

**Regulatory Reform
in the Swedish
Electricity Industry
– Good or Bad?**

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Executive Summary

Introduction

Sweden deregulated its electricity market on 1 January 1996. Before deregulation, consumers bought their power from the local electricity company, which either generated its own power or acquired it from another member of the industry's "club". There was no wholesale market, however, and absolutely no competition at the retail level. This was the traditional organisation of the electricity industry around the world, whether in private, public (national) or municipal ownership. From the late 1970s, however, an intellectual tide grew in favour of reducing the level of regulation in a number of industries: airlines and telecommunications were among those affected in the United States. During the 1980s, a few countries took steps to reduce the level of regulation in their electricity industries, and the topic was debated within Sweden. The United Kingdom and Norway started wide-ranging deregulation of their electricity industries in 1990 and 1991 respectively, and Sweden followed a few years later. This book is a study of that process.

We wish to ask whether the deregulation has been good for the people and economy of Sweden, and whether there are ways in which it could be improved. Our main tool in answering the first question will be a cost-benefit analysis, which compares the historical course of electricity prices, production and trade after deregulation with our estimates of what would have happened if the deregulation had not taken place. We then use the figures to calculate whether consumers (households and firms) are better off or worse off, and to calculate the change in the electricity industry's profits and costs. The tax revenues received by the government will also have changed. We can add up all these changes to give an overall answer to our question.

To answer our second question, we must look at a number of issues in more detail. Can we be confident that the new structure promotes security of supply? Does the new structure give companies the right incentives to make the right investments in generation and in the networks at the right time? Do we have confidence in the mechanisms used to ensure that prices to consumers (and particularly to households) are at a fair level? Would the wholesale market work better if we sometimes had different prices in northern and southern Sweden?

Before going any further, however, we stress that electricity deregulation does not mean the complete abandonment of any oversight of the industry. The concept means that we wish to

increase the use of markets within the electricity industry. The most immediate part of the Swedish reform was that Svenska Kraftnät bought half of the Norwegian electricity market to form Nord Pool, the world's first international electricity market. Consumers were allowed to change their retailer, initially on payment of a fee covering the cost of a new meter, but this charge was abolished in November 1999. To allow generators and retailers to compete, each network company had to publish a tariff for any other company that wished to use its grid, and these tariffs are subject to the oversight of the Swedish Energy Agency.

In general, proponents of deregulation believe that markets can give better incentives than regulators, at least in some parts of the industry. Electricity industries organised in the traditional manner were believed to have incurred higher costs than were actually necessary, which they were able to pass on to consumers. In a competitive market, companies have to seek out and respond to the needs of their customers, with no guarantee that they can recover the costs of bad decisions. The market is also open to those with new ideas – if these are good ones, both the innovator and consumers will gain.

Background

Before deregulation, the electricity industry in Sweden operated as a largely self-regulating “club”, dominated by the state-owned company Vattenfall. Private companies formed about one-quarter of the industry, and municipal companies the remainder. Generation was mostly from hydro-electricity and nuclear power. Svenska Kraftnät was split off from Vattenfall to run the transmission system in 1992.

With deregulation in 1996, Sweden together with Norway formed the wholesale market Nord Pool, which now also includes Denmark and Finland. Nord Pool sets the price of electricity in every hour, based on supply and demand bids. Prices are higher in dry years, and vary across national borders when the electricity grids are congested. Mergers among various medium-sized companies mean that Sydkraft (part of Germany's E.ON group) and Fortum (of Finland) each form about one-fifth of the industry, while Vattenfall has just under half of generation. These three large companies are the retailers for 70 per cent of customers. Just over half of customers had switched their retailer or renegotiated their electricity contract by the end of 2004. About 6 per cent of customers changed retailer in the 11 months to February 2005.

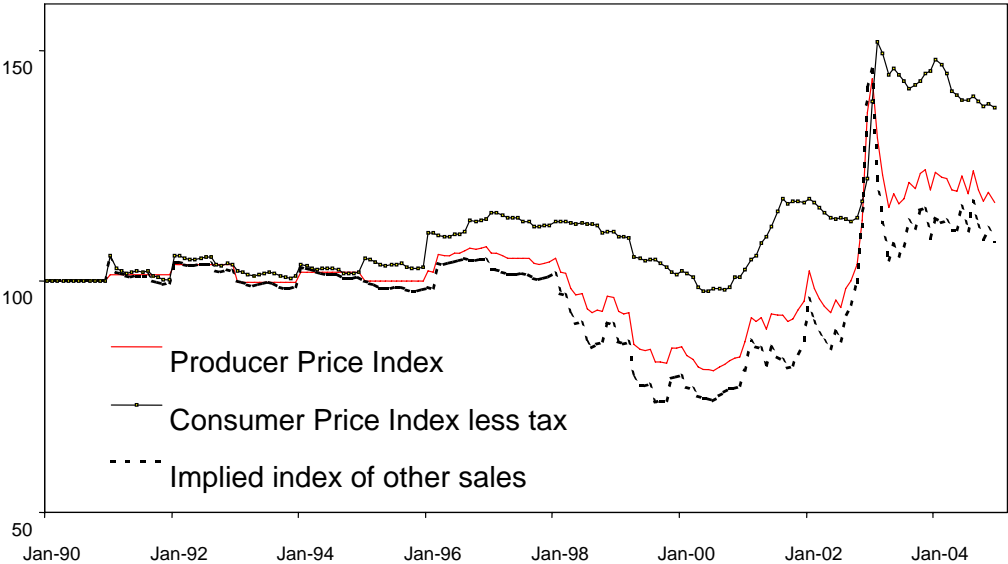
The electricity industry is subject to regulations restricting the development of further hydro-electric or nuclear power, and promoting renewable generation. Taxes on electricity have been rising over the past decade, although taxes on industrial users are very low. We do not

believe that taxes have changed because of deregulation. We also believe that the major blackouts of September 2003 and January 2005 were independent of deregulation.

Prices

In the past, prices were set to recover the industry’s average costs – municipal companies were not allowed to make a profit. Prices before tax were roughly constant in real terms in the run-up to deregulation. Figure 1 shows that consumer prices rose after deregulation, and then fell through 2000, before rising steeply in 2001 and particularly at the end of 2003. The rise was linked to high wholesale prices, affected by exceptionally low precipitation in the autumn of 2002, but consumer prices did not fall back when the wholesale price did. Using the producer price index for the industry’s overall revenues, and the consumer prices, we calculate an implied index of other sales to represent the prices paid by non-household customers. These fell faster and further after deregulation. While they briefly rose almost as much as consumer prices in response to the water shortage of 2002, they then fell back much more than prices for households.

Figure 1 Real price indices for electricity (deflated by CPI all items)



Source: Statistics Sweden and authors’ calculations.

The overall price of electricity is made up of the wholesale price, the retailer’s margin, the distribution charge, and taxes (which are not shown in Figure 1). The wholesale price on Nord Pool has varied inversely with the amount of water available for generation. It was low

between 1997 and 2000, and particularly high in 2002 and 2003. Retail margins have gradually risen, probably starting at levels too low to be sustainable. Customers who have switched supplier or renegotiated their contract pay less than those who have not, and the gap has risen steadily over time. Distribution charges, which were not separately identified before deregulation, have not changed much over the period since.

Investment

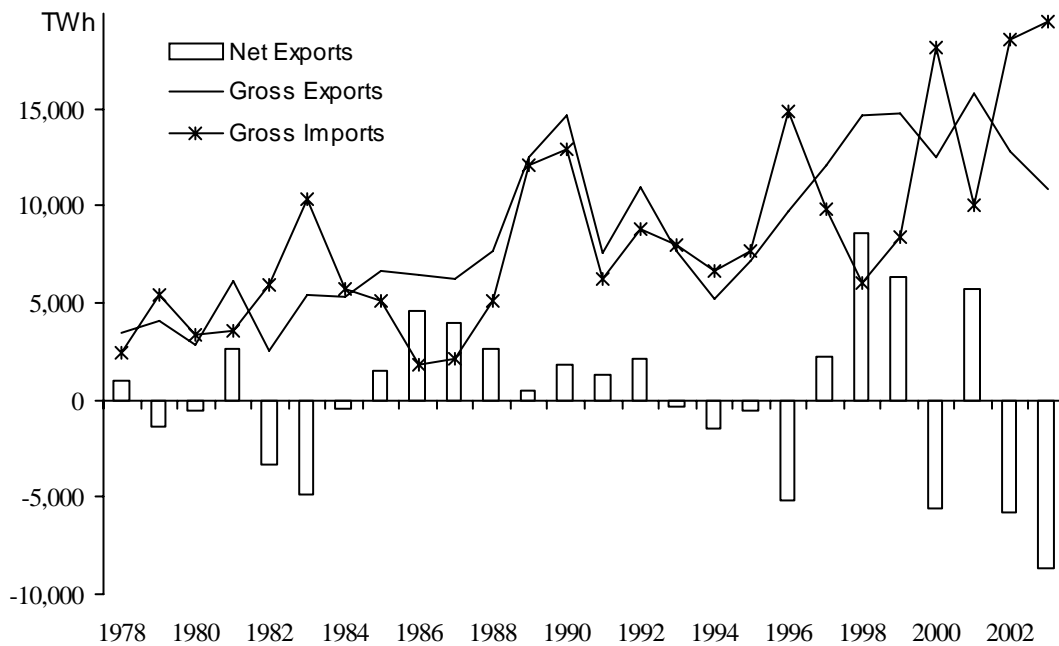
Investment in generation is desirable if we need more capacity in order to produce the power that consumers are willing to pay for. As long as market prices reflect this willingness to pay, generators should have enough incentive to build plant when it is needed.

There has been little investment in generation since deregulation, and the ratio of consumption to capacity has been rising. Making better use of capacity was an aim of deregulation. Sharing reserves and trading with neighbouring systems allow Sweden to consume more power without needing extra capacity. The fall in reserves went too far, however, and Svenska Kraftnät is paying for up to 2,000 MW of reserve capacity, mostly from stations mothballed soon after deregulation. There are several options that could replace this temporary scheme. We note that promoting greater demand-side responsiveness could lead to savings in capacity, and also reduce any market power among generators.

Trade

The Nordic countries have been trading electricity for many years. A hydro system with little variation in cost over the course of the day can trade with a thermal system with high costs at the peak and low costs off-peak. The hydro system exports at the peak and imports power off-peak. It also exports in a wet year and imports in a dry year. After deregulation, trade does seem to have increased, although year-to-year changes can mask the trend. Figure 2 shows that Sweden was a net exporter in the wet years of 1997 to 1999, and an importer in the dry years of 2002 and 2003. It was also an importer in the exceptionally wet year of 2000, because Norway had so much power to export.

Figure 2 Swedish trade in electricity



Source: Authors' calculations from Nordel data.

Over the whole period since deregulation, however, Sweden's trade position has been close to balanced.

Network regulation

The network companies continue to have a natural monopoly within their areas, and it is appropriate for their prices to be regulated. The regulation should give the companies incentives to keep their costs down and achieve a high standard of performance, even though the firms know more about their situations than the regulators do. The firms must believe that the regulator will allow them an adequate return on their investments. Until 2003, Sweden's system of ex-post regulation concentrated on investigating firms that had raised their tariffs, and could be seen as a (rather weak) form of capping on the firms' prices.

A new system of regulation is based on a network performance assessment model. The model calculates the cost that an efficient firm would face in building and operating a network in similar conditions to the regulated firm. On top of this basic network, the model can include an allowance for surplus capacity (a redundancy factor) to reduce outages. A firm with a high level of outages is only allowed to recover the cost of the basic network, but firms with lower

outages are allowed part or all of the redundancy factor. This gives an incentive for the firm to reach a high level of quality. However, many firms currently have such high outage levels that if they made small improvements, they would not receive any reward for them, since their outages would still be too high for any of the redundancy factor to be added to their prices, and they would only be paid for the basic network. We believe that this is undesirable, and suggest ways in which more firms could be given incentives to make continuous improvements. At the same time, it is important to relate the incentives to reduce outages to customers' willingness to pay for the higher quality network, or we could have too much investment. To reduce the burden of regulation, it might be appropriate to set revenues for several years at a time, rather than examining each company every year.

Market power

Many electricity markets have been vulnerable to the exercise of market power, when large firms have had the ability and the incentive to raise prices to undesirable levels. There have been studies showing that the Nordic market could be exposed to market power, particularly if there are more cross-border mergers in future. At the same time, there has been little evidence that prices have actually been raised by significant amounts to date. In a market with many hydro-electric producers, the exercise of market power involves moving production between periods, raising prices at some times but reducing them at others (when it has less impact on the firm's profits), and is more complicated to detect than the straightforward reduction of output that would be observed in other markets.

Sweden has gained from the creation of Nord Pool, however, for the market in which Swedish generators compete is now usually twice as large as Sweden alone, and can be nearly three times as large. Even when there is transmission congestion between countries, and the market is not much larger than Sweden on its own would be, prices in Sweden are generally quite close to those that would be observed if the entire Nord Pool area was uncongested. While regulators should be vigilant against further mergers, we do not believe that market power is currently a serious problem on the wholesale markets.

Market power in the retail sector may be a different matter. Prices to industrial customers seem to move closely with wholesale prices, implying that there is little market power there, but prices to household customers change more slowly. Furthermore, there is a significant difference between the prices paid by households who switch supplier or renegotiate their contract, and those who do not. This is probably explained by the (real or perceived)

transactions costs in switching or renegotiating, which would tend to imply that incumbent companies do have market power over those customers who have not switched, and that they find it more profitable to keep their prices up than to reduce margins and try to win back the switchers. Competition may not have been powerful enough to protect all household customers, and measures to make it more effective, such as those recently proposed by the Regulatory Reform Commission, should be supported.

Geographical pricing

At present, Sweden is a single price area within Nord Pool, even if there is congestion within the country's transmission system. An alternative would be to divide the country into several price areas, and allow prices to differ when there is congestion within Sweden. We believe that this could give better incentives, both to generators and to Svenska Kraftnät. If one area has an unusually low (high) amount of water in storage, and transmission constraints prevent electricity trading between regions, prices in that region will become high (low). Generators who are aware of this possibility will conserve (or use) water as the imbalances start to emerge, making it less likely that they will have a serious impact on the system. Systematic price differences between regions act as a signal that more transmission capacity is required.

When there was no congestion, there would be no price differences. When there was congestion within Sweden, the borders might be uncongested, and so each part of Sweden would still be within a larger market within Nord Pool. Northern Sweden might be coupled with Northern Norway, given the large amount of hydro-electric power within those regions, while Southern Sweden might often share prices with the thermal-dominated systems of Eastern Denmark or Finland. This should calm fears that regional price areas would reduce competition within Sweden. Other patterns of price areas might emerge as the location of generation changes over time. If regional price areas did create persistent price differences, however, there would be winners and losers. It is a political question, as much as an economic one, as to whether it is worth creating these differences.

Support for renewable generation

Sweden promotes renewable generation through a market for tradable green certificates. Renewable generators also receive support indirectly from the EU Emissions Trading Scheme, since it raises electricity prices, but not their costs, but additional support can be justified if renewables have other benefits beyond the reduction in carbon emissions. A tradable certificates scheme is well-suited to the liberalised electricity market, since any

renewable generator is eligible for support, and all customers (of a given type) contribute to that support. To ensure that potential generators are willing to invest, it is important to make the scheme as permanent as possible, and not to change the rules unnecessarily.

The scheme allows certificates to be held from one year to the next, and for retailers to pay a penalty if they do not have enough certificates. These features are fairly standard for green certificate schemes. The Swedish penalty, however, depends on past market prices for certificates. This could create some unusual price patterns over time. We find that the price will tend to rise when the probability of a shortage of certificates is high, which is the right signal for investment, but recommend that the way in which prices could evolve is studied further.

Cost-benefit analysis

Electricity deregulation has affected Sweden in many different ways. Some groups may be better off, others may be worse off. Cost-benefit analysis is a method of attempting to assess such gains and losses in a way that can help to indicate whether the policy has been good or bad for society as a whole.

The basic idea is to measure as many as possible of the changes brought about by a policy, to put a value on those changes, and then to add up those values. If the sum is positive, then the gains exceed the losses, and the policy may be presumed to be good for society. The key difference between a cost-benefit analysis and the business planning carried out before a commercial investment decision is that cost-benefit analysis tries to capture costs and benefits that are not going to be realised in monetary terms, such as environmental effects.

Cost-benefit analyses are traditionally carried out before a policy is adopted, to help make the right decision, but they can also be used to evaluate a past decision. A number of studies have estimated the gains from electricity deregulation in the UK and in the Nordic countries. We have built a model of the Swedish electricity industry from 1996 to 2003 in order to carry out a similar analysis. We compare what actually happened with a counter-factual scenario which we believe represents what might have happened if the industry had not been deregulated. We calculate prices, quantities, profits and costs, and combine them in a measure of welfare. The key question is whether this measure is higher or lower in our counter-factual than it was with deregulation.

Our results will depend upon our assumptions. We assume that deregulation increased Sweden's trade with its neighbours by 50 per cent, but without changing the pattern of flows,

as between wet and dry years. Without deregulation, there would have been more investment in generation, to maintain the industry's previous relationship of 248 MW of generating capacity for each TWh of demand supplied. We believe that the fixed costs per MW of capacity would have risen by 1 per cent a year, relative to the level actually observed under deregulation. Output from nuclear stations would have been marginally lower, by 1 per cent in the years to 1999, and 2 per cent from 2000 onwards. We use a simple model of the generation sector to calculate the industry's variable costs of running thermal power stations to meet the demands not supplied by nuclear, hydro, or traded power.

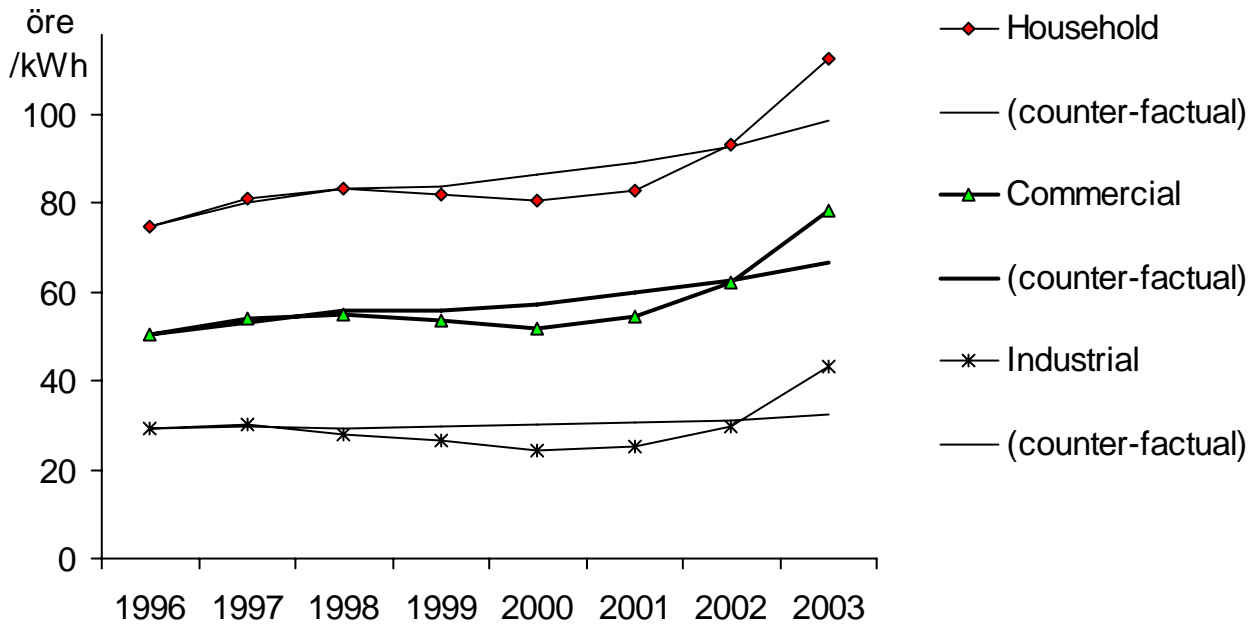
Consumer demand reacts to prices, with a 10 per cent rise in price producing a reduction in demand of between 1 and 2 per cent, depending on the type of consumer (industrial consumers are the most sensitive). Retail prices were built up from energy prices, network prices and taxes. While tax rates were not affected by deregulation, we believe that the costs of, and charges for, the networks would have been higher without liberalisation. In our central counter-factual, energy prices would have remained constant in real terms, rising by the rate of price inflation. As a sensitivity analysis, we present results to show what happens when we vary these assumptions.

Results

Figure 3 shows the prices in our central counter-factual, compared to actual electricity prices. We estimate that prices were lower under deregulation in the years around 2000, but that prices were higher in 2003 than they would have been under continued regulation.

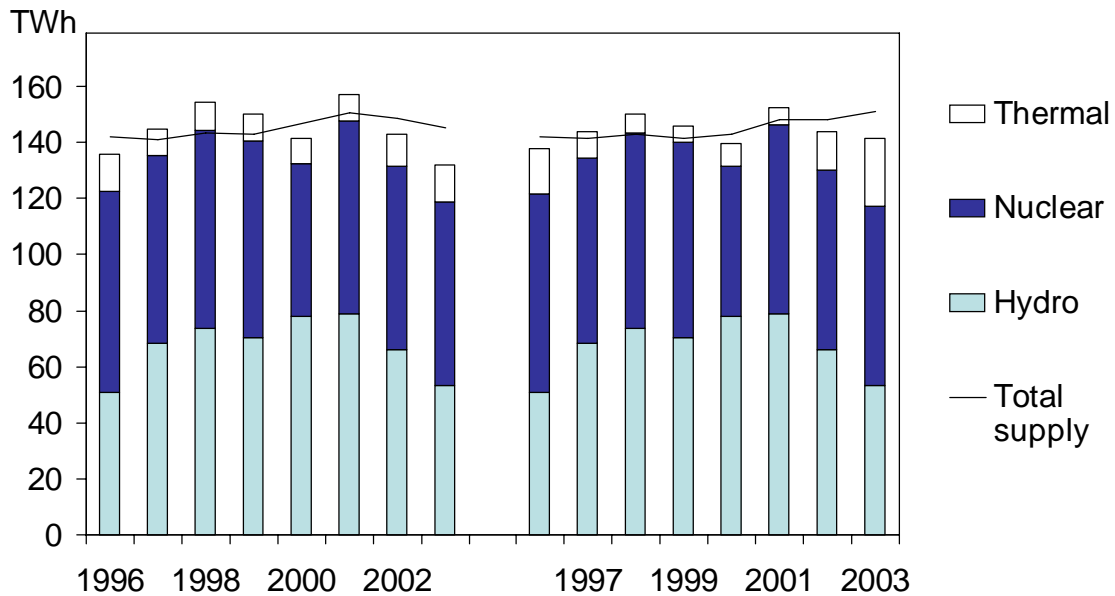
The demand for electricity moved inversely with the price, and Figure 4 shows how it was met. The lines show the total demand – the left hand side gives the actual figures and the right hand side our counter-factual – while the bars show the different kinds of generation. The difference is made up by net imports. Trade is lower in the counter-factual scenario, while thermal generation also varies.

Figure 3 Electricity prices in öre per kWh



Source: Authors' calculations.

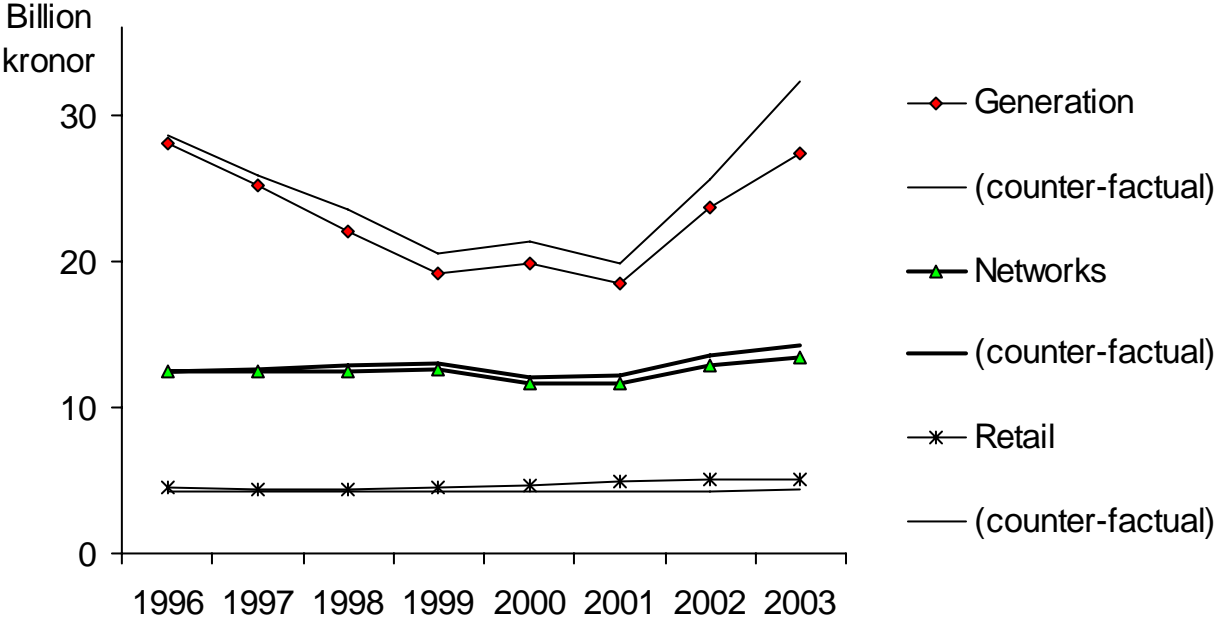
Figure 4 Generation in TWh – actual outputs (left hand side) and counter-factual (right hand side)



Source: Authors' calculations.

Figure 5 shows our estimates of how the industry's costs changed with deregulation. Generation costs rose, because of the additional capacity, while costs in retailing would have been lower, with no costs of transferring customers. Network costs would have been higher, without the example, and the pressure on profits, coming from deregulation.

Figure 5 Costs in billion kronor



Source: Authors' calculations.

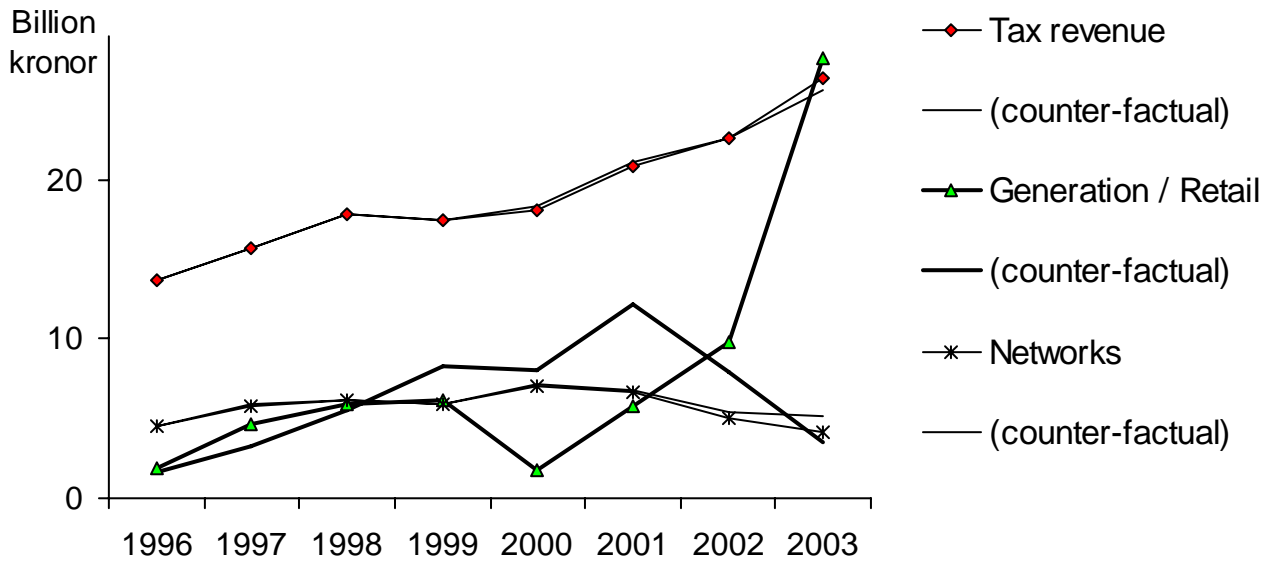
Figure 6 shows that deregulation reduced profits in generation and retailing between 1999 and 2001, but led to a huge increase in 2003, when a shortage of water led to high prices without having as much impact on average costs. Tax revenues and profits in the networks, in contrast, were not much affected.

Figure 7 shows the changes in consumer surplus coming from deregulation. For most of the period, all consumer groups gained from deregulation, but the high prices of 2003 made all groups worse off in that year.

Adding up the gains and losses, we find that deregulation has raised welfare in Sweden in every year since 1996. The gain is largest in 2000, which was a wet year with low prices, but it was also substantial in the dry years of 2002 and 2003. The overall gain from deregulation

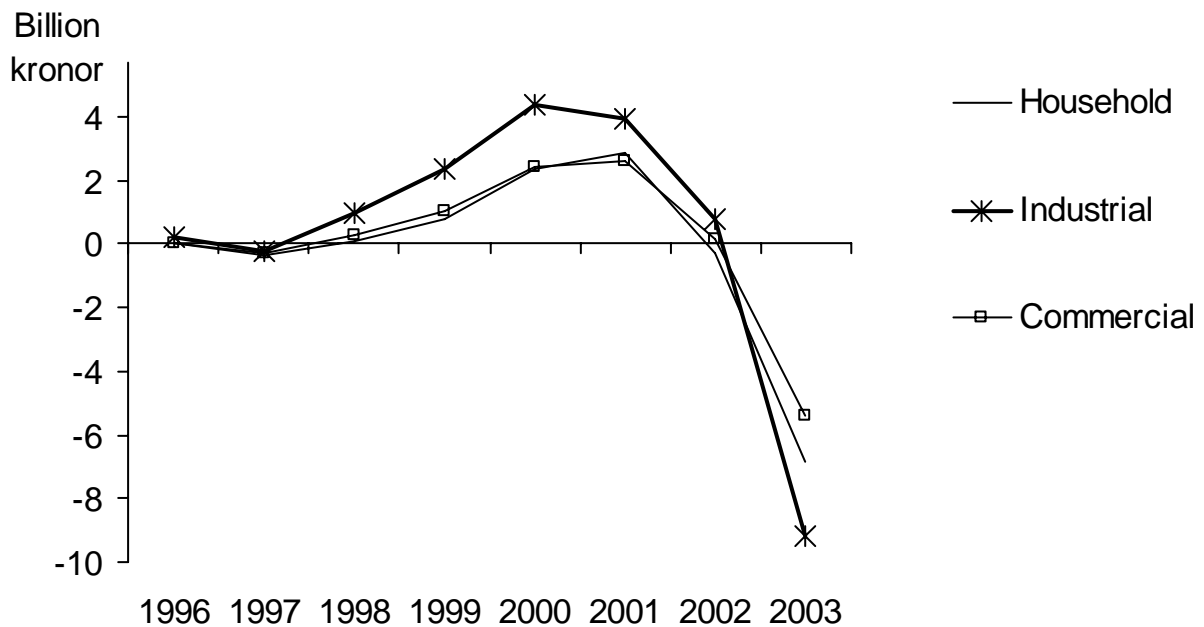
is equivalent to 10.9 billion kronor over eight years, discounted to 1996, using a social discount rate of 5 per cent a year.

Figure 6 Profits in billion kronor



Source: Authors' calculations.

Figure 7 Welfare changes from deregulation



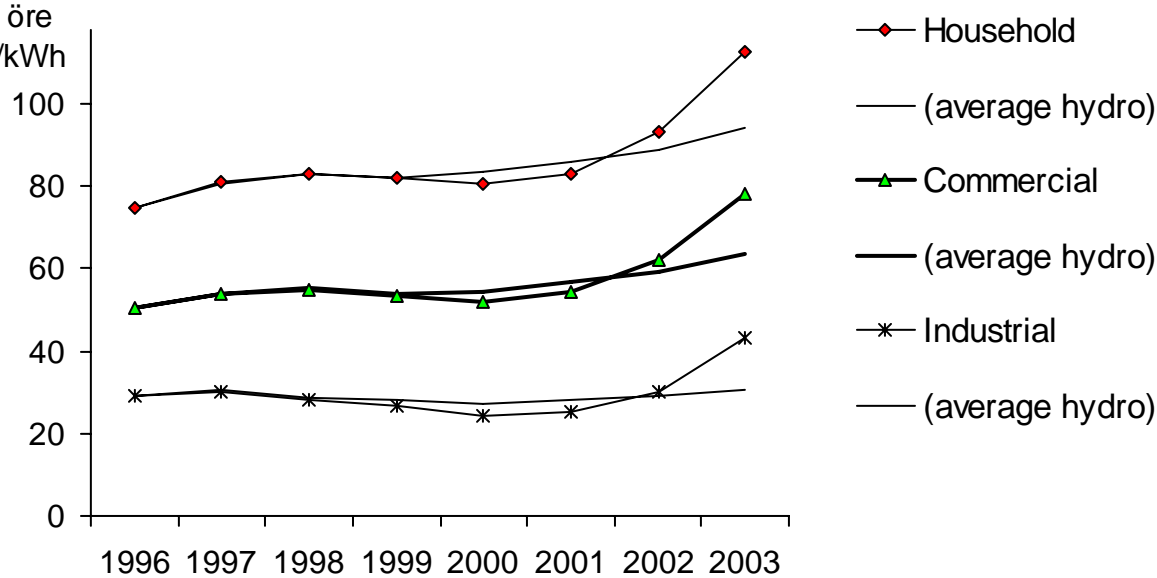
Source: Authors' calculations.

For sensitivity analysis, we have changed many of our main assumptions and run our model again. We assumed that nuclear output would have not fallen, that generators' fixed costs or network costs would not have been higher, that trade would have been 50 per cent lower (instead of 33 per cent), and that energy prices would have risen by 1 per cent a year in real terms. We also studied a case in which energy prices would have fallen in line with the cost of generation under continued regulation. In each of these alternative scenarios, deregulation still produced a gain in welfare, of between 6.9 and 11.2 billion kronor.

We also ran a scenario in which hydrological conditions were average in every year, since electricity prices have been affected by the unusually wet and dry years of the recent past.

Figure 8 shows that these simulated prices would have been higher than the actual prices in the wet years around 2000, but lower in the dry years of 2002 and 2003. The simulated prices under deregulation were consistently lower than the prices under continued regulation (and the same hydro conditions). Overall, we believe that deregulation would have raised welfare by 13.1 billion kronor if these hydro conditions had occurred in each year from 1996 to 2003, a slightly higher gain than with the actual conditions.

Figure 8 Electricity prices in öre per kWh – actual and simulated prices under deregulation



Source: Authors' calculations.

Conclusions

We believe that electricity deregulation has been good for Sweden. The electricity industry has successfully operated with a much lower level of capacity, relative to demand, than would have been the case before 1996, even in the extreme conditions of 2002/03. The avoided investment has been the main source of gains which we estimate to have been worth around 11 billion kronor over the first eight years since deregulation.

Deregulation has not been without winners and losers, however. We estimated that deregulation reduced prices in most of the years since 1996, bringing gains to consumers (both households and companies buying electricity), and losses to electricity companies. The extremely high prices of 2003, however, reversed many of these gains and losses, so that consumers appear to have become worse off for the time being, and the electricity industry better off. If prices can revert to more normal levels, we would expect this to be reversed once again.

We have studied the level of investment, the regulatory incentives facing network operators, the possibility of having separate Nord Pool price areas within Sweden, and the system of tradable green certificates for renewable generation. We believe that these issues are sufficiently important to deserve study, but do not believe that we have found any fundamental problems in need of urgent repair.

We are conscious that the Regulatory Reform Commission has recently produced its own report into deregulation. This report concluded that deregulation was working well, but came up with its own list of issues where changes might bring benefits. We have deliberately tried to look at a different range of issues from the commission, but are encouraged that its overall position is similar to our own. There are clearly ways in which the working of the electricity industry could be improved. This does not surprise us, even nearly a decade after deregulation, because the industry is so complex, and because many changes can involve winners and losers, making them hard to implement. The fact that deregulation could be made to work better, however, does not mean that it is working badly. We believe that electricity deregulation has been good for Sweden.