</b> (3.1)
Poland	<b>16.7*</b> (2.3)	<b>9.7*</b> (2.7)	<b>16.6*</b> (2.3)	<b>9.8*</b> (2.7)	<b>14.8*</b> (2.2)	<b>9.1*</b> (2.6)	<b>11.3*</b> (2.2)	<b>7.7*</b> (2.5)
Portugal	<b>-4.9*</b> (2.1)	<b>18.1*</b> (2.4)	<b>-5.4*</b> (2.1)	<b>17.8*</b> (2.4)	<b>-5.4*</b> (2.0)	<b>17.9*</b> (2.3)	<b>-4.6*</b> (2.0)	<b>18.3*</b> (2.3)
Slovakia	<b>-5.4*</b> (2.3)	<b>19.6*</b> (2.7)	<b>-5.3*</b> (2.2)	<b>20.0*</b> (2.6)	<b>-5.5*</b> (2.2)	<b>21.3*</b> (2.6)	<b>-5.5*</b> (2.2)	<b>22.9*</b> (2.6)
Slovenia	<b>-12.7*</b> (2.3)	<b>17.8*</b> (2.6)	<b>-11.3*</b> (2.2)	<b>18.1*</b> (2.6)	<b>-8.7*</b> (2.2)	<b>18.7*</b> (2.6)	<b>-6.6*</b> (2.2)	<b>19.4*</b> (2.5)
Spain	<b>4.0*</b> (2.0)	<b>17.0*</b> (2.3)	<b>3.7</b> (1.9)	<b>17.1*</b> (2.3)	<b>3.4</b> (1.8)	<b>17.4*</b> (2.2)	<b>3.6</b> (1.8)	<b>18.0*</b> (2.1)
Sweden	<b>20.8*</b> (2.1)	<b>34.9*</b> (2.4)	<b>20.3*</b> (2.0)	<b>35.2*</b> (2.4)	<b>18.2*</b> (1.9)	<b>35.0*</b> (2.3)	<b>15.3*</b> (1.9)	<b>34.2*</b> (2.2)
Switzerland	<b>7.6*</b> (1.8)	<b>32.7*</b> (2.3)	<b>7.4*</b> (1.9)	<b>32.6*</b> (2.3)	<b>6.5*</b> (1.8)	<b>32.1*</b> (2.2)	<b>5.4*</b> (1.8)	<b>30.9*</b> (2.1)

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United Kingdom	<b>7.8*</b> (2.0)	<b>8.9*</b> (2.3)	<b>7.8*</b> (1.9)	<b>8.5*</b> (2.2)	<b>7.8*</b> (1.2)	<b>7.8*</b> (2.1)	<b>7.6*</b> (1.8)	<b>7.0*</b> (2.1)
United States	<b>-8.6</b> (2.0)	<b>-9.0*</b> (2.4)	<b>-1.0</b> (2.0)	<b>-9.5*</b> (2.3)	<b>-0.7</b> (1.9)	<b>-10.0*</b> (2.3)	<b>-1.9</b> (1.9)	<b>-10.1*</b> (2.2)
N	870	870	840	840	780	780	720	720
R <sup>2</sup>	<b>.65</b>	<b>.59</b>	<b>.66</b>	<b>.60</b>	<b>.67</b>	<b>.63</b>	<b>.67</b>	<b>.66</b>
Adj. R <sup>2</sup>	<b>.64</b>	<b>.57</b>	<b>.65</b>	<b>.59</b>	<b>.66</b>	<b>.62</b>	<b>.65</b>	<b>.64</b>

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