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The Iberian Exception:

An overview of its effects over its first 100 days

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Executive summary

This paper offers an independent assessment of certain key economic effects of the Iberian Exception (IE), the common name for legal measures affecting the Iberian power market that were introduced in June 2022 by the Spanish and Portuguese governments. Their stated aim was to reduce the major component of electricity prices for many Iberian consumers, a component which was indexed to Iberian wholesale power market spot prices—power market prices that were rising alarmingly due to extremely tight international markets for natural gas. According to the Iberian governments, this objective was to be attained by terms of the IE that subsidize a reduction in wholesale power market prices, with the subsidy financed in part by a new element added to the bills of consumers benefiting from that wholesale price reduction. Another Spanish governmental aim was to reduce the Government's published measure of inflation, which was linked to a regulated retail price indexed to Iberian wholesale spot power market prices.

The Spanish Government maintains that, during its first 100 days, the IE provided substantial benefits for consumers affected by the IE, which included over 10 million small consumers as well as many large ones. However, the authors of this study question that view. We argue that the effect of the IE on retail prices depends critically on the assumptions about what would have occurred in the absence of the IE, that is, in a counterfactual scenario. Although counterfactuals are always difficult to construct, the Government's counterfactual methodology ignores demand elasticity in Iberia and in France, and this inflates their estimate of immediate consumer benefits. Using hourly data on the wholesale electricity market for the first 100 days of the IE, this paper's analysis of alternative counterfactuals that reflect the effects of demand elasticity shows substantially lower benefits of the IE for consumers than the Spanish Government methodology suggests. The analysis here suggests that affected consumers could have paid somewhat less for the energy component of their electricity bills in the first 100 days of the IE, had it not been introduced.

We identify several other potential short- and long-term effects of the IE that deserve further study. These include increased margins for fossil-fired generators, reduced margins for some decarbonized inframarginal plant, heightened investor perceptions of regulatory risk, weakened incentives for efficient consumption, and higher carbon emissions and gas prices.

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Introduction

In June 2022, the Spanish and Portuguese governments introduced parallel laws, commonly called the Iberian Exception (IE), to reduce wholesale electricity prices by decoupling them from wholesale natural gas prices, which had been rising sharply since the first quarter of 2021. The IE was also a Spanish governmental response to its own circumstances, notably that the energy component of regulated retail power prices of many Spanish consumers was directly indexed to Iberian wholesale spot prices, and that these retail prices were a key input to Spain's official inflation index. At the time, the Iberian market intervention was contrary to general European Union (EU) policy but was approved as an exception by the European Commission after the Spanish and Portuguese governments agreed that its intended reduction in Iberian wholesale market prices would also apply to export sales of power to other EU countries, notably to France.

The IE led to a reduction in wholesale Iberian power market prices, primarily by offering an out-of-market subsidy to fossil-fired generation, notably gas-fired generation.[1] These generators reduced their offers to reflect the subsidy they would receive, resulting in lower power-market clearing prices than would otherwise have occurred. This subsidy is called the generator contribution (GC). It was funded primarily by requiring the affected Iberian consumers, with electricity prices indexed directly to wholesale power prices, to make a demand contribution (DC); the affected consumers included over 10 million small consumers in Spain. Customers with power purchase contracts on fixed prices were initially not required to pay the DC. However, with the annual renewal of fixed price contracts, many in Spain were deemed also to be benefiting from lower wholesale power market prices and therefore had to pay the DC, often in addition to the fixed price they had already agreed on multi-year contracts.

The Spanish Government (including the Ministry responsible for energy[2]) maintain that the IE significantly reduced the cost of electricity for affected consumers during its first three months.[3] We have found no official public document outlining the methodological basis for the Ministry's calculation. However, our understanding is that the Ministry's calculations are based on a counterfactual that assumes no change in demand when wholesale prices fall. Various authors have used that methodology to estimate the savings for affected consumers. For instance, Sancha (2022) estimates savings of about 18 per cent for the period from 15 June to the end of September 2022, which is slightly longer than the first 100 days. This paper refers to that methodology as the Spanish Government's methodology.

Drawing on detailed hourly data published by the Iberian market operator (OMIE[4]) for the first 100 days of the IE implementation, this paper questions the Spanish Government's methodology for estimating consumer benefits. We argue that this methodology ignores the effect of the IE on electricity demand, in particular the increase in power flows over the interconnector between Spain and France. The lower Iberian wholesale power market prices resulting from the IE significantly increased exports, principally from Spain to France, and may also have increased Iberian consumer demand. Higher exports and domestic demand increased Iberian power generation and Iberian wholesale power market costs and prices by amounts that the Ministry's methodology apparently ignores. The analysis summarized in this paper demonstrates that the net benefits for Spanish consumers were less than the Government suggests. Under the main scenario presented in this paper, the energy component of electricity prices for these consumers during the period studied was higher under the IE than if there had been no such governmental intervention.

[1] The subsidy to fossil-fired plants included gas- and coal-fired generation during the IE's first 100 days. It was extended to cogeneration, but this occurred after the 100-day period. The IE also contained other terms affecting hydro, nuclear, wind and solar facilities.

[2] The Ministry for the Ecological Transition and the Demographic Challenge.

[3] See La Moncloa (2022); Europa Press (2022).

[4] OMI-Polo Español S.A. (OMIE) was appointed in 2015 as Nominated Electricity Market Operator by the competent Spanish and Portuguese authorities.

Given the importance of the energy component for consumer prices during the period studied, a continuing focus on the impact of the IE is justified. Furthermore, because the IE contributed to a significant increase in gas-fired generation and consequent carbon emissions in Iberia during its first 100 days, this issue also merits further tracking. Finally, given that our analysis suggests that increasing demand under the IE led to increased margins for fossil-fired plants, generator margins under the IE merit further investigation.

Our analysis, like the Ministry's claims, is necessarily based on assumptions about what would have happened in the absence of the IE, that is, in a counterfactual scenario. Although we are convinced that our counterfactual assumptions and analytical methodology are more realistic than those of the Government, we recognize that our assumptions and analysis are open to challenge and refinement. Nevertheless, our analysis suggests that the Ministry's estimates of the benefits of the IE for Spanish consumers in the first 100 days are misleading.

Although this paper focuses on short-run and quantifiable consequences of the IE, the introduction of the IE introduced other distortions with potential longer-term economic consequences. The first is that the IE seems likely to have reinforced Spain's reputation for regulatory risk. Second, the IE apparently redirected revenues and profits toward fossil-fired power plants and away from decarbonized generation, a direction seemingly inconsistent with the Iberian governments' stated energy transition objectives. Furthermore, to the extent that consumers believed that the IE significantly reduced their net power costs (which was certainly the case for French imports), the Ministry will have discouraged consumer investments in the efficient use of energy (e.g., installing heat pumps or power storage capacity), indirectly contributing to higher demand and prices for electricity and gas than would otherwise have occurred.

Since the IE has been extended to the end of 2023, and may be extended again, further work is needed to analyse the IE's consequences and to develop other and better approaches to manage the consequences of extreme natural gas prices for Spain and Portugal. Although gas prices recently have been lower than during the period studied, we believe it would be advisable to be prepared for possible future accidents, strikes, or strategic withholdings that could again curtail gas supply and inflate gas prices.

This paper has seven sections. The first presents an introduction to the Iberian electricity market (MIBEL), the second introduces the IE in more detail, and the third introduces a conceptual model of the effects of the IE. The fourth section analyses the quantitative impact on prices for affected Spanish consumers during the first 100 days of the IE, using the counterfactual assumptions that we understand the Government has made. The fifth section analyses the impact on consumers over the same period under two alternative counterfactual scenarios that consider demand elasticity. The sixth identifies several areas for further research, and the final section presents concluding comments.

1. The Iberian electricity market (MIBEL) supply, demand, and prices

MIBEL (Mercado Ibérico de Electricidad) integrates the Spanish and Portuguese wholesale electricity markets. OMIE (Iberian Energy Market Operator, Spanish Pole) manages the MIBEL spot market, which includes a daily market and six intraday markets. OMIP (Iberian Energy Market Operator, Portuguese Pole) manages the MIBEL derivatives market. Prices in the Spanish and Portuguese markets are usually the same. This paper focuses on the OMIE-managed daily market and usually refers to the Iberian market, except in the case of trade between Spain and France.

The power transmission interconnectors between Spain and France are managed by the two national system operators. Congestion occurs when these transmission lines reach capacity and are unable to carry additional electricity flow due to the risk of overheating. In the EU, this capacity limit or point of congestion leads to congestion rents, which are defined as the difference in the wholesale prices between the two interconnected markets multiplied by the volume of the power flowing one way or the other over the interconnector. These congestion rents are revenues collected by the two national system operators and are normally used to help fund network expansion or to support other system costs. Congestion rents are normally shared 50/50 between the two system operators. However, as part of the IE, Spain agreed to share its 50 per cent of the French–Spanish congestion rents with all the consumers in Spain, Portugal, and Morocco affected by the IE.

As in most countries with liberalized electricity systems, the Iberian wholesale electric power market is based on marginalist principles. Producers and consumers (or retail suppliers acting in their stead) make their energy supply and demand offers for each of the 24 hours of the following day.[5] When arrayed by price, these offers constitute supply and demand curves. The supply curve is upward sloping, that is, more power will be offered and supplied by generators as market prices increase; the demand curve is downward sloping, that is, less power will be bid for and consumed as market prices increase. In conformity with basic economic logic, market equilibrium prices and volumes are set where the supply and demand curves cross. The market operator then dispatches generation units in ascending order of cost until the total of generation offers reaches the market equilibrium requirement.

Generators' offer prices in any hour are generally determined by their short-run marginal costs, which include variable operation and maintenance costs, but the marginal costs of fossil fuel plants are dominantly the costs of the fuels consumed. In general, generators' bids are associated with their technologies, although this is not always the case since different cost structures and commitments may lead them to bid different values. In Iberia, gas-fired generation plants and thus their gas supply costs largely determine wholesale power market prices during most hours of most days. In the first 100 days of the IE, gas-fired combined cycle plants fixed the price 44 per cent of the time, while manageable (pumped storage and conventional reservoir) hydro did so 41 per cent of the time (Table 1.)

Table 1: Generation at the margin in MIBEL over the first 100 days of the IE

<table>
<tr><th>Generation at margin</th><th>Hours</th><th colspan="2">%</th></tr>
<tr><td>Combined cycle gas turbine</td><td>1,056</td><td>44</td><td></td></tr>
<tr><td>Pumped storage hydro</td><td>277</td><td>12</td><td rowspan="2">41</td></tr>
<tr><td>Conventional reservoir hydro</td><td>701</td><td>29</td></tr>
<tr><td>Renewables, cogeneration & waste</td><td>341</td><td>14</td><td></td></tr>
<tr><td>Conventional thermal (coal)</td><td>25</td><td>1</td><td></td></tr>
<tr><td>Total</td><td>2,400</td><td>100</td><td></td></tr>
</table>

Source: OMIE (2022)

Even when the marginal technologies are hydro or other renewables, their offers are often determined by the price of gas-fired plants. In the case of manageable hydro, bidding in line with gas generation costs is usually due to the opportunity cost of the hydro resource, namely the alternative of using stored water later when gas generation is needed to meet demand, and market clearing prices reflecting gas costs are higher. For intermittent resources, like wind, solar, and run-of-river hydro, generators' offer prices also sometimes reflect the cost of buying electricity in short-term imbalance markets to meet expected deviations from day-ahead commitments. These short-term market prices for imbalances also usually reflect the cost of natural gas-fired plants.

Generation offers are accepted and generation units are dispatched by the power system operator in merit order, from the lowest to the most expensive offer prices. However, the owners of generation units do not necessarily receive the spot market clearing price. Most generation is covered by contracts (with retailers, final consumers, or financial markets), the details of which are beyond the scope of this paper. References here to generation revenues and costs ignore the distribution of economic consequences across ownership and contractual interests. They simply refer to the aggregate benefits and costs of

[5] In fact, there are seven markets with different time frames, but there is no need to take separate account of them in this overview of the effects of the IE.

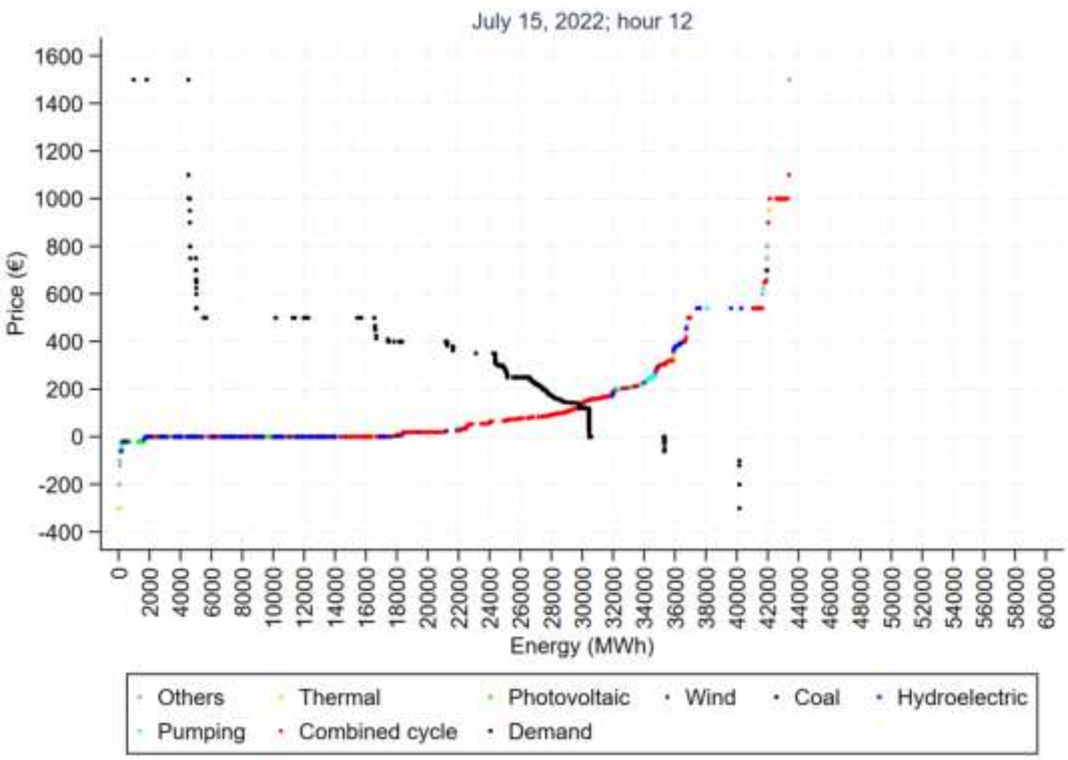
each major type of generation in the Iberian power system using the wholesale spot market price and the GC, if applicable, as a metric.

In the case of consumer demand and consumer offer prices, a distinction can be made between two kinds of demand. On one hand, the demand of retailers supplying residential consumers can be viewed as vertical sections of the overall demand curve because their customers' demand is assumed to be price inelastic, at least in the very short run—that is, essentially unaffected by power prices. Accordingly, retail suppliers offer prices set at a level that aims to ensure their customers' demand is satisfied. In practice, this distinction may underestimate the elasticity of demand by smaller consumers, especially in the mid- to long term. On the other hand, the demand of large customers (industrial, commercial, etc.) can be viewed as a price-elastic, downward sloping section of the overall demand curve, reflecting a decrease in the economic attractiveness of electric power use in their productive activities as power prices increase.

Critically, export demand (over interconnectors) is, like the demand of some large Iberian consumers, price elastic and finely attuned, on an hourly or even shorter time scale, to the level of Iberian wholesale prices compared to foreign (most importantly, French) wholesale prices. When Spanish wholesale market prices are below French wholesale prices, Spain will export until prices are equal in both markets or until the interconnector is full, at which point the two systems share the congestion rents[6] 50/50. Conversely, generators in France can serve as a source of power supply to Iberia when French wholesale prices are lower than Spanish prices.

Using OMIE data, for illustrative purposes, Figure 1 depicts actual supply and demand offers in the Iberian market relating to one hour during one day in the first 100 days of the IE.

Figure 1: Illustrative supply and demand curves for the Iberian wholesale market, 15 July 2022, hour 12



Source: Based on OMIE (2022a) and own elaboration.

[6] Congestion rent (per kWh) is equal to the difference between the wholesale prices in the two markets when the network is congested, that is, is at capacity.

2. The Iberian Exception

The Iberian Exception (IE) was designed to decouple the wholesale electricity price in the Iberian market from the wholesale market price of natural gas. The IE was introduced by Spanish Royal Decree-Law 10/2022 (and parallel Portuguese legislation) after a long negotiation with the European Commission. It was approved for 1 year but has since been extended by the Commission until the end of 2023.

The stated Spanish and Portuguese governmental objective behind the IE was to reduce the wholesale price of electricity and consumers' power costs at a time when natural gas prices were very high and rising. Whereas in 2019 wholesale power costs were approximately €16 billion (37 per cent of the total cost of electricity), in 2022 they were over €37 billion (61 per cent of total cost), as shown in Figure 2. Since the energy component of Spain's regulated retail electricity tariff[7] for over 10 million consumers was indexed to the wholesale spot market, rising wholesale power prices were causing considerable social and political alarm in 2021 and 2022. Over time, the Government reduced taxes and other charges to cushion the impact of high electricity costs on consumers, but these moves offset the effect of rising gas and wholesale power market prices only to a limited degree.

Figure 2: Cost taxonomy of the Spanish electricity system, 2018–2022

Millones de €	2018	2019	2020	2021	2022
Total	46.317	42.402	36.199	46.155	61.481
Variación anual (%)	+10,71%	-8,45%	-14,63%	+27,50%	33,21%

Source: Fundación Naturgy (2023), p. 36.

It should be noted that the regulated retail electricity tariff was a key input to reported Spanish rates of inflation. Limiting wholesale power prices with the IE also addressed the Spanish Government's concern about the country's high reported rates of inflation in 2021 and early 2022.

Beyond limiting the immediate impact of wholesale electricity prices on consumer electricity prices and published figures on inflation, the IE was also consistent with the Spanish Government's view that the current European wholesale market design needed to be reformed. The view was that the cost and offer price of the marginal resource needed to meet demand (normally natural gas-fired generation) should not determine the market price for all the lower-cost, inframarginal hydro, renewables, and other generators.

[7] The PVPC (*Precio Voluntario para el Pequeño Consumidor*) is the regulated retail price for small consumers, of which there were more than 10 million when the IE was introduced.

The IE's reduction in wholesale power market prices was achieved by paying a subsidy to fossil generators; the subsidy is referred to as a generator contribution (GC). The fossil generators, referred to here as the "privileged" or "affected" generators, adjusted their offer prices to reflect this subsidy, which is based on the difference between a new governmental wholesale gas reference price and the daily price of natural gas in the Iberian gas market (MIBGAS). The GC subsidy is intended to motivate generators to submit offer prices to the market operator that would be lower than prior to the IE by the amount of the GC. This would in turn lead to market clearing prices that were also lower by the amount of the GC than they would be in the absence of the IE. The lower market clearing prices on power generation received by affected generators under the IE, in comparison to prices without the IE, are (at least in theory) just offset by the GC.

To calculate the GC, the gas reference price starts with a value of 40 €/MWh during the first 6 months of application[8], increasing subsequently by 5 €/MWh monthly, until it reaches 70 €/MWh at the end of the period.[9] However, the gas purchase prices actually paid by generators are set by international gas market forces, and generators are free under the IE to bid into the electricity market as they see fit. In practice, generators' bids were often higher than implied by MIBGAS prices (discounted by the GC) because generators purchased gas in international markets, notably the Title Transfer Facility (TTF) market in Amsterdam, where gas prices were often higher than in the MIBGAS. As explained in detail later, the higher cost of gas for some generation, along with higher demand for electricity, resulted in higher margins for some gas-fired plants and lower benefits for consumers under the IE than the Government's methodology suggests.

It is important to note that the GC is financed in large part by a new adjustment cost or demand contribution (DC) imposed by the IE on a large class of Iberian consumers.[10] These affected consumers are ones with power prices linked to wholesale power market prices, and deemed by the Iberian governments to benefit from the reduction in the wholesale prices brought about by the IE. This adjustment cost or DC is an important offset to any wholesale power market price reduction brought about by the IE, as discussed below. Under the IE, Spain's share of the congestion rents[11] obtained by the Spanish transmission system operator related to the cross-border electricity trade between France and Spain were also allocated to the financing of the GC but, as discussed below, these rents were small compared to the DC.

The amount of the DC compensation per kWh paid by affected Spanish and Portuguese consumers can vary depending on several factors. The DC will generally be greater:

- the higher the price of gas in MIBGAS;
- the lower the reference gas price;
- the greater the volume of fossil-fired (mainly gas-fired) generation and the greater the fossil share of total generation;

[8] It might be useful to set these reference prices into context. For many years, gas in Europe in general traded at prices well below 40 €/MWh. Over the course of 2021, however, for reasons mentioned earlier, the international market price of gas shot up to levels of over 100 €/MWh in December. In 2022, price spikes reached levels of over 200 and nearly 350 €/MWh. In short, the GC was a significant intervention in the setting of Iberian wholesale electric power prices. However, for most Iberian customers, the IE also mandated a new and offsetting increase in their power bills, the Demand Contribution, that helped finance the GC subsidy and was almost equally as large, as is discussed below.

[9] Following the EU's extension of the IE until the end of 2023, the reference price will rise more slowly than initially planned.

[10] There are two parts to the adjustment cost: one refers to the higher costs of generators operating in the day-ahead and intraday market managed by OMIE; the other to the costs or savings associated with ancillary services managed by Red Eléctrica de España (REE), the system operator. The analysis in this paper focuses on the adjustment cost, or DC, related to the markets managed by OMIE. We recommend further research on the adjustment costs related to ancillary service costs.

[11] Congestion rents are not generally used to reduce the energy component of electricity retail prices and thus do not usually have an immediate impact on consumer prices. They may be used for many other purposes that typically affect future system costs. The IE is unusual in using these rents effectively to reduce current effective retail prices.

- the lower the congestion payment to Spain related to the Spain–France interconnector; and
- the lower the share of demand that must pay the compensation (DC).

As noted earlier, in granting Spain and Portugal an exception to its general policies with respect to interventions in power market prices, the European Commission required that the Iberian wholesale prices would continue to be accessible to other EU members. This meant that France could continue to import power at Iberian wholesale market prices without paying the DC required of affected Iberian consumers. Although France benefited from the IE reduction in Spanish wholesale prices, we note that this benefit was partially offset by the increased congestion rents it shared 50/50 with Spain, which in turn had agreed under the IE to share its rents with all consumers with a DC requirement, including those in Spain, Portugal and Morocco.

The IE affected fossil generators by both reductions in the level of power market prices and receipts of the off-market GC subsidies described above, which largely offset one another. However, the IE reduction in market prices also affected inframarginal generation (that is, plants with lower marginal costs and offer prices than the plants setting market prices)—but without offsetting GC subsidies. There are two categories of inframarginal plants potentially affected by the market price reductions: merchant plants; and regulated renewables generators that sell into the market and have a guaranteed minimum return. We consider the merchant plants to be especially relevant.[12] They include nuclear, hydroelectric, and merchant wind and solar plants, all of which—at the time the IE was introduced—were already subject to a €67/MWh price cap introduced in September by Royal Decree-Law 17/2021, or a windfall tax if selling directly into the spot market without any hedging tool. That price cap applied to 90 per cent of their output, thus leaving 10 per cent that might be sold at market prices if not already contracted at lower prices (which they often were). That cap also did not apply to generators of less than 10 MW, or to extra-peninsular Iberia. The system savings obtained by the application of lower prices to inframarginal generation could be used to reduce the costs of the Spanish electricity system, for instance reducing access tariffs and consumer tariffs. However, the savings on inframarginal generation resulting from the IE were small, and less than would have been the case if the Government had taxed extraordinary profits based on the higher wholesale market price that would have obtained without the IE. Although this paper provides some analysis of the effect of the IE on inframarginal generation, it is a topic that deserves further research.

Because of its design, the IE certainly did reduce wholesale power market prices relative to what they would otherwise have been, and those wholesale price reductions were reflected in the invoices of consumers whose prices were indexed to wholesale market prices. However, as just noted, those consumers were also required by the IE to make a DC to subsidize fossil generators; that contribution offset the IE's reduction in wholesale power market prices. Consumers with fixed price contracts were initially exempt from contributing to the financing of the fossil generators. But Spanish Government legislation effectively required most consumers to help finance the generation subsidy when their fixed price contracts were renewed at the end of one year, even when those contracts were multi-year contracts.

In addition to predictable concerns related to Government intervention (including concerns about distorted price signals that could lead to operating and investment inefficiencies in Iberia), the most fundamental consequence of the lower MIBEL wholesale power prices was an increase in demand within Iberia and especially for exports to neighboring countries, notably France. The data available on trade between France and Spain suggest that the IE's implementation immediately led to a substantial increase in Spanish exports to France, resulting in higher levels of Iberian generation, higher marginal generation costs and offer prices, and consequently higher costs per MWh to be recovered from Iberian consumers exposed to the wholesale market, than would have been the case without the IE.

[12] The regulated renewables are discussed later in this paper, beginning in Section 3.1. They also sell into the market but, ultimately, their returns are regulated so that they earn at least their guaranteed minimum return.

3. Effects of the IE: a conceptual overview

The standard economic framework for analysing a universal subsidy illustrates that it ultimately raises the cost and price of the subsidized product (Perkins and Rainaut, 2023). It is understandable that governments wish to protect consumers against dramatic increases in electricity prices. However, a subsidy acts like a price cap that reduces incentives to cut back on the proportion of energy consumption that consumers would have been willing and able to pay if they faced higher prices. The result is that governments or consumers pay an even higher price for the energy than had there been no intervention since higher demand increases the market price of electricity. Ultimately, the cost to society rises. We accept this standard framework, which applies in the case of the IE.

However, the effects of the IE are more complicated, for several reasons. First, the price limit is introduced indirectly through a subsidy paid to the fossil-fired generators that set the marginal prices in the wholesale market. It is not a direct subsidy to retail consumers or a cap on retail prices. Second, it is not universal; it applies to consumers whose retail prices are indexed to the wholesale market. Third, these same consumers fund the generator subsidy through a DC. Fourth, that contribution depends on multiple factors, including the level of congestion rents in trade with France and the percentage of demand paying the compensation. As a result, it is not immediately evident whether retail prices fell or rose due to the IE during its first 100 days. The Spanish Government maintains that retail prices fell significantly because of the IE. To the extent that consumers thought this was true, they may well have behaved in line with the standard economic framework, with all its implications. This certainly applies for exports to France. But, what if the actual effect of the IE was to raise retail prices to Iberian consumers compared to what they would otherwise have been? Consumers may have consumed more than they otherwise would have because they believed prices were lower, even when they were not.

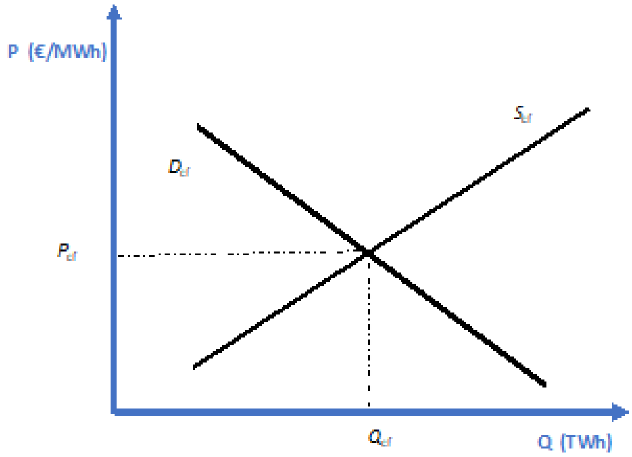
In a complicated situation like this, the only way to assess whether retail prices for Spanish consumers are falling during the period studies is to compare them to a counterfactual. This section offers a conceptual overview of the effects of the IE, assuming a counterfactual where there is demand elasticity, at least for some consumers.-The overview identifies five effects of the IE, assuming demand elasticity.

- The privileged fossil generators that would have run in the absence of the IE obtained additional margins under the IE because market prices were higher than they would have been without considering demand elasticity. This was due to a rise in demand, notably from France, resulting from the IE's depressing effect on Iberian wholesale prices, the consequent need to rely on additional and more expensive generation to meet that demand, and the increase in market clearing prices reflecting the higher cost of additional generators.
- The additional privileged fossil generators that operated because of the IE, but that would not have operated without the increase in demand from price-elastic customers and the lower market prices brought about by the IE, also obtained revenues and margins.
- The non-privileged generators (merchant and regulated) saw their revenues decline because wholesale market prices were lower than they would have been in the absence of the IE, although some regulated generators may recover revenues in the future because of minimum rate of return guarantees.
- The system experienced a reduction in the margins (between market prices and price caps on inframarginal plants) that could be used to reduce system costs and consumer prices, again because of a lower wholesale market price under the IE.
- The immediate impact on the affected consumers (that is, whose prices are indexed to the wholesale spot price) depended on the difference between the reduction in wholesale prices and the size of their DC to finance the subsidy (GC) to fossil generators. This difference depended *inter alia* on demand elasticity.

3.1 Impact on generators

In thinking about the actual Iberian power prices and volumes in the first 100 days of the IE, relative to the power prices and volumes that might have prevailed in a counterfactual, non-IE world, it is perhaps easiest first to consider counterfactual supply and demand curves S_{cf} and D_{cf}, that is, supply and demand curves as they would have been in the absence of the imposition of the IE, which we refer to simply as the counterfactual case. As shown in Figure 3, the pre-IE supply and demand curves S_{cf} and D_{cf} result in the counterfactual equilibrium market prices and quantities P_{cf} and Q_{cf} at the intersection of the S_{cf} and D_{cf} supply and demand curves. The supply curve rises to reflect the rising cost of generation to meet higher levels of demand. The declining demand curve reflects demand elasticity with respect to price.

Figure 3: Illustrative Iberian supply and demand curves, and resultant power quantity and price, in a counterfactual scenario without the IE



Source: Authors'

As discussed in Section 2, the IE complicated the determination of supply and demand balances by subsidizing the cost of gas for the fossil generators through the generator contribution (GC) and the demand contribution (DC) imposed on some Iberian power consumers. The GC subsidy provided by the IE tended to reduce the fossil generators' actual supply price offers to the market operator by the amount of the GC,[13] as depicted in Figure 4 below by the lower (dashed) supply curve S_{act}. This reflects the situation that existed in Iberia during the first 100 days under the IE. However, for Iberian consumers whose power prices were linked to wholesale market prices, the IE also required those affected consumers to pay a DC that is the major contributor to financing the GC and that, for affected consumers, substantially offsets the IE's reduction in wholesale power prices.[14]

If all buyers of power in the Iberian market had been subject to the requirement for a DC; *if* the DC had been equal to the GC; and *if* no consumers had failed to recognize that the GC-related reduction in wholesale power market prices was offset by the DC (and thus were mistakenly led to increase their demand for power consumption), *then* the demand curve D_{act} in Figure 4 would essentially shift

[13] As explained in Section 2, the Iberian governments' desired reduction in generators' offer prices by the amount of the GC was not a legal mandate, and generators were free to bid as they saw fit.

[14] As discussed in this paper, not all Iberian consumers during the first 100 days of the IE were affected by the requirement for a DC. For any total GC amount paid to privileged generators, the lower the proportion of customers contributing to that total GC through their DC payments, the greater the amount of the DC charge per MWh for those affected consumers. The GC was also financed in part by congestion rents arising from price differentials between the French and Iberian markets on power trades between the two; these rents increased as a consequence of the IE, but were relatively small, as shown below. Furthermore, prior to the IE, those congestion rents were used to reduce Spain's future power system costs.

downward by the same amount as the supply curve S_{act}, resulting in essentially unchanged demand volumes and price-setting marginal generation costs.

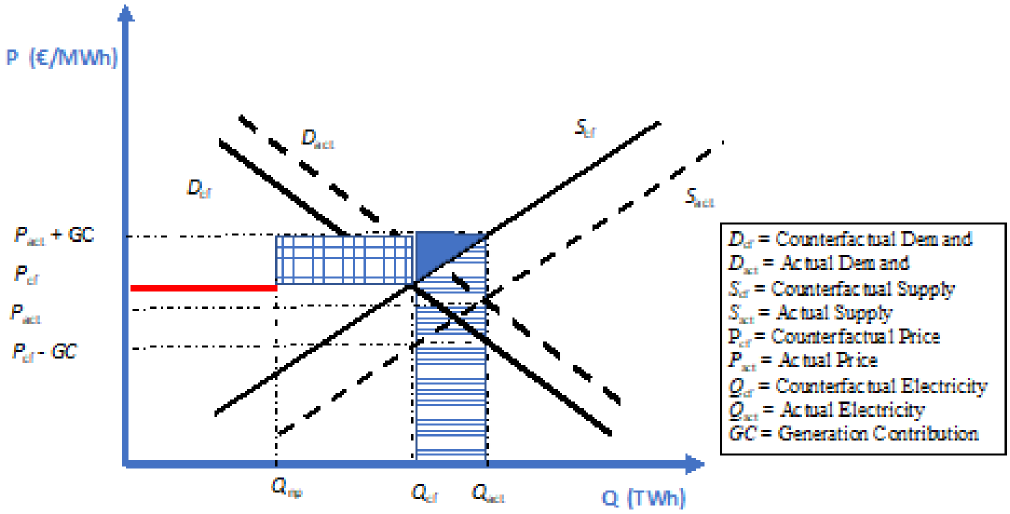
However, as noted above, a condition for the European Commission's granting of the IE was that France is exempted from the DC requirement, thereby violating the first and important conditionality in the preceding paragraph. This means that the French power market operator could find it attractive under the IE to import power from Iberia, at Iberian market prices substantially above those that the affected Iberian consumers would find economic, because such Iberian consumers also had to pay a DC to help finance the GC subsidy to privileged generators. Although not depicted in detail in Figure 4, this French import demand has the effect of increasing (moving to the right) the amount of power demanded at any given Iberian power market price and, in overall effect, raising the D_{act} demand curve relative to the D_{cf} demand curve, because France is not an advantaged buyer in the counterfactual D_{cf}, that is, in the absence of the IE.

It should be noted here that France and Spain shared some benefits of power exchanges motivated by price differentials between their two power markets. (Below we address the adverse consequences for Iberian consumers of French demand supplied by Iberian generation.) France received half of the benefits of the congestion rents on the French–Spanish interconnector, with Spain obtaining the other half. However, as part of the IE, Spain agreed to share its congestion rents with all consumers subject to the DC, which included consumers in Spain, Portugal, and Morocco. These congestion rents reduced the DC by a small amount, as explained later.

If (as the Ministry apparently assumes) the IE's reduction in generators' supply offers had no effect on the amount of power consumed—that is, if the quantity demanded under the IE had remained at the counterfactual level Q_{cf}—then the market clearing price would have been likely to decline by the full amount of GC, from P_{cf} to $P_{cf} - GC$, where the S_{act} supply curve corresponds to pre-IE demand quantity Q_{cf}. However, given that demand related to the Iberian wholesale market, notably the demand stemming from France, was sensitive to prices (as reflected in the downward-sloping demand curve D), demand volumes under the IE increased relative to what would have been pre-IE levels, leading to new equilibrium points Q_{act} and P_{act} at the intersection of the IE-related supply and demand curves S_{act} and D_{act}, respectively. This shows that the likely IE-related reduction in wholesale power prices relative to the counterfactual, $P_{cf} - P_{act}$, was less than GC, contrary to what we believe was a Ministry assumption in its assessment of the benefits of the IE.

The implications of the foregoing overview for generators can perhaps be conveyed most simply by focusing on the shaded sections of Figure 4.

Figure 4: Illustrative Iberian supply and demand curves and resultant power quantity and price with and without the IE.



Source: Authors'

Note: act = actual (with the IE); cf = counterfactual (without the IE).

First, the blue hatched box (between prices P_{cf} and P_{act} + GC, for quantity Q_{np} to Q_{cf}) corresponds to an increase in compensation for the privileged generators that were operating in merit order before the IE was introduced, and that were also operating under the IE. Market-clearing prices for all volumes of generation under the IE decreased from P_{cf} to P_{act}, but all privileged generators received the GC, which increased their total compensation to P_{act} + GC. Moreover, because of demand elasticity, the decrease in actual market clearing prices *P*act relative to counterfactual market prices P_{cf} was less than GC, as shown in Figure 4. The primary reason was that the attractiveness of prices at P_{act} levels for French consumers, who were not required to pay a DC charge on top of the IE-reduced wholesale market price, expanded demand such that the D_{act} curve intersected with the S_{act} curve at a higher demand volume, Q_{act}, than Q_{cf}. This resulted in a market clearing price Pact that was higher than P_{cf} – GC because the additional demand volume had to be met with generation that had higher costs and resulted in a market clearing price higher than P_{cf} – GC. The privileged generators that would have operated even without the IE received this uplift in total compensation on all the volumes supplied by that group, that is, the volume Q_{cf} – Q_{np}, where the latter volume was supplied by non-privileged generators.

The privileged generators presumably continued to supply the same volumes using the same gas supplies, producing power with the same conversion efficiencies/heat rates, and paying the same carbon charges as they would have in the absence of the IE, so the uplift in their total compensation would have represented additional profit. However, the extent to which their costs might have changed, if any, is an empirical question that deserves further research.

Second, the dark blue and light blue column in Figure 4 corresponds to additional generation that only runs due to the increased demand under the IE. For the privileged generators supplying the incremental volumes Q_{act} – Q_{cf}, the entire column bounded by those volumes and the P_{act} + GC price represents increased revenues and therefore increased costs passed on to consumers buying in the spot market. The minimum additional profit margins of the IE for generators supplying the additional generation are reflected in the triangle at the top of the column (dark blue in Figure 4). The lowest-cost units first dispatched would have a minimum profit margin determined by the difference between the market clearing price of P_{act} + GC and their costs, as shown in the S_{cf} supply curve. The last units dispatched would have supply costs equal to the market clearing price and no incremental profits. However, these are minimum additional margins; some industry experts would argue that most generators tend to include a profit or “industrial” margin of 5 to 10 per cent on the total amount of the power on offer. If so, the increased revenues brought about by the IE would have meant substantial increases in net profits for these generators.

Third, the thin red horizontal area (below P_{cf}) in Figure 4 reflects the potential losses of some non-privileged inframarginal generators compared to what would have happened without the IE. The wholesale price reduction resulting from the IE (from P_{cf} to P_{act}) reduced their market revenues on the output represented in Figure 4 by Q_{np}. As discussed in the previous section, the negative effect on the inframarginal merchant generators was limited. Most inframarginal merchant plant output already faced a price cap of €67/MWh (or a windfall tax if the plant was unhedged), so the net impact of the reduced wholesale market price affected only a small percentage of the incremental revenue (red horizontal area beneath the counterfactual price P_{cf}).[15] Furthermore, for other inframarginal plants, the regulated renewables and cogeneration, the adverse consequences may have been limited by guaranteed minimum rates of return (to be recovered later). We suggest that even market prices depressed by the IE would still have provided returns above the minimum guarantees and thus would require no makeup payments after the 100 days addressed in this paper. As noted in Section 4, NERA (Arnedillo et al 2023, 2023a, & 2023b)[16] has a different view on this matter, and this topic may deserve further research.

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[15] To clarify the point with an example: suppose the application of IE reduced market prices from P_{cf} = €200/MWh to P_{act} = €150/MWh. Non-privileged generators producing power in the amount of Q_{np}, and subject to price caps, would be receiving €67/MWh plus 10 per cent of the difference up to the market price (see Section 2). Income would fall from receiving €80.3/MWh [67 + 0.1 × (200 – 67)] to €75.3/MWh [67 + 0.1 × (150 – 67)], reducing their income by €5/MWh. This income reduction is represented by the red area in Figure 4.

[16] NERA is an economic consulting firm where the authors of these publications work. For brevity, the three Arnedillo et al publications will be referred to as “NERA” in the remainder of this article.

Fourth, the IE's price reduction for generation amounts up to Q_{cf} (the area between P_{cf} and P_{act} for generators not otherwise price-capped) reflects revenues that otherwise could potentially have been taxed to finance system costs and to benefit consumers through lower access tariffs or reduced charges to cover policy costs.[17]

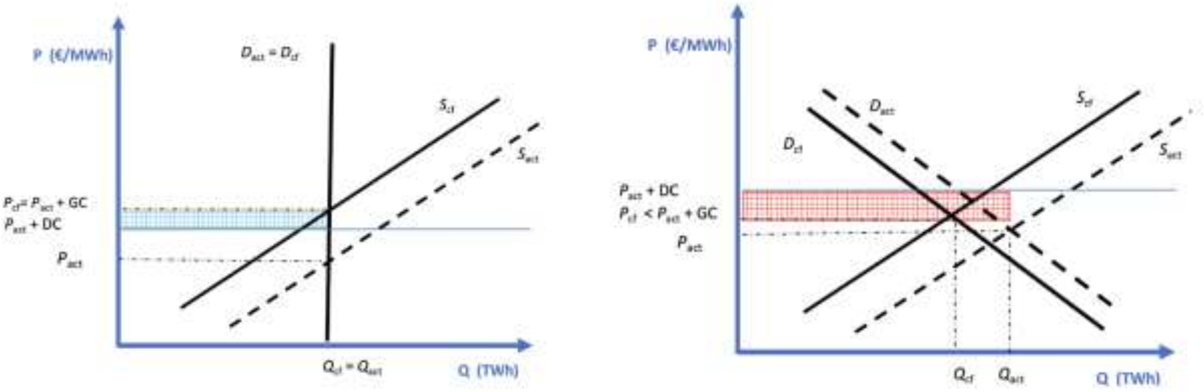
3.2 Impact on consumers

To illustrate the impact on consumers, this subsection compares two approaches to analysing the counterfactual: one with and one without demand elasticity. To simplify the comparison, the analysis ignores congestion rents, which help to finance the GC. This is to explain how demand elasticity can change the DC, which is the main revenue source funding the GC.

Figure 5 shows an illustrative case concerning possible differences in consumer power costs per MWh under the IE (P_{act} + DC), and in a counterfactual case without the IE (P_{cf}). The left-hand side of Figure 5 represents the Spanish Government's approach, which assumes a vertical demand curve, so there is no change in demand when prices rise or fall. In that case, the consumer benefits are represented by the blue hatched area. The counterfactual wholesale price (P_{cf}) equals the market price under the IE (P_{act} + GC). That counterfactual price is greater than the wholesale price the consumer pays under the IE (P_{act} + DC).

By contrast, the right-hand side of Figure 5 represents an approach with a downward-sloping curve that reflects demand elasticity. In this counterfactual, due to demand elasticity, wholesale prices (P_{cf}) are higher and demand lower than when following the Ministry methodology. For instance, in Figure 5, the red hatched area reflects that, with demand elasticity, the counterfactual price (P_{cf}[18]) paid by the consumer could be less than the price paid under the IE (P_{act} + DC). In other words, consumers may pay more under the IE than if the IE policy had not been introduced.

Figure 5: Illustrative Iberian supply and demand curves, and resultant power quantity and price, with and without the IE



Source: Authors'

Note: act = actual (with the IE); cf = counterfactual (without the IE). Ministry (left) and alternative (right) counterfactuals.

As stated, this is simply an illustrative case. A final determination of the relative sizes of the GC and the DC per MWh would need to consider at least two other factors that enter the determination of their total amounts. These are the amount of generation supplied by privileged generators; and the fraction of total Iberian power consumption that is used by affected customers. This is because, setting aside the contribution of congestion rents to the financing of the total GC, the total GC is determined essentially by the governmentally determined GC per MWh of the privileged generation multiplied by the amount

[17] In the same sense as in note 15, system revenue fell from €119.7/MWh [0.9 × (200 – 67)] to €74.7/MWh [0.9 × (150 – 67)]. In other words, the €50/MWh price reduction because of the IE is divided between a reduction in income from non-privileged generators (€5/MWh) and a reduction in system income (€45/MWh).

[18] Note that P_{cf} will be less than P_{act} + GC whenever the demand curve is decreasing.

of that privileged generation. The DC (which is a levy per unit of consumption) is determined essentially by dividing the total GC by the consumption of affected consumers. The higher the share of total Iberian power consumption that is supplied by privileged generators, the higher the total DC. The higher the share of Iberian consumption by affected consumers, the lower the DC on a MWh basis.

4. The Ministry's methodology for estimating effects of the IE on Spanish consumers

It is difficult to simulate what would have been the market dynamics and the effects of the Iberian wholesale power market if the IE mechanism had not been introduced, that is, to develop a counterfactual scenario. That said, several analysts, notably the Ministry, have relied on what we view as overly simplified assumptions relating to counterfactuals. This section focuses on our understanding of the methodology used by the Ministry.

4.1 Description

In order to assess the effects of the IE on Spanish consumers during its first 100 days, the Ministry focuses on a comparison of (1) the overall power costs under the IE of Spanish consumers affected by wholesale power prices, that is, the actual power market prices received by privileged fossil generators and passed on to affected consumers, plus the actual DC also paid by affected Spanish consumers; and (2) a projection of the power market prices that would have been passed on to affected consumers in the absence of the IE. To make a projection of power market prices in the absence of the IE, the Ministry approach necessarily develops a set of assumptions about a counterfactual scenario that would have occurred in the absence of the IE.

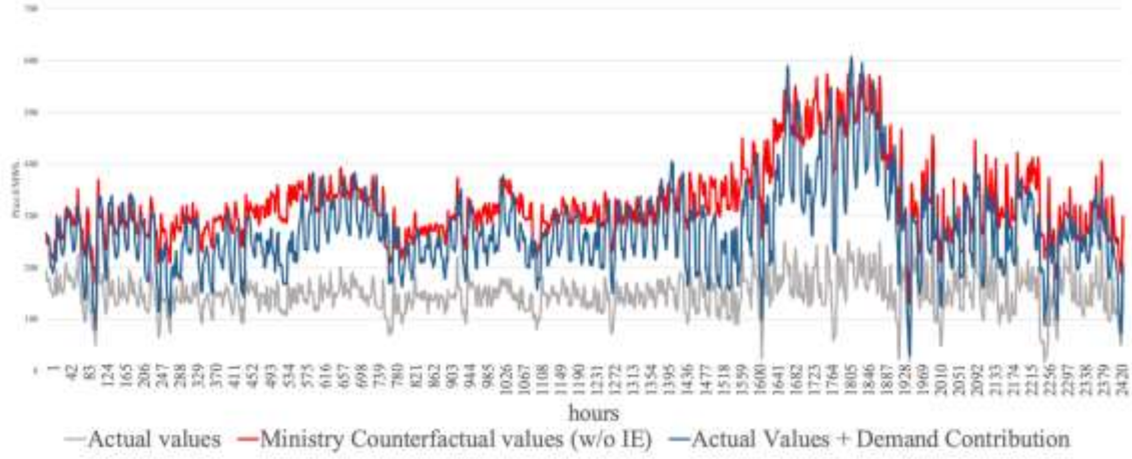
To estimate wholesale market prices in its counterfactual, the Ministry methodology begins with the actual MIBEL hourly data on market prices for the first 100 days of the IE that are published by the Iberian market operator (OMIE). It then increases those prices by the hourly compensation (GC) amount that privileged generators received under the IE, also as recorded by OMIE. This results in estimated wholesale power market prices in the counterfactual that are markedly higher than the actual prices under the IE.

The Ministry then estimates the average hourly savings of consumers affected by the IE as the difference between its counterfactual wholesale market price (with no DC), which is (2) above, and the total of the actual wholesale price under the IE and the actual DC required of affected consumers under the IE, which is (1) above.

The Ministry may have considered possible changes in domestic and export demand due to the different effective costs of power for consumers affected by the IE (market prices plus DCs) relative to its estimation of costs (simply its counterfactual market prices) in its counterfactual. However, to our knowledge there is no official public document or other evidence to confirm that the Ministry's calculations of the effect of the IE took any such potential differences in demand into account. The Ministry methodology described in this paper assumes that they did not quantify any potential demand-side effects.

Figure 6 depicts the three key patterns of prices per MWh for affected consumers over the first 100 days of the IE, according to the Ministry methodology. The grey curve traces actual wholesale market prices under the IE. The blue curve reflects what affected Iberian consumers actually paid under the IE; this includes the actual wholesale price and the DC paid by Iberian consumers as part of the GC subsidy paid to fossil generators. The red curve is the Ministry's estimate of the counterfactual wholesale prices had the IE mechanism not been applied. This red curve is simply the pattern of actual market prices plus the generator compensation (GC) received by the privileged generators. The red curve is usually above the blue curve, implying significant savings from the IE for affected consumers.

Figure 6: Three key patterns of prices per MWh for affected consumers according to the Ministry methodology, 15 June–23 September 2022



Source: OMIE (2023b, 2023c) and own elaboration

Note: grey = MIBEL hourly market prices; blue = hourly market prices plus DC; red = Ministry's counterfactual wholesale prices, i.e. had the IE not been introduced.

Table 2 quantifies the results presented in Figure 6. According to this interpretation of the Ministry's counterfactual, if the IE had not been introduced, the average wholesale market price would have been about 120 per cent higher than the actual price, assuming the same demand, but there would have been no DC required of affected consumers. This suggests that, relative to the Ministry's counterfactual, the IE yielded savings for Spanish consumers of approximately 20 per cent, or about €1,400 million (53.9 × 26,022 = 1,402,586), over its first 100 days. As noted above, these results ignore the impact of lower net consumer power costs under the IE on the quantity of power demanded (that is, the results ignore any possible demand elasticity with respect to price).

Table 2: Comparison of actual values under the IE and Ministry counterfactual values, 15 June–23 September 2022

Parameter	Actual values (under IE)	Ministry counterfactual values (without IE)	Ministry counterfactual values vs. actual values	Ministry counterfactual values vs. actual values
Wholesale Iberian average MIBEL price (€/MWh)	148.5	326.8	+120 %	178.3
Average demand contribution for affected Iberian consumers (€/MWh)	124.4	0	-100 %	–124.4
Average total cost for affected Iberian consumers (€/MWh)	273.0	326.8	+20 %	53.9
Average hourly total Spanish demand (MWh)	26,022	26,022	0 %	0

Source: OMIE (2023b, 2023c) and own elaboration.

Note that the first three rows of the table refer to Iberia as a whole. Since the Ministry analysis focuses on the effect of the overall Iberian costs on only the Spanish subset of customers, the last row breaks out total demand volumes for Spain alone.

4.2 Commentary

That the Ministry calculations fail to reflect possible demand elasticity for both Iberian consumption and exports to France and Morocco is, in our view, a flaw in their analysis. In the absence of the IE, MIBEL wholesale market prices would have been substantially higher and demand, especially export demand from France, substantially lower, thereby reducing generation volumes and the marginal cost of generation in Iberia. Like this paper, NERA also identifies increased exports to France as a significant change resulting from the IE. The following section discusses and quantifies the relevance of the Ministry's oversight.

NERA also charges the Ministry with overestimating the consumer benefits of the IE by including the IE's reduction in the revenues of renewables generators as a consumer benefit, but ignoring the guaranteed minimum returns in several renewables generation contracts that could cause a later reimbursement and increase in consumer costs. While this effect is possible, we do not think as a practical matter that the IE reduced renewables' returns below guaranteed levels. If that is correct, a reduction during the first 100 days of the IE would not lead to make-up consumer charges at some future point. However, the issue of the effect of the IE on renewables may deserve further research.

5. Effects of the IE on Spanish consumers—an alternative quantitative analysis

This section presents an alternative quantitative analysis of the effects of the IE on affected Spanish consumers during its first 100 days.

Any counterfactual relating to the IE must examine the potential impact of the IE on both supply and demand. As discussed in Section 4, the Ministry's counterfactual focuses on the supply side of the market. Lowering wholesale prices was a direct and obvious target of the IE's subsidies to the generators that determine wholesale power market prices, but this effect was substantially offset for affected Iberian consumers by the IE's DC requirement. However, French imports were not subject to this requirement, and the IE's reduction in market prices relative to what would have prevailed in its absence clearly increased the attractiveness of French imports from Spain, as demonstrated in Section 5.2. Some analysts,[19] notably including NERA, but not the Ministry, mention such demand effects. This paper presents an analysis of the IE's consequences for Spanish consumers that quantifies those effects on demand.

This section begins with a qualitative overview of two alternative counterfactuals that emphasize the impact of demand elasticity. These two counterfactual scenarios are then quantified and used to assess the effects of the IE. The first scenario reflects demand elasticity in Spain; the second scenario reflects demand elasticity in Spain as well as in export markets—specifically potential changes in electricity trade with France. The second is the counterfactual we use to assess the impact of the IE on Spanish consumers and other affected parties.

Both new counterfactual scenarios utilize OMIE hourly data on actual supply and demand offers under the IE to estimate what generators and consumers (or their representatives) would have bid in the absence of the IE.

- The market clearing price projected in these counterfactuals reflects the highest generator offer price needed to equate supply and demand volumes.

[19] Other authors such as Brito (2022) recognize that demand can be elastic, but do not estimate the effects of that elasticity. Hidalgo *et al*. (2022) use Bayesian structural models to build a counterfactual, incorporating causal relationships, projecting the time series of energy prices for PVPC customers, and thus estimating savings. However, they study the effect on only a limited part of the market, and they do not incorporate demand elasticity in their modelling.

- Gas- and coal-fired generators submit offer prices that equal the offer price they submitted under IE, plus the extra GC compensation paid to those generators under the IE.
- Other producers, especially dispatchable hydro and some intermittent renewables, whose offer prices reflect their opportunity cost, submit offer prices in line with gas-fired generation.
- Some renewable and other generators are subject to price caps (€67/MWh) that continue to apply in the assumed absence of the IE.

This paper estimates a counterfactual supply curve for the Iberian market—that is, the generation offers that would have prevailed in the absence of the IE—using the actual hourly offers made by generators in the first 100 days of the IE, plus the actual GC received by privileged generators. This fact-based approach seems reasonable and logical, and is a quantification of the conceptual S_{cf} supply line depicted in Figure 4. This approach parallels that used by the Ministry, so differences in the conclusions of the Ministry and this paper do not arise from the determination of a counterfactual supply curve.

This paper also uses actual (IE) data on Iberian demand offers, after adding the actual DC, as a reasonable and logical basis for modelling the counterfactual demand curve, depicted as D_{cf} in Figure 4.

As discussed above (subsection 3.1), the Ministry, to the best of our knowledge, made no explicit determination of a demand curve, and appears to have implicitly assumed a completely inelastic (vertical) demand curve, that is, a volume of demand unchanged by price. The Ministry's omission of demand considerations in its analysis is almost certainly the major source of the disparity between the Ministry's conclusions and those of this paper regarding the effects of the IE on Iberian power consumers.

We do not have access to comparable time series of actual supply and demand offers that may be available for the French market; we have only the actual hourly market prices that applied to trade over the interconnector in the first 100 days of the IE. Because of the availability of power at Iberian market prices depressed by the IE, actual French market prices may have been lower than they would have been in the absence of the IE. Lacking the detailed French market data just mentioned, we cannot quantify the effect of the IE on French power market prices with precision. However, we argue below that the IE probably had little effect on French wholesale prices.

With the foregoing caveat with respect to exact French market prices and import volumes, because the IE directly caused Iberian wholesale power market prices to be lower than they would have been otherwise, the total demand for Iberian electricity (over the Spanish interconnector with France and from Iberian industrial and commercial consumers) and total Iberian generation volumes almost certainly were higher under the IE than they would have been in its absence. Because of this higher generation volume, marginal Iberian generation costs under the IE were also surely higher than they would otherwise have been, and these differences are reflected in the counterfactuals studied below.

5.1 First alternative counterfactual reflecting elasticity of demand in Iberia

Our first alternative counterfactual focuses on Iberia. The first part of this subsection is conceptual and explores the qualitative impact of the IE on Iberian electricity demand, the Iberian electricity market equilibrium, and affected consumers in Spain. The second part presents quantitative results.

Conceptual overview

Our first counterfactual recognizes that residential demand is generally quite inelastic in the short run, but also that some industrial and commercial demand is elastic and will respond to day-ahead spot prices. In practice, large consumers and their suppliers enter demand offers at prices that enable producers to make and sell their products and services at a profit.[20]

Under the IE (the "actual" situation), by reference to the day-ahead MIBGAS market, large consumers could know the approximate level of the DC that they would have to pay in advance of making their bids into the day-ahead electricity market. For most large consumers, their bids for power supply could thus reflect the net cost to them after taking account of (that is, adding the amount of) their DCs. They could then enter bids for energy at prices up to the value of that energy to them.

To reflect supply, demand, and prices under the IE, this paper uses the actual data for the IE's first 100 days. Graphically, in combination with the demand of smaller consumers, the demand curve of large consumers (D_{act} in Figure 4) intersects with the supply curve (S_{act} in Figure 4) established by the offers of generators, resulting in the actual market clearing prices and volumes shown in the OMIE records for the first 100 days of the IE. The Ministry uses these same volume numbers as the basis for its counterfactual analysis, and thus implicitly assumes that the demand curve is vertical. To the contrary, the analysis in this paper assumes that the demand curve is downward sloping.

The modelling of this paper's first counterfactual reflecting Iberian demand elasticity leads to different wholesale equilibrium prices and volumes than the Ministry's approach. This new counterfactual equilibrium reflects the absence of generator subsidies, a consequent need for generators to look entirely to the wholesale market to cover their costs, considerably higher offer and wholesale spot prices, the absence of consumer DCs, higher electricity retail prices per MWh for affected consumers and—reflecting the price elasticity of large consumers—different volumes of demand and generation (D_{cf} and S_{cf} in Figure 4).

The calculation of the IE's net benefits for affected consumers depends on the difference between what consumers would have paid in the counterfactual (P_{cf}, reflecting wholesale prices with no IE-related charges) and what they actually paid under the IE (a lower wholesale price P_{act} plus the IE-related DCs). Provided that price-elastic consumers recognize that their net power prices in the counterfactual are higher than what they paid under the IE (including their DC to the payment of generator subsidies), their demand (and thus Iberian generation) would have been lower in the counterfactual. The essential difference from the Ministry's calculation is that this paper's counterfactual equilibrium depends both on supply and demand (in this first counterfactual case, lower Iberian demand) and the effects of lower demand on generation supply costs.

The analysis in this counterfactual follows the Ministry's approach to congestion rents, namely, to include the benefits of those rents under the IE and ignore them in the counterfactual. This is justified on the grounds that congestion rents are not normally used to reduce the energy component of retail prices. Ignoring them in this counterfactual increases the estimated benefits of the IE, but the difference is very small, as illustrated in subsection 5.2 which examines a counterfactual that includes trade with France.

Modelling process and results

The quantitative modelling of this paper's first counterfactual uses publicly available hourly data from OMIE for supply and demand offers, as well as OMIE's data on the DC, GC, and export volumes under the IE.

Assuming no change in international trade compared with what occurred, the modelling estimates the effect of the IE on Iberian demand by large consumers. Using the same format as Figure 6 (but different colours for the counterfactual), Figure 7 compares the actual market prices (grey curve), those same market prices plus the DC (blue curve), and estimated wholesale prices had the IE not been applied (green curve). As in the Government's counterfactual (their red curve), the green curve in this alternative counterfactual remains mostly above the blue curve, reflecting savings experienced by the affected Iberian consumers because of the IE.

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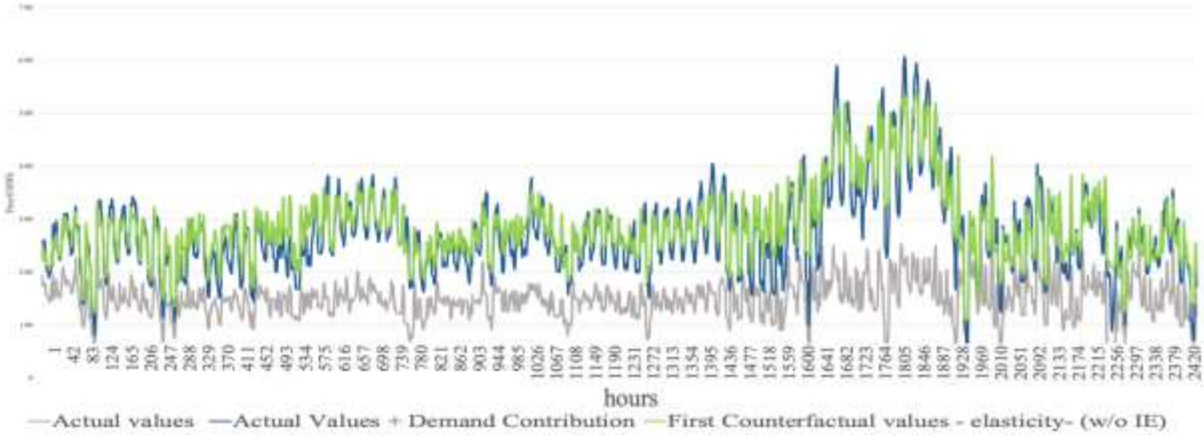
[20] The hourly energy demand of industrial and large commercial consumers relative to price is related to their production processes and the market value of their products. Their offer prices to buy electricity in the market reflect a limit above which they would have no incentive to buy more power and produce a higher volume of products or services.

Figure 7: Three key patterns of prices per MWh for affected consumers (first alternative counterfactual), 15 June–23 September 2022



Source: OMIE (2023c) and own elaboration.

Note: grey = hourly market prices; blue = hourly market prices plus DC reflecting actual results; green = prices that the market would have reached had the IE not been in force. This is the first counterfactual assuming demand elasticity only in Iberia itself.

Table 3 compares the actual values resulting from the IE with the counterfactual values of the scenario summarized in Figure 7. Absent the IE, given the demand elasticity reflected in OMIE's data on actual consumer purchase bid prices and the generator supply curve reflected in actual OMIE generator offer prices, Spanish demand in this counterfactual would have been lower by 3 per cent, and wholesale prices would have been higher by 161 €/MWh, but the IE's demand charge (124 €/MWh) would not exist, so the net cost for Iberian consumers would have been higher by 36 €/MWh, or 13 per cent. Although the IE savings of 13 per cent are lower than the savings estimated using the Ministry's methodology, this first-pass analysis tends to support the Ministry conclusion that affected Spanish consumers (PVPC consumers and larger consumers whose prices are indexed to the spot market) would have benefited from the IE. However, this estimate almost certainly overstates the consumer benefits of the IE because it assumes that only large Iberian consumers would have reduced demand in response to significantly higher wholesale prices in the counterfactual scenario. If more consumers had reduced demand in the counterfactual, wholesale prices would have been lower than shown in Table 3, and the benefits of the IE would have been less.

Table 3: Comparison of actual values under the IE and the first alternative non-Ministry counterfactual, 15 June–23 September 2022

Parameter	Actual values (under IE)	First counterfactual values (without IE)	First alternative counterfactual values vs. actual values	First alternative counterfactual values vs. actual values
Wholesale Iberian average MIBEL price (€/MWh)	148.5	309.0	+108 %	160.5
Average demand contribution for affected Iberian consumers (€/MWh)	124.4	0	–	–124.4
Average total cost for affected Iberian consumers (€/MWh)	273.0	309.0	+13 %	36.1
Average hourly total Spanish demand (MWh)	26,022	25,214	–3 %	808.0

Source: OMIE (2023c) and own elaboration.

More importantly, this first counterfactual scenario, as apparently does the Ministry analysis, ignores the effect of the IE's reduction in Iberian wholesale market prices on French imports, the increase in Iberian generation required to meet that demand increment, the associated increase in the marginal cost of that additional generation, and the consequent increase in power market prices in Iberia. As suggested by Figures 3–5, these supply cost considerations can have a significant effect on net consumer costs per MWh. This last point is addressed quantitatively in the next subsection, which considers the supply-side implications of the higher exports to France that were brought about by the IE.

As a lead-in to the analysis of the effects of French electricity demand on Iberian market prices in this paper's second counterfactual analysis, it is worth commenting briefly here on the justification for using the actual French wholesale prices (during the 100 days studied) as the basis for analysing flows over the interconnector, and for estimating the resulting congestion rents.

First, the new equilibrium hourly Iberian power market prices determined in the first counterfactual are used to estimate what the congestion rents with France would have been in the absence of the IE, assuming that French market prices are the same in this paper's second counterfactual case as they were under the IE.[21]

Second, the assumption of maintaining the same French market prices is open to challenge, but in our view is reasonable and is unlikely to have a substantial effect on the conclusions. Although the percentage difference in interconnector flows between actual flows and the counterfactual estimate may seem large, this is a large difference in a number that is small relative to the size of the overall French power market.[22]

[21] These rents are calculated as the difference between the system market prices in France and Spain in each hour, with the rents divided evenly between the two systems. For both alternative counterfactuals, the congestion rents would have been substantially lower than they were under the IE.

[22] While the change in the average volume of energy exchanged on the interconnector is striking in percentage terms, the maximum hourly interconnector flow was less than 2 GWh, which is only 2 per cent of the French market, albeit a higher percentage of the Iberian market. This suggests that exports from Spain were unlikely to significantly affect the French equilibrium market price.

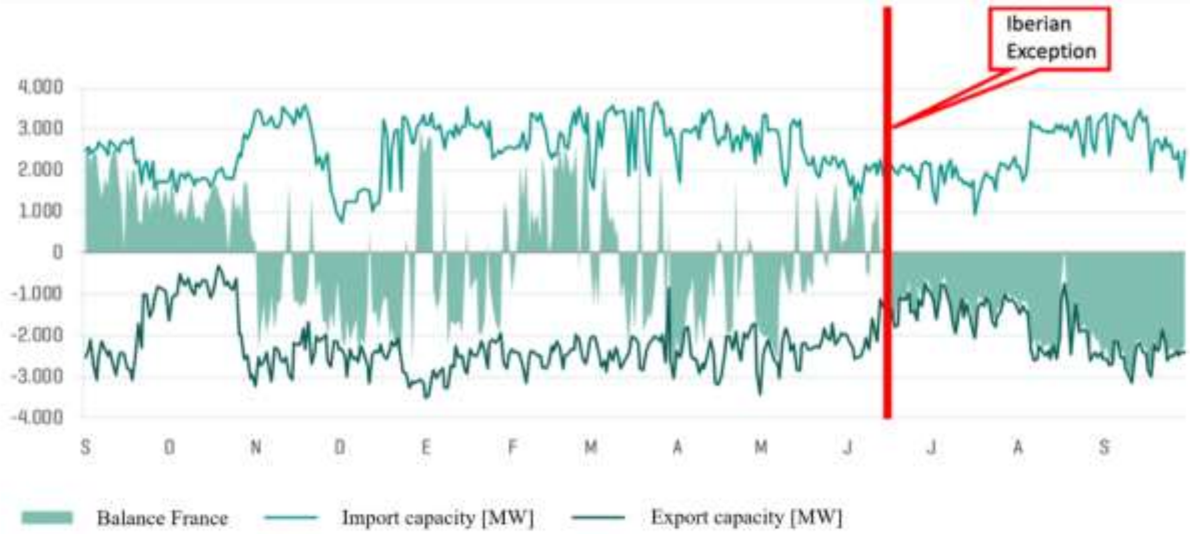
Third, given major availability problems in the French nuclear sector (and further problems with hydro generation) during the first 100 days of the IE, French power market prices were highly likely to have been based largely on the costs of gas-fired plants, either in France or elsewhere. In that case, absent the IE, French and Iberian market prices would have tended to be roughly similar, thus resulting in no large and continuous price- and demand-driven flows over the interconnector in either direction.[23] This is also suggested by the interconnector flows in both directions prior to the IE that are shown in Figure 8 below. Nor would the modest price differentials on flows between the two markets that did take place generate large congestion rents per MWh.

Fourth, as shown in Table 3, the discount in Iberian wholesale prices caused by the IE is estimated to be enormous, over 50 per cent. Not surprisingly, given any such discount, French imports and exports change radically between actual history and this paper's counterfactual scenario without the IE, with France basically importing to the limit of the available transmission capacity after the implementation of the IE, at substantial market price differentials, thus yielding significant rents, which contributed to funding the GC and reducing the DC. This argument also suggests that rents in this paper's second counterfactual would be substantially lower than were actual rents under the IE, as quantified in the following subsection.

5.2 Second alternative counterfactual reflecting elasticity of Iberian industrial demand and exports to France

Given the significant reduction in Iberian wholesale market prices caused by the IE, it seems unreasonable to ignore, as the Ministry methodology appears to do, the likelihood that the IE would affect international trade. Figure 8 shows the hourly exchanges with France for the nine months preceding and the first 100 days following the imposition of the IE. The figure clearly shows a major change in the pattern starting the day when the IE was introduced; basically, French exports to Spain stopped and exports from Spain increased essentially to the limit of interconnector capacity.

Figure 8: Actual hourly flow of the Spain–France interconnection (MWh), September 2021–September 2022



Source: REE (2022)

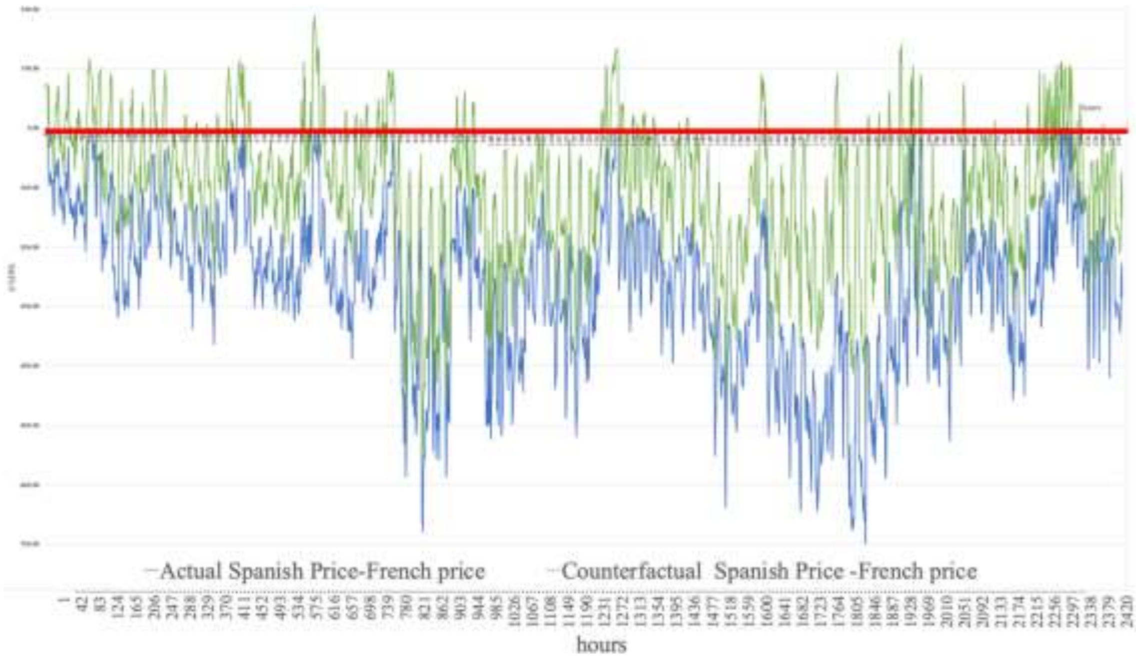
To make quantitative estimates of the implications of this paper's second counterfactual scenario, the Iberian wholesale prices calculated in the first alternative counterfactual scenario are compared with the actual French wholesale prices for each hour over the first 100 days of the IE. For the reasons

[23] We are aware that this is a key assumption, and recommend further research to test the assumption, preferably modelling the details of the French and European supply and demand curves during the period.

explained in subsection 5.1, in our view the IE would not have substantially changed French wholesale prices. It is therefore reasonable to use the information available on actual French prices under the IE as the basis for making an initial assessment of the impact of the IE on trade, and of the resulting congestion rents. The assumed direction of the flow over the interconnection is always from the lower to the higher priced market in each hour. The price information is used to calculate a congestion rent (per MWh and in total) over the 100 days.

Below, our quantitative model compares the consequences for affected consumers under the IE with those in the second counterfactual, which reflects Iberian and French demand elasticity and the potential for changes in the flows between Spain and France. The direction of flow on the interconnector reflects the price difference between the Iberian and French wholesale markets. The change in behaviour reflects the significant reduction in Iberian market prices resulting from the application of the IE. If the IE mechanism had not been introduced (that is, as in this second counterfactual), Iberian wholesale prices would sometimes have been likely to be higher than French prices. Figure 9 captures the model's estimated price differences between the two markets under the IE and in this counterfactual scenario during the first 100 days (2400 hours) of the IE's operation. It is important to note that, as foreshadowed in subsection 5.1, the modelling of this counterfactual case explicitly considers the effect of this scenario's reduced French demand on Iberian generation volumes and marginal costs relative to the actual generation volumes and costs under the IE.

Figure 9: Price differences between Spain and France with and without the application of the IE mechanism during the first 100 days of operation of the IE, 15 June–23 September 2022



Source: OMIE (2023c) and own elaboration.

The blue curve represents the difference in French and Spanish wholesale prices under the IE. Under the IE, French prices are systematically higher than in Iberia, which explains the flows in Figure 8, with France always importing from Spain. By contrast, the green curve, which reflects the counterfactual, includes 401 hours when French prices are lower than Spain's, which would have meant that France exported to Spain, reversing the actual flows under the IE. The counterfactual results obtained in this new simulation are presented in Table 4.

Table 4: Comparison of actual values according to the IE and the second alternative counterfactual, 15 June–23 September 2022

Parameter	Actual values (under IE)	Second counterfactual values (without IE)	Second counterfactual values vs. actual values	Second counterfactual values vs. actual values
Wholesale Iberian average MIBEL price (€/MWh)	148.5	265.7	+79 %	117.2
Average demand contribution for affected Iberian consumers (€/MWh)	124.4	0	–	–124.4
Average total cost for affected Iberian consumers (€/MWh)	273.0	265.7	–3 %	–7.3
Average hourly Spanish demand (MWh)	26,022	24,496	–6 %	–1,526
Average hourly Spanish congestion rents (M€)	0.251	0.064	–75 %	–0.187
Spanish demand contributors (%)	59			
Average hourly Portuguese demand (MWh)	5.376			
Portuguese demand contributors (%)	35			

Source: OMIE (2023c) and own elaboration.

Note: assuming France exported to Spain when actual French prices were lower than projected Spanish prices.

5.3 Effects of the Iberian Exception

Based on the scenario results summarized in Table 4, several effects of the IE are worth highlighting.

Effect on Spanish and Portuguese electricity consumers

The Iberian wholesale market prices in this paper's second counterfactual scenario are significantly higher than under the IE, but that wholesale price difference is less than the DCs borne by affected Iberian end consumers under the IE. Therefore, as shown in Table 4, the additional cost of the IE for affected Spanish consumers would have been 3 per cent, or about €270 million,[24] during the first 100 days. A sensitivity analysis that includes congestion rents in the counterfactual does not substantially affect the result.[25] This additional cost for affected consumers contrasts with the €1,400 million that the Ministry approach estimates as the savings for these consumers over the same period.

[24] From Table 4: 26,022 MWh x 59% x 7.3€/MWh x 2400 h = €269 million.

[25] A sensitivity analysis that includes the congestion rents as an immediate revenue source under the counterfactual leads to a very small reduction in prices because congestion rents of €150 million are only 1 per cent of the total cost of the wholesale market over the 100 days studied. The net effect of including these congestion rents in this counterfactual would be to increase the cost of the IE for affected consumer from 3 to 4 per cent.

The case of Portugal is similar, but with a significantly lower percentage of consumers affected, this results in an additional IE cost for Portuguese consumers of around €33 million[26] during the first 100 days of the IE.

On the other hand, consumers with fixed price contracts would not have seen their prices modified by the IE, so it had a neutral effect on them.

Effect on congestion rents

Congestion rents per kWh were equal to price differences between the wholesale prices on either side of the interconnector between France and Spain. These rents were shared 50/50 between the French and Spanish electricity systems. The application of the IE resulted in an increase in these rents relative to a counterfactual case without the IE, motivated by the IE's artificial reduction of wholesale prices in the Spanish market. The hourly average congestion rent for each country amounted to €251,000 under the IE compared to an estimated €64,000 had the IE not been introduced. That amounts to an increase in congestion rents of €450 million, from €150 million to €600 million, for each country over the IE's first 100 days.

In this way, the French system saw its revenues from congestion rents increased by almost €450 million in the 100-day period considered. Normally, Spain would have used all its congestion rents to finance the costs of the system. However, presumably to win approval for the IE from the European Commission and from Portugal, Spain agreed to dedicate the entire €600 million from its congestion rents to finance the IE, thereby reducing the DC for affected consumers from Spain, Portugal, and Morocco.[27]

Spain's share of the congestion rents was approximately €500 million and covered 13 per cent of the costs of the IE over the 100 days. Were it not for those rents, the DC of Spanish consumers would have risen by €17/MWh. Portugal's share of the congestion rents over the same period saved Portuguese consumers subject to the mechanism almost €82 million.[28] Morocco obtained an €11 million reduction in its DC.[29]

Planet Earth

By stimulating electricity demand for Spanish generation, the IE contributed significantly to an increase in gas-fired generation in Spain. By way of illustration, in the full year 2022 (of which about half involved the IE), natural gas consumption in the electricity sector in Spain grew by 47 TWh[30], an increase of 52.6 percent compared to 2021 (ENAGAS, 2022). Based on the IE assumption of 55 percent efficiency for gas-fired plants, the latter generated an additional 26 TWh of electricity in 2022. Some of the higher demand was due to dry hydro conditions, but the increase in exports to France (from a Spanish import balance of 0.9 TWh in 2021 to an export balance of 19.8 TWh in 2022)[31] represents approximately 80 percent of the increase in additional gas-fired generation. We do not know to what extent the greater demand for Spanish electricity increased European demand (or international prices) for gas, since France might well have had to produce or buy gas-fired generation had Spain not introduced the IE. Nevertheless, it is worth noting that total Spanish consumption of natural gas fell by 3% in 2022, with higher electricity demand almost fully compensating for a decline of 21% by conventional uses.

Assuming CO_2 emissions of 0.38 tons per MWh, and this paper's analysis of Iberian generation volumes, the IE caused an additional 577 tons of CO_2 to be emitted per hour in Iberia relative to our second counterfactual without the IE, which is equivalent to 1.4 million tons of CO_2 during the first 100 days of the IE mechanism. However, it is very difficult to know to what extent the increased emissions

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[26] From Table 4: 5,376 MWh × 35% × 7.3€/MWh × 2400 h = €33 million.

[27] Note that the DCs were calculated after taking account of the congestion rents.

[28] From Table 4: average hourly Portuguese demand (MWh) × Portuguese DC (%) × average reduction of DC due to congestion rents €/MWh × total hours = 5.376 MWh × 35% × 17 €/MWh × 2400 = €82 million.

[29] Average hourly Moroccan demand (MWh) × average reduction of DC due to congestion rents €/MWh × total hours = 278 MWh × 17 €/MWh × 2400 = €11 million.

[30] 47 TWh of gas is approximately equivalent to 4.04 BCM.

[31] As partly reflected in Figure 8 of this report, which illustrates that Spain did not import from France from the day that the IE was introduced. (REE, 2022)

in Iberia increased global emissions, since we do not know how France and Morocco would have met their demand if Spain had not exported to them.

6. Suggestions for further research

The previous section summarized some of the quantified effects of the IE on electricity prices for affected Spanish and Portuguese consumers over the first 100 days of the IE, relative to effects in two counterfactual scenarios developed in this paper. It also estimated the sharing of congestion rents among neighbouring countries, as well as some other immediate effects including higher CO_2 emissions and support for higher global gas prices. These and other consequences of the IE deserve further research, as summarized below.

6.1 Immediate effects of the IE

Consumers

The impact of the IE on consumers requires further research. First, as with any counterfactual, the analysis presented in Section 5 reflects assumptions about how Spanish generators and consumers, as well as foreign electricity actors, would have behaved had the IE not been introduced, and refers only to the first 100 days. While these assumptions seem reasonable, and more realistic than the Ministry's counterfactual, further analysis is certainly warranted, both within the same period and over longer periods. Sensitivity analysis is especially warranted to estimate the likely pricing and trading relationship between France and Spain. We have presented reasons why we doubt that French wholesale prices would have been substantially different in the absence of the IE. However, it could be argued that the supply conditions in France, specifically the nuclear maintenance problems and drought, would have required France to import the same amount of electricity from Spain with or without the IE. To assess that claim requires modelling the sort of detailed hourly market data for France that was used for Spain; data and models to which we do not have access. It is also sensible to extend the analysis to cover a longer period, especially because the first 100 days of the IE included extremely high natural gas prices, and one would expect analogous problems in the French generation sector.

Second, there is a need for further quantification of the DC that financed the IE. It included two components, one related to compensation for generation in markets managed by OMIE, and another for markets managed by Red Eléctrica de España (REE). The analysis in this report includes only the compensation related to the OMIE markets. Our initial assessment suggests that any savings or costs related to the REE markets do not materially change the conclusions. However, this issue is worth further study.

Third, consumers with fixed price contracts were exempt from paying the DC at the outset of the IE. However, when they renewed what were often multi-year fixed price contracts, they were treated as if they were beneficiaries of the IE and thereby required to pay the DC. This often meant they were obliged to pay more than agreed in the multi-year fixed price contract. In that case, consumers that had hedged against price volatility were effectively being punished for doing so. Further study of the impact on these consumers is warranted. One hypothesis is that the Government aimed to increase the volume of affected demand that was funding the IE to reduce the per-unit cost, and it did so at a cost to the consumers who had signed multi-year fixed price contracts.

Generators

According to the conceptual analysis presented in Section 3, the IE had significant effects on generator margins. Further research is required to extend this analysis and to quantify the effects, which are summarized below.

First, the privileged generators (combined cycle gas and coal generators) benefited from the IE because of its consequent increase in demand, largely due to increased French imports of power. Fossil-fired generators that would have been dispatched without the IE enjoyed increased revenues (market prices plus GCs) and margins under the IE. Most if not all the incremental fossil-fired generation that ran because of the increased demand resulting from the IE will also have obtained revenues and increased margins that otherwise they would not have enjoyed.

Second, the remaining (inframarginal) generators that were free to sell into the spot market may have seen their profits reduced due to lower wholesale market prices under the IE, without receiving the offsetting GC provided to privileged generators. However, some of this inframarginal generation was not affected directly by the lower wholesale market prices because it was already subject to a price cap, or a windfall profit tax, introduced before the IE came into effect.

Third, NERA has argued that the IE limited returns on regulated renewables generators, and that this will later lead to a reimbursement and an increase in consumer costs. Although we do not think as a practical matter that the IE reduced renewables' returns below guaranteed levels, this issue may deserve further research.

6.2 Potential longer-term implications of the IE

It is difficult to be precise about the longer-term effects of the IE. However, some of the possible impacts that are detrimental to the energy transition can be identified and deserve further research.

First, following the standard economic framework introduced in Section 3, if the IE does reduce prices for final consumers, or consumers think their prices are lower, the effect will be to reduce incentives to cut back on some of the energy consumption that consumers would have been willing to give up if they faced higher prices. This will discourage end-user investment in energy conservation and efficiency in use (e.g., heat pumps) and in technologies for shifting demand away from periods of peak prices. The result is to increase demand, perhaps especially at times of peak demand, or to reduce it by a less than efficient amount. This in turn contributes to additional fossil generation, the costs of which consumers (or taxpayers) will have to bear.

Second, any unexpected government intervention in the wholesale market, such as the IE, reinforces a well-deserved perception of regulatory risk, especially in Spain. On the supply side, the reduction of the wholesale price for inframarginal plants not covered by contracts or regulatory price caps almost certainly increases the perceived risk and cost of capital for investment in renewables and other inframarginal assets.

There is one possible longer-term effect of the IE that could potentially be beneficial in supporting the energy transition. To the extent that the IE signaled to consumers (probably erroneously) a sustainable reduction in the end-user price of electricity, the IE intervention to reduce prices might have encouraged electrification.

7. Concluding comments on the research

This paper summarizes our initial assessment of the impact of the IE on non-exempt Spanish consumers in its first 100 days. First, it questions the Spanish Government's claims that the IE reduced affected consumer prices by up to 20 per cent. The analysis here suggests that the energy component of affected consumer prices fell by less than that; and that, based on this paper's scenario reflecting the effects of the IE on French power imports, affected consumers might have paid less if the IE had not been introduced. A key reason for the difference in views is that our methodology takes into account changes in both demand and supply.

Second, the conceptual analysis in Section 3 suggests that the IE increased fossil generator margins and diminished margins for decarbonized generation. This is an important issue since it is presumably not the objective of the IE. Further research is required to assess that hypothesis and to quantify its effects.

Finally, although further analysis of the IE exception is certainly warranted, it is difficult to escape a general conclusion, namely, that intervention in electricity markets introduces many distortions, some predictable and others perhaps not, that have a damaging effect on the energy transition. Perhaps the greatest concern is related to distorted prices signals: suggesting to consumers that they need not contract to hedge price volatility and invest to manage their demand; and suggesting to upstream investors that they should adopt a higher cost of capital to reflect regulatory risk in Spain. These signals are especially problematic now, as Spain, Portugal, and the rest of the EU commit to a transition that requires massive investments by consumers and industry throughout the energy system.

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