Deregulation: New Understandings, New Responsibilities

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Abstract

Deregulation has created notable successes. But as time passes, notable flaws have emerged in several deregulated industries. Three cases, in electrical power, rail transport and broadband telecommunication, illustrate both the nature of the problem, and an analytical approach for understanding and mitigating the unintended consequences of deregulation. The nature of the problem is unexpected consequences in patterns of investment, which in turn impacts prices and level of service. Often, all of the stakeholders, corporation and consumer alike, suffer. The analytical approach is System Dynamics simulation, which has proven to be a reliable method to address these complex issues. Investment response under different regulatory regimes in the three cases is modeled variously by classic SD decision rules, and by (appropriately constrained) optimization. The simulation analysis accounts for historically observed unexpected investment behavior, and offers guidance on how to avoid the undesirable aspects. The responsibilities of both corporations and regulators would seem to call for the use of System Dynamics in considering virtually any broad regulatory change.

Keywords: Deregulation, unintended consequences, System Dynamics, investment incentives, cyclical, telecommunications, transportation, electricity, power

1. Introduction: The Iron Law of Unintended Consequences

Government regulators in many industries have responsibility to assure that the public receives the best services at the best prices, delivered in fair and economically viable ways. Particularly during the 1970s, around the world, the concept of the superiority of free-market competitive solutions began to penetrate the world of regulated industries. The methodology was the centuries-old process of government decision-making, discussion and debate, starting from well-established principles (such as the superior performance of free markets) and calling in expert testimony to understand pros and cons, from both academic experts and corporate stakeholders. Even though the pros and cons could not be resolved or balanced (even after long periods of debate), the government regulators had the courage to make the decision. This process was suffi-

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cient to create some notable successes. Airline customers and long-distance telephone customers enjoyed ever-decreasing prices and increased choices of suppliers.

But success was far from uniform. It is now virtually a tradition that when an auction-type market is set up, there will be both players who do not fully understand what they're doing, and flaws that allow "gaming". But the regulators adjust the rules each auction, so that eventually a stable, sensible market is established. Unfortunately, some of the latent flaws in a regulatory scheme can take years to emerge, as consequences of distortions in capital investment behavior work themselves out over years and sometimes decades. In the cases discussed here, participants chronically under-invest, or invest cyclically. In such instances, not only do the corporate investors suffer, but also consumers are less well off. The first case illustrates this, in the arena of electric power generation.

2. Deregulating wholesale electricity into cyclicality

In the US, deregulation of wholesale power generation was debated then enacted in many regions in the US during the 1990s. Monopoly utilities had to sell off power plants (while keeping transmission and distribution assets). Wholesale electricity in these regions became a commodity, with spot and forward markets, and long-term contracting. Motivations to invest in power plants changed. Monopoly utilities formerly looked at future demand versus supply (including capacity presently in development (both pre-construction and under construction). The utility would execute the lowest-cost means of delivering the future demanded power. Through regulatory price setting, return on those investments was guaranteed. But after deregulation, for-profit ("merchant") generators had to look both for profitable operation (that is to say, adequate prices) as well as future demand versus supply. And (competitor's) capacity in development became less influential at dissuading apparently profitable construction. In the terminology of feedback control systems, there is less supply-line feedback. Figure 1 illustrates. The net effect of this change in decision-making caused investments in power plants to occur later and larger in deregulated markets.

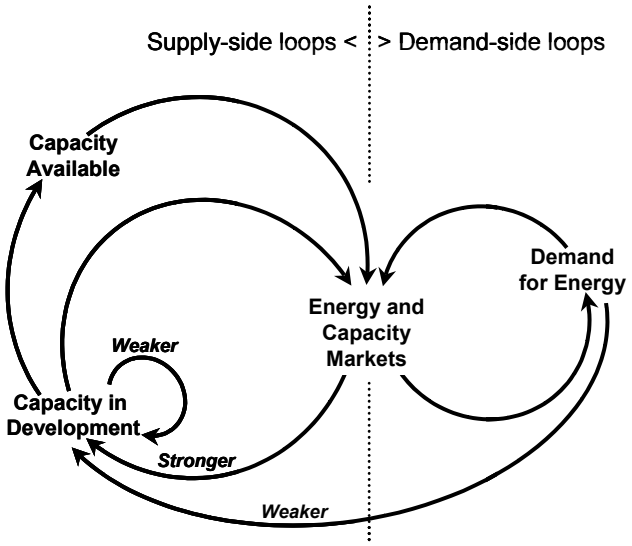

Figure 1: Supply-side and demand-side feedback loops that act through delays to determine the cyclic stability of the electricity market

The results of this change in investment rules was most visible in California, from 2000 to the present, but the same pattern repeated in many other regions. Utilities and merchant generators had held off new investment during the mid-1990s when the debate surrounding deregulation made the payoff to investment uncertain. So when deregulation became clear in the late 1990s, there was a shortage of generating capacity, and prices spiked. (In California's case, the spike was amplified by hot weather, abnormal

fuel (natural gas) prices, and unusual restrictions on long-term contracting.) Consumers lost because of high prices and brownouts, and the utilities lost from paying still higher prices for power, in some cases leading to bankruptcy. But then the price spike made power generation enormously profitable and investment flowed in. So shortly, there was excess capacity, and depressed prices and investment. And investors lost much of their investments as prices and asset values plummeted.

The power generation construction pipeline is again empty in most parts of the country, and the stage is set for another price spike and investment surge toward the end of this decade. The power industry has become cyclical, like so many other industries dealing in commodity products whose production capacity comes on line only after a few years of delay. These industries include aluminum, copper, passenger aircraft, cocoa, and oil tankers, to name a few.

How do we assert this version of history, rather than, for example explaining behavior as normal one-time transition, or greed of energy corporations? General theory and a specific study, using the method of System Dynamics (SD) computer simulation (Forrester 1961, Sterman 2001). The cyclical dynamics of commodity markets have been studied for years (Meadows 1977, Weymar 1965). There has been exploratory modeling of cyclical behavior in electricity markets (Ford 2001). There are classic rules of thumb for how changes in feedback loops destabilize systems, which would predict that regulated power markets would be much less stable (Graham 1977). But most specifically, this picture of cyclicality emerged from a study targeted at the impact of deregulation (General Electric Power Systems 2003). We used a simulation model to perform a controlled experiment, comparing a continuation of monopoly utility investment decisions, with the deregulated market regime actually in effect in two US regions. The results of the experiment, summarized in Figure 2, are quite clear: deregulation, by changing the investment decision-making, made the power market far more cyclical. Further model experimentation suggests that market rules for long-term contracting and price setting of those contracts has considerable impact on the stability of investment, wholesale prices, and ultimately, prices to the consumer.

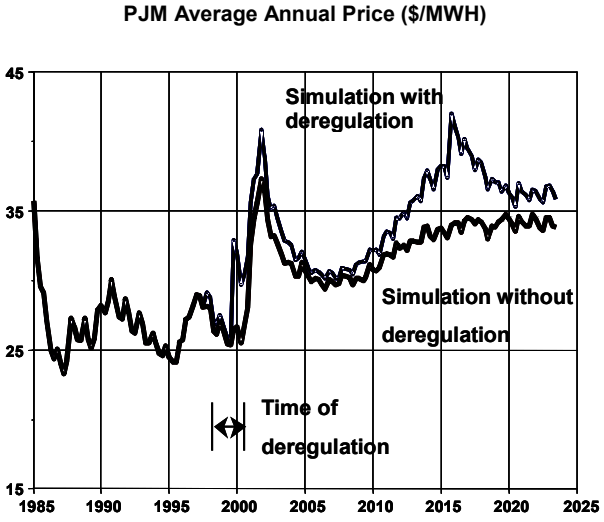

Figure 2. Comparison of two simulations, one simulating deregulation, and one continuing a regulated monopoly. Electricity prices are far less cyclical under monopoly regulation.

3. British Rail Deregulation Chokes Infrastructure Investment

Britain under Margaret Thatcher privatized numerous publicly owned services, but even she shied away from privatizing the national rail system. However her successor, John Major, broke up British Rail into more than 100 separate parts that were sold, privatized or franchised (Martin 2002). These firms include 25 train operating companies (TOCs) operating passenger routes, 6

rail freight companies, 3 rolling stock leasing companies, a single firm responsible for all network infrastructure (Railtrack), and numerous track renewal and maintenance companies. A complex set of contractual incentives and obligations governs how the pieces interact.

Today, 7 years after the privatization scheme became fully operational, it is clear that the incentives are perverse. The interests of Railtrack are often at odds with the interests of the Train Operating Companies (TOCs) and the important objectives of efficient utilization of the network as a whole and maintaining high safety standards. In particular, the penalty arrangements between Railtrack and the TOCs encourage choices that damage network performance. For instance, Railtrack was reluctant to schedule maintenance operations that would be disruptive to service; the result is a backlog of deferred maintenance works that has become increasingly urgent and disruptive to correct. Similarly, TOCs have been known deliberately not to recover a service after an infrastructure failure because they could make more money on penalties recoverable from Railtrack compared with the cost of disruption (Muttram 2003). The privatization is widely perceived to have failed. Neither passengers nor the TOCs are doing well, and the government acted recently to renationalize Railtrack to restore the needed investment and safety discipline to network infrastructure operations.

How do we lay today's poor performance at the feet of the incentives structure, rather than the complexity of the organizational structure or the unfamiliarity of the operating companies with the passenger railroad business? We have simulated an analogous UK rail privatization, the "Public-Private Partnership" (PPP) that partially privatized the world's second largest subway system, the London Underground (which corporately is London Underground Limited, or LUL). The Underground, like British Rail before it, had suffered from decades of under-investment and was struggling to deliver consistent service while patching and mending its infrastructure as finances permitted. Confronted by the government's mandate to investigate structural options that would bring in private investment, LUL was keen to avoid the performance and safety pitfalls that have plagued the overland railways in any restructuring that it would be forced to undertake. To help LUL do better, we simulated, in great detail, capital investment and maintenance decisions and the organizational and (various options for) contractual incentives that would guide them (Mayo *et al.* 2001).

We first simulated Underground system performance under a wide range of potential structural and contractual options (and under a variety of possible future conditions) to identify intrinsic benefits

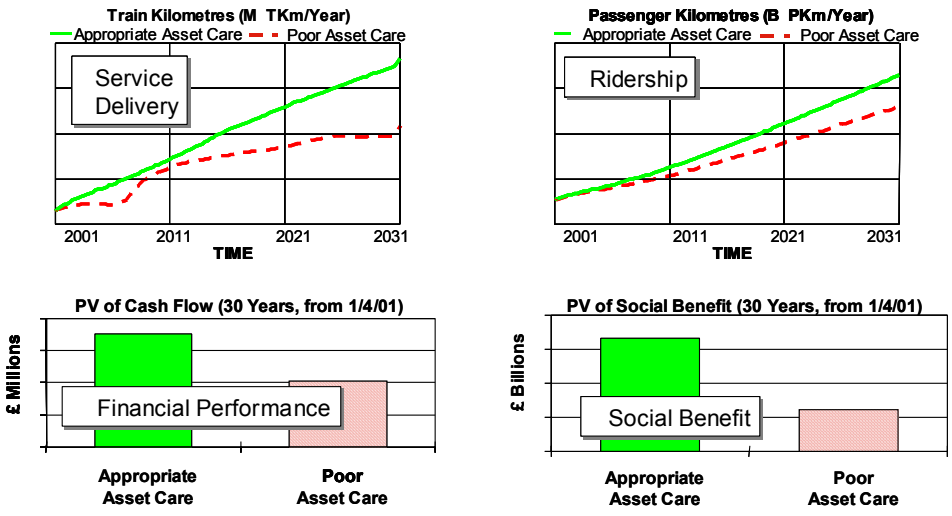

Figure 3: How important is it for the London Underground to incentivize appropriate asset care in a Public / Private Partnership? Without it, service, riders, cash flow and social benefit all will suffer.

and risks associated with particular choices. One of the key findings was that the quality of implementation and of the incentives regime was more important to maintaining and improving future Underground performance along key dimensions than which structure was selected. Indeed, simulation showed that all of the potential structures involving private ownership of infrastructure had the potential to slide into a vicious circle of declining asset condition and impaired service delivery in the absence of an appropriately geared bonus and penalty regime. More worrisome was the finding that once began, this cycle of decline was extremely difficult and time consuming to reverse, and so the key objective for LUL was to do everything possible to avoid its onset in the first place. Figure 3 illustrates how vital it is to provide strong rewards and penalties to encourage the private sector to undertake the appropriate levels of asset maintenance and investment. These critical success factors were emphasized throughout the process, as we worked with LUL in preparing the ITT document, and both worked with the bidders prior to bidding and with LUL to evaluate the bids.

Through this work, and in contrast to the British Rail experience, the Underground entered into the government-mandated PPP with their eyes wide open, understanding how all the parties would need to interact to produce the desired results and which aspects of the contract would require especially careful management. Additionally, by taking the unique step of sharing the insights from and content contained within the simulation model with bidders, LUL felt it had done all it could to make a compelling case for focusing on getting the most critical things right to its future private sector partners (Mayo *et al.* 2003).

4. Broad-band Deregulation Disincents Investors from Jumping on the Technology Train

In the US, deployment of broadband to homes, via cable and telephone lines, has gone surprisingly slowly. Even during the Internet boom, telephone companies did not deploy their broadband technology (DSL, or Digital Subscriber Line) nearly as fast as observers expected. And cable companies, not pressed by aggressive phone company deployment, only gradually upgraded their systems to carry broadband Internet access. A part of the telephone company's hesitation was the regulatory obligation to rent DSL lines to third parties, by "unbundling" that part of their networks. The US telecommunications regulator, the FCC (Federal Communications Commission) intended this regulation to enhance competition and speed up the penetration of broadband into the US population. Instead, it had almost the opposite effect.

How can we ascribe slow growth to unbundling as such, rather than some other factor, for example some irrational refusal of incumbent phone companies to give anything to their competitors? We have simulated voice and broadband penetration and unbundling in a non-US market. To address the rationality issue, we simulated each competitor as formally optimizing their investment and pricing strategies, and for non-incumbents, the rent (unbundled lines) versus build strategy. (The optimization was with respect to Net Present Value of cash flows, all of which were generated inside the model for all products and companies.) Figure 4 illustrates. To address the regulator's responsibilities directly, the market model included several metrics of social benefit, including the population's access to various technologies, the number of choices among service providers, and price levels.

We simulated the markets with and without unbundling regulations. The results were surprisingly reminiscent of US markets. With mandatory broadband unbundling, competitor's best choice was to rent existing broadband. The incumbent's best choice was to invest and price conservatively (less investment, higher prices), since competitors removed a substantial portion of the growth and profit potential, with correspondingly less possibility of market domination. Moreover, the conservative investment significantly slowed the transition to still higher-speed technologies. Consumers ended up using mostly the first-generation broadband technology, at higher prices. The only positive result was that consumers had more superficial choice, being able to access the same phone lines through multiple resellers.

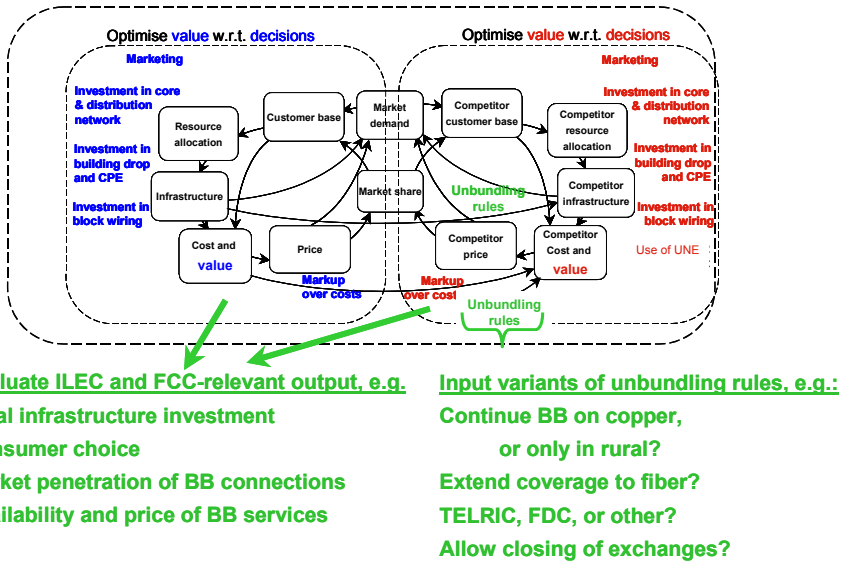

Figure 4. Understanding impact of regulatory regime change by optimizing competitor's strategy under each regime. Differences in the two results are the impact of the regulatory change.

The broadband deregulation study is of particular interest for professional modelers, in that it was executed, not in specialized simulation software, but in an Excel® spreadsheet. It demonstrates that many of the desirable modeling practices found within the specialized discipline of System Dynamics (SD) are not restricted to SD practitioners or software. These include:

- Conceptualization through causal diagrams
- Formulation of cause-and-effect relationships for decision-making
- Simulation of market feedback loops through difference equations
- Validation of simulated behavior against historical time series
- Evaluation of policy direction, rather than point prediction
- Sensitivity testing of policy direction results
- Constrained optimization to simulate complex decision-making (e.g. in Milling 1972, Krallman 1980, Homer 1999)

The key point for stakeholders in regulatory debates is that the new understanding and responsibilities pertain not to use of a particular brand of software, or even school of thought of quantitative modeling, but rather use of a broad range of well-established and sensible modeling techniques, be they described in terms of classic econometrics or System Dynamics.

5. Knowledge about market regulation provides conceptual guidance that is far from definitive, so issues are settled by discussion and debate

> More generally, there is no firm basis in economic theory to say how many competitors are "enough" in the abstract or across all markets or in all circumstances, and opinions vary considerably.
>
> --National Research Council 2002, pg. 187

> There's less here than meets the eye.
>
> --Tallulah Bankhead

Although the topic of regulatory economics and its weaknesses would easily fill a paper in its own right, it is important to note here that this extensive body of knowledge does not provide nearly as much certainty as one might assume. There is an extensive but conceptual literature on merits of the capitalist system, dating back the start of the study of "political economy" and extending into the present day. There are the simple static models, now textbook models, showing why consumers are less well off under monopolies as under competitive markets. There are extensive empirical studies of particular industries, but it is extraordinarily difficult to rigorously derive any generally-applicable conclusion from such studies—too many factors are different from industry to industry, from country to country and from time to time. These studies of course include the instances of major consumer benefit from antitrust actions and deregulation.

In the absence of a potent and comprehensive end-to-end analytical framework, today's regulators must evaluate objections made by different parties and negotiate individual concerns on a point-by-point basis. Regulators struggle to be precise about the range of choices that consumers are anticipated to have in a deregulated market place, or to gauge the likely penetration rate of new market entrants. When it comes time to assess the expected benefits of the scheme, who receives them and by when, regulators typically rely on piecemeal analysis and gut instinct to guide them. The resulting scheme is then positioned as the best that can be done. The most common outcome is thus an experiment, on the real system and in real time, on how new rules and regulations will alter the market, and waiting – often years – to learn the results.

For example, in the discussions that shaped the initial framework for wholesale electricity deregulation in California, a variety of competent economists were participating. They explicitly highlighted the several flaws that would later cause bankruptcy and brownouts. However, to put it politely, these views were firmly rejected. But this is always the danger for arguments based purely on conceptual analysis and examples in other industries or countries.

The three cases above testify to the practical need to go well beyond simple blanket application of principles, concepts and examples. Regulatory decisions depend on understanding the result of many different players' actions that interact in complex ways, and whose consequences are distant in time and venue. The industries cited are far from the textbook case of isolated markets, with no product substitution, little technological progress, and supply and demand able to quickly and precisely adapt to each other. Such complications mean that simple market solutions are nearly certain to have undesirable side effects, often for all major stakeholders.

As the three cases showed, even allegedly even-handed discussion and debate produced regulatory answers that were far from optimal, for both the public and investors. The three cases also demonstrate that it is possible to achieve a far greater understanding of the impact of a regulatory regime on market performance. The practical implication of these examples is simple but profound.

6. Responsibility to stakeholders calls for deregulation tested in end-to-end dynamic models of specific cases

Even though deregulation is driven by generally noble aims, the large number of deregulations that have failed to produce their intended benefits should force a key question to be asked: "can we construct a deregulation scheme for this market that can perform better than the status quo?" And, as deregulation fundamentally impacts all the parties in the system, including customers, companies and their shareholders, suppliers, taxpayers, and local and national government, the next questions posed should be: "how do the various stakeholders in the system fare under the new scheme. Who wins, who loses, and is this what we intend?" These questions have been difficult to address, let alone follow even modestly rigorous process, using traditional decision methods.

Higher standards for government decision-making are emerging. The Canadian government, with its SmartRegulation initiative, is evolving instructions to its various regulatory bodies on the need for analyses that incorporate risk analysis and market feedback dynamics. In civil dispute resolution, the US Supreme Court has articulated standards for expert witnesses in its decisions on *Daubert v. Merrill Dow Pharmaceuticals, Inc.* and *Kumho Tire Company v. Carmichael*. These new standards in effect call for a scientific method to be used to draw conclusions, using generally accepted methodology (Stephens, Graham and Lyneis 2002). The methodology must include evaluation of possibility of error. System Dynamics methods would certainly qualify under the new rules of evidence, given the well-defined processes that cover beginning to end, from formal conceptualization to policy analysis. Error evaluation includes both the traditional varieties of behavior and policy sensitivity testing (Forrester and Senge 1980), and the more succinct fit-constrained Monte Carlo error testing (Graham, Moore and Choi 2002). Given the extremely high stakes involved – in terms of money, consumer satisfaction, and service quality to name only a few – should not a similar burden of proof be applied to any complex deregulation scheme?

We would suggest that with the availability of proven system dynamics modeling methodology (as illustrated by the cases presented within this paper) there is little excuse not to employ it to design and implement a deregulation scheme that will work. Focusing a powerful methodology on single, specific cases and questions overcomes the lack of general theory of deregulation. Applying a system dynamics approach can supply otherwise missing insight to understand the likely distribution of benefits and how they will be spread across the various parties over both short and longer term time horizons. Such insight will allow regulators to anticipate likely responses or objections from key stakeholders, and explain the nature of any tradeoffs that must be made among competing interests. Learning what works and what does not in a safe and rapid simulation environment will produce a more robust deregulatory scheme, and significantly decrease the risk associated with going down a new path to deregulation.

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