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Market Fragmenting Regulation: Why Gasoline Costs So Much (And Why It's Going to Cost More)

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WHY GASOLINE COSTS SO MUCH (AND WHY IT'S GOING TO COST MORE)

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INTRODUCTION

Virtually everyone holds an opinion on what is wrong with gasoline markets. Some critics argue that gasoline costs too much, fattening greedy oil barons at the expense of consumers.[1] Some link reducing oil producers' profits to stopping terrorism.[2] Others contend that gasoline costs too little, subsidizing suburban sprawl and gas-guzzling SUVs at

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1 *See, e.g.*, Press Release, Congresswoman Nancy Pelosi, With Skyrocketing Gas Prices, Americans Can No Longer Afford Rubber Stamp Congress (Apr. 24, 2006), *available at* http://www.house.gov/pelosi/press/releases/April06/Rubberstamp.html ("With record gas prices, record CEO pay packages, and record oil company profits, Speaker Hastert and the Majority Congress continue to give the American people empty rhetoric rather than join Democrats who are working to lower gas prices now."); Press Release, Sierra Club, Update on Congressional Action this Week on Several Environmental Fronts (Nov. 8, 2005), *available at* http://www.sierraclub.org/pressroom/releases/pr2005-11-08.asp (discussing Sierra Club's calling on Congress to "put money back in the pockets of Americans who need it, not in the coffers of multinational oil companies"); *Surges in Energy Prices*, The Nader Page, Mar. 13, 2004, http://www.nader.org/interest/031304.html ("The expanding volume of consumer dollars here are going to the oil industry.").

2 *See* Gary S. Becker, *Let's Make Gasoline Prices Even Higher*, BUS. WK., May 31, 2004, at 24, *available at* http://www.businessweek.com/magazine/content/04_22/b3885046_mz007.htm.

the expense of the environment.[3] Web sites track gasoline prices[4] and grocery stores sell low-cost fuel to lure shoppers.[5] Policy makers debate whether gas taxes should be cut to lower the cost of living;[6] need to be increased to make drivers pay the full cost of their behavior;[7] or whether gas taxes should be a user fee for highway use.[8] The Federal Trade Commission (FTC), congressional committees, and a host of state governments have repeatedly investigated gasoline prices, searching for someone to blame when prices rise.

These debates treat gasoline as a fungible commodity, widely traded in a national or international market. And for most Americans, gasoline gives every appearance of being just such a commodity—you can fill up in Boston or Dallas, Los Angeles or Cleveland, from pumps that look much the same from city to city, and your car will run without noticeable differences in performance regardless of where you bought gas. But Gulf Coast refinery closures in the wake of Hurricanes

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[3] *See, e.g.*, Thomas L. Friedman, *Seeds for a Geo-Green Party*, N.Y. TIMES, June 16, 2006, at A31 (calling for a $1 per gallon gasoline tax to "increase the price of gasoline to a level that would ensure that many of the most promising alternatives—ethanol, biodiesel, coal gasification, solar energy, nuclear energy and wind—would all be economically competitive with oil and thereby reduce both our dependence on crude and our emissions of greenhouse gases"); Jacob Weisberg, *I Smell Gas*, SLATE, Apr. 26, 2006, http://www.slate.com/id/2140613 ("Cheap gasoline imposes its own costs on society: greenhouse gas emissions, air pollution and its attendant health risks, traffic congestion, and accidents. The ideal way to cope with these externalities would be with higher gas taxes or a carbon tax.").

[4] *See, e.g.*, UCAN's Gasoline Price Tracking Service, http://home.fueltracker.com/home.html (last visited Apr. 12, 2007) (providing low gas prices for San Diego County); GasBuddy.com, http://www.gasbuddy.com (last visited Apr. 12, 2007) (locator for low gas prices in the United States and Canada).

[5] Kathy Showalter, *Grocers See Gold in Gas, Add Discounted Pumps*, BUS. FIRST OF COLUMBUS, June 12, 2006, *available at* http://columbus.bizjournals.com/columbus/stories/2006/06/12/story3.html (describing trend toward subsidized gas prices as means of luring customers to grocery stores); U.S. FED. TRADE COMM'N, THE PETROLEUM INDUSTRY: MERGERS, STRUCTURAL CHANGE, AND ANTITRUST ENFORCEMENT 42 (2004) [hereinafter FTC, MERGERS] (stating that "the FTC observed significant growth in low-price gasoline retailing by supermarkets, club stores, and mass merchandisers").

[6] *See, e.g.*, Russell Nichols, *Bill Proposes Gas Tax Cut to Save 21 Cents a Gallon*, BOSTON GLOBE, May 11, 2006, at B1, *available at* http://www.boston.com/news/local/articles/2006/05/11/bill_proposes_gas_tax_cut_to_save_21_cents_a_gallon (discussing proposed temporary repeal of Massachusetts gasoline tax to reduce cost of living for "working families and small businesses").

[7] *See, e.g.*, Friedman, *supra* note 3 (calling for gasoline tax increases).

[8] David J. Forkenbrock & Paul F. Hanley, *Mileage-Based Road User Charges*, PUBLIC ROADS (Mar./Apr. 2006), http://www.tfhrc.gov/pubrds/06mar/02.htm ("For almost a century, the motor fuel tax has been the mainstay of highway finance in the United States. This method has the advantage of being roughly proportional to the distance traveled and thus has the desirable attribute of being a pay-as-you-go form of user charge.").

Rita and Katrina highlighted the fragility of gasoline markets,[9] and significant differences in gasoline prices throughout the United States over the last few years[10] have raised questions about whether a national market really exists. If the gasoline market is not a national one, there are serious implications for both consumer welfare and public policy. Broad, national markets are able to absorb the impact of regulations at lower costs to the consumer than are narrow, fragmented markets. Moreover, fragmented markets offer the potential for implicit collusion among producers, collusion that can be facilitated by regulatory measures.

A recent regional price spike in Phoenix, Arizona illustrated the fragmented nature of U.S. gasoline markets. On July 30, 2003, the pipeline supplying gasoline to Phoenix ruptured, cutting gasoline supplies to Phoenix by 30%.[11] Phoenix gas stations sought alternate supplies from West Coast refineries, offering to pay higher prices to bid the gasoline away from California retailers. These West Coast refineries had limited gasoline supplies, however, after earlier unplanned refinery closures had left them with lower than normal inventories. Because the Environmental Protection Agency (EPA) requires Phoenix to use a special blend of gasoline to control air pollution, gasoline from nearby Tucson could not be sold in Phoenix until the EPA waived the boutique fuel requirement on August 20.[12] Once the waiver was granted,

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[9] *See* U.S. CONG. BUDGET OFF., THE MACRO-ECONOMIC AND BUDGETARY EFFECTS OF HURRICANES KATRINA AND RITA: AN UPDATE 19-20 (2005), *available at* http://www.cbo.gov/ftpdocs/66xx/doc6669/09-29-EffectsOfHurricanes.pdf (describing impact of Hurricanes Rita and Katrina on refineries); U.S. FED. TRADE COMM'N, GASOLINE PRICE CHANGES: THE DYNAMIC OF SUPPLY, DEMAND, AND COMPETITION 28-29 (2005) [hereinafter FTC, GASOLINE PRICE CHANGES] (noting that as a result of Ivan, crude oil production immediately fell by 83% and continued below normal for several months, with reductions in crude from Venezuela also occurring due to tanker delays caused by the storm).

[10] CARL E. BEHRENS & CAROL GLOVER, CONG. RES. SERV. ISSUE BRIEF IB10134, GASOLINE PRICES: POLICIES AND PROPOSALS 1 (Oct. 27, 2005), *available at* http://fpc.state.gov/documents/organization/56862.pdf (In the five years before 2004, "gasoline prices demonstrated a great deal of regional volatility but less of an increase at the national level.").

[11] This example is drawn from FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 1-6.

[12] The delay was due to Arizona's delay in requesting a waiver, not the EPA's processing. The waiver was requested on August 19 and granted on August 20. *Id.* at 3-4.

gas from Tucson was trucked to Phoenix, raising prices in Tucson but lowering them in Phoenix.[13]

U.S. gasoline markets are fragmented and that fragmentation stems from over a century of often inconsistent, overlapping regulations of gasoline and petroleum markets. This article charts the sources and extent of that fragmentation and its likely effects on the domestic gasoline market. We highlight the dangers of following the current regulatory trend toward additional fragmentation and recommend that policy makers and industry analysts acknowledge the market's fragile condition and take remedial steps to avert future crises. Part I outlines the characteristics of competitive markets and examines the structure of the gasoline market as shaped by the traits of gasoline, refining, distribution, and crude oil. Part II turns to the regulatory measures that affect the market for gasoline, tracing the impact of economic and environmental regulation. We then identify the incentives created by the structure of U.S. environmental regulation that lead to the creation of regulatory market externalities and we suggest measures to reduce those incentives and so avoid market fragmentation. Part III concludes with recommendations for avoiding this problem in the future.

I. COMPETITIVE MARKETS AND THE MARKET FOR GASOLINE

The impact of regulation on gasoline markets can be understood only against the backdrop of the role market forces play in competitive markets and an understanding of the complex nature of gasoline production and marketing. This section provides a baseline for our analysis of the regulatory market externalities created by economic and environmental regulations.

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[13] *Id.* at 5-6. Tucson prices also rose because the pipeline passed through Tucson on its way to Phoenix. The break, which was between the two cities, prevented the Phoenix-blend gasoline from being shipped to Phoenix, reducing storage capacity in Tucson and thereby reducing supplies in Tucson. *Id.* at 6. Although the waiver resolved the immediate problem, the use of waivers discourages investment in capacity to produce the boutique fuels, potentially worsening the problem. NAT'L PETROLEUM COUNCIL, OBSERVATIONS ON PETROLEUM PRODUCT SUPPLY I-19 (2004) [hereinafter NPC, OBSERVATIONS].

A. The Role of Competition

The United States was founded with an eye toward creating a national market.[14] Preserving that national market thus enjoys a longstanding tradition in American jurisprudence—and with good reason.[15] Economic theory teaches that markets discipline firms, forcing them to cut costs to compete and survive.[16] Recent business news demonstrates that this is not simply a textbook concept: Wal-Mart has forced retail costs down;[17] competition from Toyota and Honda has pushed General Motors to force its suppliers to drastically cut costs; and the competition from Southwest Airlines has driven passengers' costs down significantly in many markets.[18] This

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[14] William N. Eskridge, Jr. & John Ferejohn, *The Elastic Commerce Clause: A Political Theory of American Federalism*, 47 VAND. L. REV. 1355, 1369 (1994) ("In light of the nation's experience under the Articles of Confederation, there was a consensus after the adoption of the Constitution that the federal government should be able to exercise national authority to facilitate a national market."); *see also* Paul B. Stephan, *Redistributive Litigation—Judicial Innovation, Private Expectations, and the Shadow of International Law*, 88 VA. L. REV. 789, 820-23 (2002) (describing courts' role in protecting the national market from "predatory localism" under the Constitution). The Founders understood the importance of expanding the internal market beyond the borders of the individual states. As Richard Posner has written, a key role of the Commerce Clause was to prevent states from erecting barriers to interstate commerce: "When so interpreted, the commerce clause becomes a charter of free trade—a subject of detailed economic analysis since Adam Smith—and, relatedly, an element of an efficient federalism." Richard A. Posner, *The Constitution as an Economic Document*, 56 GEO. WASH. L. REV. 4, 17 (1987); *see also* Robert G. Natelson, *The Legal Meaning of "Commerce" in the Commerce Clause*, 80 ST. JOHN'S L. REV. 789 (2006) (analyzing contemporary sources and concluding that the Commerce Clause was intended to address commercial activity); Nathaniel Stewart & Andrew P. Morriss, *Hedgerow Economics: The Marriage of Green Policy and Economic Regulation* (working paper on file with authors).

[15] *See* F.M. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 38 (2d ed. 1980) ("Over the long pull, there is one simple criterion for the survival of a business enterprise: Profits must be nonnegative. . . . [F]ailure to satisfy this criterion means ultimately that a firm will disappear from the economic scene.").

[16] F.M. SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 20-21 (3d ed. 1990).

[17] *See* Steven Greenhouse, *Mixed Grade for Wal-Mart on Report Card*, N.Y. TIMES, Nov. 5, 2005, at C4 ("A respected economic forecasting firm, Global Insight, found that by keeping its prices low and pressuring rival retailers over the last 19 years, Wal-Mart has kept the Consumer Price Index 3.1 percent below what it would have otherwise been."); Emek Basker, *Selling A Cheaper Mousetrap: Wal-Mart's Effect on Retail Prices* 1, 28 (Univ. of Mo., Working Paper 04-01, 2005), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=484903 (finding price impacts on commodity goods from Wal-Mart stores opening).

[18] *See, e.g.*, Steven A. Morrison, *Actual, Adjacent, and Potential Competition: Estimating the Full Effect of Southwest Airlines*, 35 J. TRANSP. ECON. & POL'Y 239, 253-54 (2001) (estimating savings from competition from Southwest at $12.9 billion in 1998).

competition has costs for some market participants: Wal-Mart's competitors have suffered from Wal-Mart's low prices;[19] General Motors' suppliers are fewer and leaner and their workforces are smaller and less well paid as a result of G.M.'s cost-cutting;[20] and the major American "legacy" airlines have been regularly forced into bankruptcy, cutting their employees' compensation by the upstarts.[21] It also has benefits: retail customers, car purchasers, and airline passengers all pay substantially less as a result of the market pressures produced by competition.

The competitive pressures in these examples derive from the breadth and depth of the markets in which these firms operate. Because a bottle of a particular shampoo in Dallas is (aside from its location) identical to a bottle of the same shampoo in Boston or, for that matter, a bottle in Bombay, the market is deep. Because there are many possible shampoos that deliver roughly equivalent hair-cleaning experiences, the market is broad. As a result, Wal-Mart can buy shampoo to resell in a market that is both deep and broad. If a bottle of shampoo costs less in one location than in another (taking transportation costs into account), Wal-Mart can buy in the cheaper location and ship the bottle to the more expensive market. If the maker of one brand raises its price, Wal-Mart can buy from a different manufacturer. The same is true in our other examples. If auto parts can be made more cheaply in Mexico than in Detroit, General Motors can obtain parts from Mexico instead of from Detroit. If the profitability of airline fares is higher in one market than another, Southwest can shift planes from the market where the profits are lower to the market where the profits are higher. Of course, by shifting resources to the higher-margin markets, market pressures increase in the more profitable markets as supply in them increases, and decrease in the less profitable markets as supply

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[19] *See, e.g.*, Steven Greenhouse, *Wal-Mart, Driving Workers and Supermarkets Crazy*, N.Y. TIMES, Oct. 19, 2003, § 4, at 3 ("Wal-Mart has already helped push more than two dozen national supermarket chains into bankruptcy over the past decade.").

[20] *See* Jeffrey McCracken & Lee Hawkins Jr., *Buyouts Promise a Big Boon for GM*, WALL ST. J., June 23, 2006, at A2 (describing General Motors' payment to workers to leave it and its supplier, Delphi).

[21] *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-04-836, LEGACY AIRLINES MUST FURTHER REDUCE COSTS TO RESTORE PROFITABILITY 41-44 (2004), *available at* http://www.gao.gov/new.items/d04836.pdf (discussing impact of low-cost carriers' entry).

there decreases. Over time, therefore, prices tend to converge across linked markets.[22]

Consider the counterfactual: What if trade barriers blocked markets from expanding and deepening? What if shampoo sold in Dallas were required to be formulated differently from shampoo sold in Boston?[23] What if auto parts made in Mexico were subject to lengthy inspections when they were brought into the United States?[24] What if airlines needed regulatory permission to fly between cities and that permission could be denied if allowing a flight would injure competitors?[25] These barriers to trade would fragment the relevant markets and reduce competitive pressures. This would benefit existing providers of shampoo, auto parts, and air travel, as well as existing providers of other competing products, since the reduction in market pressures could allow market incumbents opportunities to charge supra-competitive prices or reap other benefits from reduced competition. The costs of fragmenting these markets would fall on consumers, who would face higher prices for the goods and services. Fragmented markets also raise important equity considerations, since consumers in such markets will face different prices for similar goods.[26]

Curbing market forces has effects on more than price. Competition pushes firms to innovate in product design, cut costs in production, find new markets, and engage in a host of additional beneficial activities.[27] As discussed below,

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[22] Before they actually converge, of course, new events may produce a new set of price pressures.

[23] This is not entirely fanciful. Guatemala requires sugar sold there to have vitamin A added, a requirement that serves no purpose other than to protect Guatemala's high-cost sugar industry from imports. *See* CANADIAN AGRI-FOOD TRADE ALLIANCE, EMERGING MARKETS: WILL CANADA MEET THE CHALLENGE? (Nov. 30, 2004), *available at* http://www.cafta.org/emerging_markets.html (listing fortification requirement as a non-tariff barrier to trade).

[24] *See* Joel R. Paul, *Do International Trade Institutions Contribute to Economic Growth and Development?*, 44 VA. J. INT'L L. 285, 295 (2003) (discussing non-tariff barriers to trade).

[25] *See* Richard D. Cudahy, *The Airlines: Destined to Fail?*, 71 J. AIR L. & COM. 3, 8-9 (2006) (describing pre-deregulation control of routes by Civil Aeronautics Board).

[26] *Cost to Consumers of Deregulation of Crude Oil: Hearing Before the Subcomm. on Oversight and Investigations of the H. Comm. on Interstate and Foreign Commerce*, 96th Cong. 43-44 (1980) [hereinafter *Cost to Consumers*] (In an exchange over the impact of price controls in the 1970s on consumers, the then-Secretary of Energy, Charles Duncan, argued that uniformity of gasoline prices across the nation constituted equitable treatment of consumers.).

[27] *See, e.g.*, DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER 549 (1991) ("Competition [in the 1950s and 1960s] took other forms [besides price] as well. Never had motorists been better served. Tires and oil were checked, windows were washed, drinking glasses and sweepstakes entry forms were

improvements in gasoline quality since World War II are largely attributable to "[i]ntense competition in the petroleum industry."[28] Similarly, the rapid rise in microprocessor capabilities in recent years tracks the fierce competition between Intel and AMD.[29] Such innovations yield widespread benefits. In the case of microprocessors, a wide range of products which incorporate microprocessors become more powerful and less expensive as microprocessors fall in price.[30] Markets also serve an important role as a discovery process, with prices revealing opportunities to market participants.[31]

Competitive markets depend on the ability of firms to enter and exit product markets. Perfect competition rarely exists outside the textbook, but the existence of rivals forces firms to innovate and compete even when competition is imperfect.[32] Even the existence of potential rivals can be an important source of pressure on incumbent firms.[33] Not surprisingly then, incumbents often try to prevent competition by seeking regulations that raise barriers to entry.[34] By

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handed out—and all for free—in order to win and hold the affection of motorists. . . . Texaco also proudly assured its patrons that, for their benefit, it had gone so far as to 'register' all its restrooms throughout the forty-eight states.").

28 NAT'L PETROLEUM COUNCIL, IMPACT OF NEW TECHNOLOGY ON THE U.S. PETROLEUM INDUSTRY 1946-1965, at 261 (1967) [hereinafter NPC, IMPACT]; *see infra* note 322.

29 *See, e.g.*, Benjamin Pimentel, *Intel Ramping up Competition with AMD*, S.F. CHRON., June 8, 2006, at D1, *available at* http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2006/06/08/BUGA8JAT7F9.DTL (describing product quality and price cuts resulting from competition).

30 *See* Gordon Moore, Intel Keynote Transcript, Intel Developer Forum, Fall 1997, http://www.intel.com/pressroom/archive/speeches/gem93097.htm (noting that drop in price of microprocessor performance has expanded range of products including processors).

31 *See* F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 525-26 (1945).

32 The airline industry is an excellent example of the impacts of such competition. Despite their desperate need to raise fares, the legacy carriers (American, Continental, Delta, Northwest, and United) have been forced to discount fares and restructure their businesses in response to competition from discount carriers such as Southwest. *See* THOMAS PETZINGER, JR., HARD LANDING 317-33 (1995) (describing impact of Southwest Airlines).

33 *See, e.g.*, Joel B. Dirlam & Alfred E. Kahn, *Leadership and Conflict in the Pricing of Gasoline*, 61 YALE L.J. 818, 826 (1952) (describing how potential competition limits market leaders in gasoline markets as "[a] good margin may tempt independents and majors, other than the leader, to cut price in order to increase volume. Implicit competitive influences of this sort may place very narrow limits upon the discretion of the leader, even though overt price warfare is sporadic."); *see also* William G. Shepherd, *Potential Competition Versus Actual Competition*, 42 ADMIN. L. REV. 5, 15-17 (1990) (describing potential competition theory).

34 *See* John S. Moot, *Economic Theories of Regulation and Electricity Restructuring*, 25 ENERGY L.J. 273, 273 (2004) ("Many forms of regulation . . . became

erecting barriers to entry through regulations, incumbents can deter new entrants and make supra-competitive pricing possible.

Although the environmental law literature has traditionally focused on the special case of unpriced waste disposal services in analyzing market forces,[35] market forces also have a significant role to play in reducing negative environmental impacts of production and consumption of goods.[36] For example, even where disposal of wastes to the environment is unpriced due to the failure to fully specify property rights in environmental goods, disposal of a waste product represents the loss of any potential value contained in that waste product. Increasing the efficiency of a production process, which by definition involves reducing waste production, allows a firm to produce more with the same or fewer inputs.

Gasoline provides a classic example of this process. Initially, gasoline was simply "the portion of crude petroleum too volatile to be included in kerosene. The first refiners had no use for it and often dumped an accumulation of gasoline into the creek or river that was always nearby."[37] Consumer

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suspect as creating barriers to entry and regulating price as a means of providing supracompetitive rents to producers, rather than correcting market failures.").

[35] *See, e.g.*, Noah Sachs, *Planning the Funeral at the Birth: Extended Producer Responsibility in the European Union and the United States*, 30 HARV. ENVTL. L. REV. 51, 56-57 (2006) (criticizing products whose price does not take into account the cost of disposing of their waste, noting that "[i]n this zero-price disposal market, neither manufacturers nor consumers have any incentive to reduce waste generation or packaging or to consider the costs of disposal in production or consumption decisions").

[36] *See, e.g.*, TERRY L. ANDERSON & DONALD R. LEAL, FREE MARKET ENVIRONMENTALISM (2d ed. 2001); TERRY L. ANDERSON & DONALD R. LEAL, ENVIRO-CAPITALISTS (1997).

[37] JAMES G. SPEIGHT, THE CHEMISTRY AND TECHNOLOGY OF PETROLEUM 567 (3d ed. 1999) [hereinafter SPEIGHT, CHEMISTRY]. When increasingly sophisticated cracking operations increased gasoline yields in the 1930s, they also increased byproduct gases, which initially had no economic value and were simply disposed of by venting or burning. PAUL H. GIDDENS, STANDARD OIL COMPANY (INDIANA): OIL PIONEER OF THE MIDDLE WEST 32 (Arno Press 1976) (1955) ("the quantity of these byproduct gases increased until their disposal became an economic problem"). Polymerization processes enabled refineries to turn these gases from wastes to valuable octane-enhancing feedstocks. *Id.* More generally, Miller and Shea's 1941 review concluded that "[t]he constant practical application of chemical and engineering research to refining operations has resulted not only in improvement of products to meet changing conditions and requirements but in the reduction of waste in processing and in the manufacture of an almost infinite variety of products." H.C. MILLER & G.B. SHEA, NAT'L RES. PLANNING BD., TECHNICAL PAPER NO. 3, GAINS IN OIL AND GAS PRODUCTION REFINING AND UTILIZATION TECHNOLOGY 36 (1941). Refineries continue to find ways to reduce costs by making use of waste products. *See* Eric Martin, *Environmental Protection*, *in* 2 MODERN PETROLEUM TECHNOLOGY 197, 209 (Alan G.

demand, generated by the rising automobile industry,[38] transformed gasoline into a highly valued commodity.[39] By 1900, demand for gasoline exceeded the quantities previously produced by distillation and chemical engineers began experimenting with "cracking" crude (using heat to boost gasoline yields at the expense of the kerosene yield)[40] and "widening the cut" of gasoline.[41] Ten years later, kerosene was no longer the most important product[42] and refiners were worried about a shortage of gasoline.[43] Production yields captured the magnitude of the change: In 1880, 100 barrels of crude produced, on average, 75.2 barrels of kerosene and 10.3 barrels of gasoline, while in 1940, the same 100 barrels yielded an average of 40 to 50 barrels of gasoline, but only 5.5 barrels of kerosene.[44]

Thus, in the presence of incompletely specified property rights to environmental goods, market forces sometimes provide an incentive to dispose of waste products in ways that potentially damage the environment. This is best viewed, however, as a special case caused by the failure to completely specify property rights, rather than as the paradigmatic case. The general market incentive is to reduce waste, an incentive which is greater when the cost of waste disposal is positive than when it is zero.[45] The incentive to reduce waste exists

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Lucas ed., 2000) (stating that "[t]he optimum place to recover wastes is within the refinery itself" and listing examples).

[38] U.S. auto sales doubled "approximately every two years" between 1900 and 1916. YVETTE TAMINIAU, ROOM FOR MANOEUVRE 57 (2001).

[39] U.S. DEP'T OF COM., OFF. OF DOMESTIC COM., INDUS. SERIES NO. 73, UNITED STATES PETROLEUM REFINING: WAR AND POSTWAR 14 (1947) [hereinafter USDOC, WAR AND POSTWAR] ("Demand for gasoline arising from the increased use of the automobile was the principal force behind the increasingly complicated refining technology and larger percentage conversion of crude oil to gasoline.").

[40] WILLIAM L. LEFFLER, PETROLEUM REFINING IN NONTECHNICAL LANGUAGE 4 (3d ed. 2000); *see also* YERGIN, *supra* note 27, at 111-12 (describing invention and commercialization of cracking).

[41] This was done by raising the gasoline fraction to include hydrocarbons with boiling points up to 250 degrees Celsius rather than only up to 140 degrees Celsius. TAMINIAU, *supra* note 38, at 57.

[42] GIDDENS, *supra* note 37, at 33.

[43] *Id.* at 140 ("One of the most urgent and important problems confronting the petroleum industry in 1909 was the rapidly growing demand for gasoline. . . . [A]lert refiners realized that, at the rate gasoline was being consumed by 1909, the normal supply would soon be inadequate and prices would skyrocket.").

[44] MILLER & SHEA, *supra* note 37, at 27.

[45] Some critics of market processes object to the tendency of markets to provide individuals with consumer goods, arguing that consumption itself is problematic. *See, e.g.*, BARRY SCHWARTZ, THE PARADOX OF CHOICE: WHY MORE IS LESS 221 (2004) ("Having too many choices produces psychological distress, especially when

even in the limited case of free disposal, however, because the waste itself has potential value that is lost when it is discarded, as early refiners learned in the case of gasoline.

Despite its beneficial social effects, competition is costly for market participants, so many prefer to avoid it. If participants in a market can arrange to collude, they can reduce competition and increase their profits, perhaps even approaching what a monopolist would earn.[46] Collusion on prices is, of course, illegal.[47] Monopoly profits are so desirable, however, that market participants sometimes attempt alternative methods that allow collusion without explicit agreements.[48] Where it avoids the attention of antitrust authorities, such implicit collusion can result in higher prices and reduced output.[49]

Difficulties for the would-be cartel go beyond avoiding antitrust authorities, however. By undercutting the cartel price slightly, a cheating member can greatly expand output and so gain greater revenue—provided, of course, that the chiseling goes undetected and unpunished by the rest of the cartel.[50] Because all cartel members face this incentive, a cartel without an effective enforcement mechanism will quickly unravel as members cheat the price down to the competitive price. Thus, a cartel will only succeed if it can effectively monitor its members' behavior and punish those who cheat.[51] Of course, antitrust law restricts explicit contracts in aid of cartels, and would-be oligopolists must resort to less effective,

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combined with regret, concern about status, adaptation, social comparison, and perhaps most important, the desire to have the best of everything—to maximize."). Because such criticisms rest on a presumption that a minority is entitled to dictate its preferences to the majority, however, we do not address them here.

[46] *See* JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 239-62 (1988) (summarizing literature on tacit collusion); Alexis Jacquemin & Margaret E. Slade, *Cartels, Collusion, and Horizontal Merger*, *in* 1 HANDBOOK OF INDUSTRIAL ORGANIZATION 415, 417-18 (Richard Schmalensee & Robert D. Willig eds., 1989) ("Sellers who recognize their mutual interdependence will have an incentive to cooperate as long as the profit which each can obtain when acting jointly is higher than when they act independently.").

[47] *See* Sherman Act § 1, 15 U.S.C. § 1 (2000).

[48] *See* DAVID M. KREPS, A COURSE IN MICROECONOMIC THEORY 524-26 (1990) (explaining economics of implicit collusion).

[49] *See id.* at 528-29 (discussing GE-Westinghouse implicit collusion in the turbine generator market in the 1960s).

[50] *See* Jacquemin & Slade, *supra* note 46, at 420-21 (summarizing literature on incentive to cheat). There is some evidence that this occurs in the crude oil market, with OPEC functioning only imperfectly as a cartel. *See* FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 23.

[51] Jacquemin & Slade, *supra* note 46, at 417.

more expensive, indirect methods of maintaining a cartel. Such methods can be effective and allow cartel members to escape legal sanctions, in some cases.[52]

Firms that wish to avoid competition must find a substitute for explicit contracts that allows them to coordinate their pricing behavior.[53] This is difficult, but coordinating behavior can occur even in the absence of legally enforceable restrictions. Such efforts are simpler with fewer competitors.[54] (If the cartel is successful at earning supra-competitive profits, those profits will attract new rivals.[55]) Regulations can play an important role here, as they can aid cartels by helping them restrain output by assisting informal cooperation by members.[56]

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[52] *See id.* at 453 (discussing evidence of collusive bidding practices in government auctions); *id.* at 443 (listing "cement, drugs, dyes, lumber, theaters, and tobacco" as industries that may exhibit "conscious parallelism").

[53] *Id.* at 429 (discussing the "phases of the moon" strategy used in one cartel to allocate low bid privileges). Critics of the oil industry continue to believe such behavior explains much of the industry's conduct. For example, a U.S. labor union seeking to ensure that "a far higher proportion of the international tanker fleet bringing petroleum to the United States should consist of American ships with American crews," commissioned a study of the oil industry aimed at proving that "[t]here is a hard core of joint action and control in the oil industry surrounded at its periphery by semi-independent fiefdoms which offer a somewhat deceptive patina of truly independent competition." STANLEY H. RUTTENBERG & ASSOC., INC., THE AMERICAN OIL INDUSTRY: A FAILURE OF ANTI-TRUST POLICY, at iii-iv (1973).

[54] Jacquemin & Slade, *supra* note 46, at 421. *See also* ELLIS W. HAWLEY, THE NEW DEAL AND THE PROBLEM OF MONOPOLY: A STUDY IN ECONOMIC AMBIVALENCE 114 (1995) ("Generally speaking, the difficulties of maintaining and enforcing cartel arrangements were greatly enhanced in industries that were made up of a large number of units producing a variety of unstandardized products, particularly where limitations upon entry were slight.").

[55] Jacquemin & Slade, *supra* note 46, at 421 ("A cartel . . . contains the seeds of its own undoing.").

[56] Among the best-known examples of regulations with this effect are the industry codes legalized and promoted for a time by the National Recovery Administration (NRA) during the New Deal. *See* LEVERETT S. LYON ET AL., THE NATIONAL RECOVERY ADMINISTRATION: AN ANALYSIS AND APPRAISAL 551 (1972) ("Among the avowed purposes of the National Industrial Recovery Act none stands out more clearly than the declaration of intention to revise the nature of competition in American business. . . . As a consequence of this purpose of the law, NRA codes have contained, either under the title of trade practices or otherwise, provisions designed to regulate trade activities. Indeed the codes are called codes of fair competition."). Given the opportunity to write legally enforceable rules governing competitive behavior, "business domination of the code-writing process was virtually inevitable" considering the significant rewards of institutionalizing limits to competition for market incumbents. HAWLEY, *supra* note 54, at 56. *See also* LYON ET AL., *supra*, at 568 ("[U]nder the terms of the law [business interests] were practically invited to find out what they could secure with the trust laws in abeyance."). The codes reduced competition as the NRA generally "seemed willing to go along with the rationale of trade association secretaries and business planners, to accept the ideal of 'industrial self-government' and to allow a substantial measure of cartelization." HAWLEY, *supra* note 54, at 66. *See also* DAVID M. KENNEDY, THE AMERICAN PEOPLE IN THE GREAT DEPRESSION 184 (1999) (Codes cartelized "huge sectors of American industry."). *See*

This brief survey of the impacts of market forces suggests three issues to consider in our examination of regulation's effect on gasoline markets. First, competitive forces exert more influence as the number of competitors increases, raising the question of whether gasoline regulations have reduced the number of competitors in the gasoline market. In particular, incumbent firms will naturally seek to erect barriers to entry, making it important to consider the impact of regulations on entry. Second, competitive forces exert more influence as the goods traded in markets become more like commodities, and so are more readily substituted for one another. We must therefore look to see if regulations inhibit the commodification of gasoline. Third, cartels face a serious enforcement problem when they cannot directly collude. We should therefore examine whether regulations create conditions under which refiners' profit-maximizing behavior results in tacit collusion without open violations of antitrust laws. We now turn to the particulars of the gasoline market and their influence on how these forces operate.

B. The Market for Gasoline

Like most markets, the gasoline market is not perfectly competitive even without taking into account the impact of economic and environmental regulations.[57] The two questions that must be answered are: first, whether the gasoline market so diverges from the textbook ideal as to demand regulatory intervention to increase competitiveness; and second, whether regulation has increased or decreased the market's competitiveness. We begin with the features of the market created by the technical characteristics of gasoline, refining, distribution, and crude oil. Perhaps the most important overall development in refining is the trend toward fewer, larger, more capital-intensive refineries. As we shall see, this trend is

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also LYON ET AL., *supra*, at 620 ("[T]he NRA has, through several devices and in a wide range of industries, shifted an important measure of control over prices away from individual determination and increased the degree of influence and control of industrial groups."). *See also id.* at 705-15 (discussing contemporary criticism of the NRA for fostering monopoly).

[57] *See* Severin Borenstein & Andrea Shepard, *Sticky Prices, Inventories, and Market Power in Wholesale Gasoline Markets* 1-2 (Nat'l Bureau of Econ. Res., Working Paper No. 5468, 1996) (describing price stickiness); FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 41-43 (same).

partially the result of the nature of gasoline production and distribution.

1. Crude Oil's Impact on the Market for Gasoline

"U.S. refiners compete with refiners all around the world to obtain crude oil."[58] As a result, world market trends have important impacts on U.S. gasoline supply by affecting the price,[59] amount, and type of oil that U.S. refineries can obtain.[60] Because what can be produced in a refinery depends in part on the type of crude oil used as an initial feedstock, the market for crude affects the market for gasoline.

Crude oil is a complex mixture of hydrocarbons with a variety of characteristics relevant to gasoline production including density, sulfur content, pour point, carbon residue, salt content, nitrogen content, metals content, and boiling range.[61] Crude's qualities vary considerably depending on its source.[62] Characteristics of a particular crude may make it

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[58] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 13.

[59] *Id.* at 15 ("Variation in the price of crude oil drives most of the variation in the price of gasoline."). The FTC found that changes in crude prices accounted for 85% of the variation in gasoline prices between 1984 and January 2005. *Id. See also* NAT'L PETROLEUM COUNCIL, U.S. PETROLEUM REFINING: ASSURING THE ADEQUACY AND AFFORDABILITY OF CLEANER FUELS, at C-7 (2000) [hereinafter NPC, ADEQUACY] ("The characteristics of the crude oil feedstock are critical to process selection. There are hundreds of crude oils available on the world market today that vary widely in physical properties.").

[60] Those inclined to see conspiracies behind oil issues should note that estimates of the concentration of the oil industry range from "very low" to "moderately concentrated," depending on whether all nominally independent oil firms are considered independent in fact or whether OPEC is considered a single producer (as it would be if the cartel functioned perfectly). *See* FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 21. In particular, the FTC's 2005 review of the oil industry concluded that "[m]ajor private oil companies, both individually and collectively, control only a very small share of world crude oil production." *Id.* at 22.

[61] JAMES H. GARY & GLENN E. HANDWERK, PETROLEUM REFINING: TECHNOLOGY AND ECONOMICS 22-26 (4th ed. 2001); NAT'L PETROLEUM COUNCIL, FACTORS AFFECTING U.S. PETROLEUM REFINING: A SUMMARY 53 (1973) [hereinafter NPC, FACTORS AFFECTING] ("Crude oil is a substance comprised of a very complex mixture of hydrocarbons, which are molecules consisting almost solely of carbon and hydrogen atoms in various arrangements. Crude oil contains thousands of different molecules of varying sizes . . . ."); FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 17 ("Crude oils from different fields usually have different chemical properties, including differences in density and sulfur content."); SPEIGHT, CHEMISTRY, *supra* note 37, at 244 ("It is now generally recognized that the name *petroleum* does not describe a composition of matter but rather a mixture of various organic compounds that includes a wide range of molecular weights and molecular types which exist in balance with each other." (citation omitted)).

[62] SPEIGHT, CHEMISTRY, *supra* note 37, at 215 ("Petroleum is not a uniform material. In fact, its chemical and physical (fractional) composition can vary not only

unsuitable or more costly for particular refineries and more or less expensive to formulate into gasolines with specific characteristics.[63] For example, refineries are often designed to process particular types of crude oil and cannot easily change to a different type (e.g., from lower to higher-sulfur crude) without extensive and expensive modifications.[64] The FTC considers the technological capabilities of refineries to process particular types of crudes relevant to its antitrust analysis of proposed mergers in the oil industry.[65] Indeed, refineries differ so significantly that some analysts suggest that it is not even meaningful to attempt to describe an "average" refinery.[66]

Crude oil supplies have shifted toward higher-sulfur crude of the type supplied by Saudi Arabia, and away from the lower-sulfur crudes that typified West Texas Intermediate.[67]

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with the location and age of the oil field but also with the depth of the individual well.").

[63] Carl Mortished, *Western Refineries Spurning Sulphurous Saudi Oil*, TIMES (London), Sept. 16, 2005, at 52, *available at* http://www.energybulletin.net/print.php?id=8949 ("Few refineries are able to convert" high-sulfur Saudi oil into low-sulfur gasolines required by U.S. environmental regulations.); NAT'L PETROLEUM COUNCIL, PETROLEUM REFINING IN THE 1990S: MEETING THE CHALLENGES OF THE CLEAN AIR ACT 15 (1991) [hereinafter NPC, 1990S] ("The kind of crude oil, other raw materials, and the wide array of processing units employed in its manufacture will determine the gasoline batch composition."); FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 17 ("[R]efineries are usually designed to be most productive using a specific range of crude oil. When they substitute other types of crude, their efficiency and productivity will decline."); NPC, FACTORS AFFECTING, *supra* note 61, at 13 ("A change in the type of crude oil available to a refinery will affect the capacity of the refinery to process crude oil. Many refineries are designed to process low-sulfur crude oils and would soon become inoperable if significant volumes of high-sulfur crude oils were processed."). Even as early as the 1950s, some refineries were specifically designed for particular foreign oil sources. DOUGLAS R. BOHI & MILTON RUSSELL, LIMITING OIL EXPORTS: AN ECONOMIC HISTORY AND ANALYSIS 44 (1978).

[64] NPC, FACTORS AFFECTING, *supra* note 61, at 4 ("A given refinery cannot effectively process every type of crude oil. If a refinery processes a type of crude oil for which it was not designed, the effective throughput capacity of the refinery will in many cases be reduced substantially. . . . High-sulfur crude oil . . . cannot be exclusively processed in a domestic refinery designed for low-sulfur crude oil without the installation of additional facilities and/or extensive modification of existing facilities to prevent corrosive damage and to meet product specifications."). When energy policies have dictated reallocation of crude supplies among refineries, the task has proven to be a challenge. *See infra* notes 433-44.

[65] FTC, MERGERS, *supra* note 5, at 24.

[66] NPC, FACTORS AFFECTING, *supra* note 61, at 55.

[67] JAMES G. SPEIGHT & BAKI ÖZÜM, PETROLEUM REFINING PROCESSES 27 (2002) ("In a more general sense, the average quality of crude oil has become worse in recent years. This is reflected in a progressive decrease in API gravity and a rise in sulfur content." (citations omitted)). Lower-sulfur crudes are referred to as "sweet" and higher-sulfur crudes are termed "sour."

This shift in crude supplies has occurred at the same time as the demand for lower sulfur content in gasoline has increased due to environmental regulations. As a result, many smaller refineries optimized for low-sulfur crudes shut down rather than incur the cost of modifications to handle high-sulfur crudes.[68]

Crude prices also affect refinery operations. The price of crude oil fluctuates based on a wide variety of international and political events, seasonal demand, and other factors, with the price of crude determined in the global market.[69] Changes in relative prices between crude and refinery products have substantial effects on individual refineries' profitability, and these effects can differ greatly depending on the characteristics of the refinery.[70] As a result, particular refiners may experience economic conditions that reduce their profitability, even as other refiners continue to make money, producing temporary or permanent shutdowns or product mix changes.

The evolution of the crude oil market also influenced refinery location. Refineries were initially located near oil fields but soon came to be located closer to the markets for their products, in part because of security concerns that developed during World War I,[71] and in part because of supply

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> Typical sweet crudes are West Texas Intermediate (the popular, traded crude on the New York Mercantile Exchange), most Louisiana and Oklahoma crudes, North Sea, and Nigerian crudes.
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> Sour crudes include Alaska North Slope, Venezuelan, and West Texas. Sour from fields like Yates and Wasson.
>
> Intermediate crudes include California Heavy, such as from the San Joaquin Valley and many of the Middle East crudes.

LEFFLER, *supra* note 40, at 17.

68 NPC, FACTORS AFFECTING, *supra* note 61, at 16. Sulfur comes bound with the hydrocarbons and is released when the hydrocarbons are burned, creating "one of several smelly or otherwise environmentally objectionable sulfur/oxygen or sulfur/something compounds." LEFFLER, *supra* note 40, at 16. *See also* U.S. ENVTL. PROT. AGENCY, OFF. OF COMPLIANCE, EPA 310-R-95-013, PROFILE OF THE PETROLEUM REFINING INDUSTRY 11 (1995) [hereinafter EPA, PROFILE] (noting that cost of upgrading to meet 1990 Clean Air Act Amendments also made it more economical "in some cases" to close refineries rather than upgrade to meet the new standards).

69 U.S. GOV'T ACCOUNTABILITY OFF., GAO-04-96, ENERGY MARKETS: EFFECTS OF MERGERS AND MARKET CONCENTRATION IN THE U.S. PETROLEUM INDUSTRY 18 (2004) [hereinafter GAO, MERGERS] ("The price of crude oil produced in the United States is determined in the world oil market because the decontrol of domestic oil prices in 1981 has effectively linked the U.S. oil market to the world oil market.").

70 LEFFLER, *supra* note 40, at 219-21.

71 J.D. Butler, *The Influence of Economic Factors on the Location of Oil Refineries*, 1 J. INDUS. ECON. 187, 193-94 (1953).

problems for oil field plants.[72] Limited infrastructure continues to give refiners in some locations cost advantages. Trade regulations also encouraged location of refineries near markets, as many countries adopted preferential tariffs for crude oil relative to refined products to offset crude's higher transportation costs and encourage domestic refining.[73] Locating a refinery away from oil fields requires infrastructure to deliver the crude to the refinery, and as the oil market became an international one, oil increasingly came to be transported by tanker.[74] Eventually, refineries concentrated relatively close to ports capable of handling tankers in order to reduce transportation costs once the tanker arrived.[75] As a result, "refinery operations have become more concentrated both regionally and nationally" since the 1980s.[76]

Today, the only real alternative to locating a refinery near a port is to locate it near a pipeline connected to a crude oil source (either an oil field or a port).[77] Because land near ports is desirable for other uses, and because refineries are often not considered desirable neighbors,[78] the potential sites

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72 USDOC, WAR AND POSTWAR, *supra* note 39, at 13 ("The modern [1947] refinery with its several expensive units and laboratories needed to make selected hydrocarbon products is being built at locations where markets are accessible. A steady source of supply can be depended on through trunk pipe lines, or tankers.").

73 Butler, *supra* note 71, at 195; EPA, PROFILE, *supra* note 68, at 7 ("For reasons of efficiency in transporting crude oil feed stocks and finished products, petroleum refineries typically were sited near crude oil sources (onshore petroleum terminals, oil and gas extraction areas) or consumers (heavily industrialized areas).").

74 U.S. government subsidies for tankers also played a role. *See* 1 ROBERT L. BRADLEY JR., OIL, GAS & GOVERNMENT: THE U.S. EXPERIENCE 1003-05 (1996).

75 Refineries were initially located near U.S. oil fields, but capacity soon shifted to coastal areas as the shipment of oil by tankers became common after 1920. *See* J. Sidney Gould, *Recent Changes in Location and Size of Petroleum Refineries*, 1 J. BUS. U. CHI. 497, 501 (1928) (discussing trend toward coast locations). For example, Rocky Mountain state refiners are the major market for some Canadian oil fields and the lack of more than "minimal infrastructure in place to deliver oil produced in the Rockies and Canada to other refining regions" gives those refiners a price advantage. Stock Report, Frontier Oil, MORNINGSTAR (Mar. 27, 2006), at 1.

76 D.J. PETERSON & SERGEJ MAHNOVSKI, NEW FORCES AT WORK IN REFINING: INDUSTRY VIEWS OF CRITICAL BUSINESS AND OPERATIONS TRENDS 24 (2003).

77 *See* USDOC, WAR AND POSTWAR, *supra* note 39, at 15 (describing transportation constraints on location requiring refineries to be built near ports or pipelines); *see also* YERGIN, *supra* note 27, at 410 (discussing impact of need to build pipelines and tankers to accommodate post-war boom in gasoline consumption).

78 *See* Alastair Walling, *Exposed Refineries, Price-Gouging, and the Gas Crisis that Never Was*, 20 NAT. RES. & ENV'T 55, 56 (2006) (discussing NIMBY problems of refineries); Tom van Riper, *Not in My Backyard*, FORBES, Sept. 7, 2005, *available at* http://www.forbes.com/energy/2005/09/07/katrina-oil-refineries-cx_tvr_0907refineries.html (quoting an oil analyst who stated that a company proposing a new refinery "would need to hire about 15 lawyers just to argue it won't break any environmental regulations").

for new refineries are limited.[79] Therefore, it is more costly and complicated to build a new refinery, inducing refiners to expand existing refineries rather than build new ones, and limiting competition from new entrants since owning an existing refinery is a de facto requirement for entry.

Crude markets have three important impacts on gasoline markets. First, the international nature of the crude market creates powerful incentives to locate refineries in places where crude shipments can readily reach the refinery. As a practical matter, this limits refineries in the United States to locations near domestic oil fields, near deep water oil terminals, or near pipelines connected to terminals or oil fields. Securing a feasible location for a refinery thus becomes a barrier to entry into the refining industry. Second, crude supplies are trending toward types of crude that are more costly to refine into less-polluting forms of gasoline, particularly with respect to sulfur content. This increases the capital intensity of refining, contributing to the trend toward fewer, larger refineries. It also makes entry into the refining business more difficult, an additional limit on competition. Third, the relationship between crude prices and refined products' prices has a significant impact on refinery economics, putting a premium on refineries that are capable of flexible production methods, which puts older, less sophisticated refineries at a competitive disadvantage. This contributes to the trend toward more capital-intensive refineries.

2. Gasoline Production's Impact on the Market

The method of producing gasoline also has significant impacts on the market for gasoline. At the most abstract level, producing gasoline is simply a matter of separating crude oil into the hydrocarbons with the appropriate boiling range and those with higher or lower boiling ranges. Early petroleum refineries did so by distilling off the various components from

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[79] PETERSON & MAHNOVSKI, *supra* note 76, at 23 ("The refining industry is dominated by legacy assets. In many cases these are century-old sites, chosen because they were near major population centers or crude oil supplies (e.g., major producing fields, crude oil pipelines, and ports) of that time. As a result, most major refineries are clustered along the coasts. Because of demographic shifts, the movement of industry, and changing crude oil supplies in the intervening years, this hardware legacy no longer matches the current supply-and-demand patterns for many regions and communities.").

small batches of crude,[80] making refining "a wasteful, underdeveloped operation in the hands of many people, each one working on a small scale."[81] While distilling remains an important step in refining,[82] technological progress quickly added more sophisticated processes, with a refinery today best described as "a complex network of integrated unit processes for the purpose of producing a variety of products from crude oil."[83]

Refineries use a variety of methods to transform the crude into refined products. "Any hydrocarbon can be converted into any other hydrocarbon by the appropriate applications of energy, chemistry, and technology."[84] Among the most important method is "cracking," which converts higher molecular-weight components into lower molecular-weight components by rupturing the carbon bonds with heat ("thermal cracking"), or catalysts ("catalytic cracking").[85] A second important technique is "coking," in which low-value

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[80] SPEIGHT, CHEMISTRY, *supra* note 37, at 536 ("Early refineries were predominantly distillation units, perhaps with ancillary units to remove objectionable odors from the various product streams."); *id.* at 565 (describing earliest thermal cracking units based on heating crude in pressurized containers); *see also* USDOC, WAR AND POSTWAR, *supra* note 39, at 7 ("The complexity of the large modern [1947] refinery is as marked as the simplicity of the first refinery that went into operation at Titusville, Pa., in 1861. The contrast may be drawn by comparing the expenditures of the Cities Service Oil Co. of approximately 75 million dollars for its Lake Charles, La. plant (70,000 B/D capacity) with the 15 thousand dollars spent to construct the Titusville refinery."). By 1930, there were 472 petroleum refineries operating or being built in the United States, processing 850,000,000 barrels of petroleum a year. MILLER & SHEA, *supra* note 37.

[81] DAVID O. WHITTEN & BESSIE E. WHITTEN, THE BIRTH OF BIG BUSINESS IN THE UNITED STATES, 1860-1914, at 9 (2006).

[82] SURINDER PARKASH, REFINING PROCESSES HANDBOOK 1 (2003) ("The first processing step in the refinery, after desalting the crude, is separation of crude into a number of fractions by distillation."). Refinery capacity is generally measured by distillation capacity. FTC, MERGERS, *supra* note 5, at 180. However, "capacity to produce refined products at some refineries exceeds their distillation capacity because their downstream processes rely, at least in part, on intermediates produced at other refineries." *Id.* at 180 n.4.

[83] SPEIGHT, CHEMISTRY, *supra* note 37, at 501. A 1941 government report summarized a long list of "remarkable achievements" in refining and concluded that "it is possible to rearrange the molecular structures of oils to obtain greater yields of products with more desirable properties than was possible when refining was largely a distillation operation." MILLER & SHEA, *supra* note 37, at 27.

[84] James G. Speight, *Thermal Chemistry of Petroleum Constituents*, *in* PETROLEUM CHEMISTRY AND REFINING 121, 122 (James G. Speight ed., 1998).

[85] SPEIGHT, CHEMISTRY, *supra* note 37, at 503-04. Catalytic cracking took off after World War II, with U.S. capacity increasing fivefold from 1945 to 1965. NPC, IMPACT, *supra* note 28, at 285. There may be higher molecular weight by-products produced as well. SPEIGHT, CHEMISTRY, *supra* note 37, at 503. *See also* EPA, PROFILE, *supra* note 68, at 19-24 (describing and diagramming process); LEFFLER, *supra* note 40, at 59-70 (describing process in nontechnical terms).

residual fuel oils are cracked into transportation fuels, leaving a residual of carbon with impurities known as coke.[86] Further significant advances in refinery technology and design enable refiners to extract greater amounts of gasoline and other high-value products.[87]

Refining technology evolved partially as a result of rising demand for gasoline. Oil refineries primarily produced kerosene from about 1870 (when they became "characteristic features" of the new oil industry)[88] until 1910, when the shift in demand to gasoline prompted innovative new methods to increase gasoline yields.[89] Today the primary function of most

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[86] EPA, PROFILE, *supra* note 68, at 19-20. *See also* NPC, IMPACT, *supra* note 28, at 284 (describing coking's development after 1930). Leffler gives a colorful description of coking: "If thermal cracking is like throwing a hamburger on a hot grill, coking is like Texas barbeque—slow cooked all the way through." LEFFLER, *supra* note 40, at 110.

[87] SPEIGHT, CHEMISTRY, *supra* note 37, at 585 ("The last 60 years have seen substantial advances in the development of catalytic processes. This has involved not only rapid advances in the chemistry and physics of the catalysts themselves but also major engineering advances in reactor design . . . [which together] have allowed major improvements in process efficiency and product yields." (citations omitted)). This progress had an impact on costs as well: total operating costs for refineries fell 12% in real terms from 1945 to 1965. NPC, IMPACT, *supra* note 28, at 257.

[88] SPEIGHT, CHEMISTRY, *supra* note 37, at 7; USDOC, WAR AND POST-WAR, *supra* note 39, at 1 ("In contrast to the early years of the industry, gasoline and fuel oil now compose about four-fifths of refinery production."). The early years of the oil industry "are shrouded in a statistical fog." Butler, *supra* note 71, at 188. We do know that production more than doubled between 1900 and 1910 and again by 1915, and increased tenfold between 1900 and 1930. *Id.* Kerosene was originally produced from asphalt and similar substances and by 1859, there were thirty-four companies making $5 million of kerosene per year in the United States. YERGIN, *supra* note 27, at 23.

[89] SPEIGHT, CHEMISTRY, *supra* note 37, at 565-67. "The original incentive to develop cracking processes arose from the need to increase gasoline supplies. Since cracking could virtually double the volume of gasoline from a barrel of crude oil, the purpose of cracking was wholly justified." *Id.* at 585 (citations omitted). Before the invention of methods of cracking the heavier hydrocarbons, refineries faced the serious problem of producing various products "in certain rather closely fixed proportions" as "under present methods over 50 per cent of the crude oil refined *must* go into kerosene and fuel oil classes of products. No effort or sacrifice can make a given crude yield over 50 per cent of gasoline and lubricating oils by commercially successful methods." Lewis H. Haney, *Gasoline Prices as Affected by Interlocking Stock Ownership and Joint Cost*, 31 Q.J. ECON. 635, 649 (1917). Cracking soon solved this problem. A 1924 article noted:

> The yield of gasoline has been increased greatly by the widespread use of cracking processes. A refiner using Mid-Continent crude can recover from 45 to 55 per cent of gasoline from a barrel of crude petroleum when pressure stills are used, as compared with about 25 per cent from ordinary distilling methods. Improvements in internal combustion engines should soon make possible the utilization of a still larger yield of serviceable motor fuel than is now obtainable in the form of gasoline from cracking processes.

Huston Thompson, *Distribution of Gasoline and Methods of Price Control*, 116 ANNALS AM. ACAD. POL. & SOC. SCI. 89, 90 (1924). Thermal cracking made it possible to convert refineries is to produce gasoline, with other products generally treated as byproducts.[90] Over 80% of the volume of finished products falls into the "light petroleum products" class (gasoline, diesel, home heating oil, and jet fuel).[91]

As a result of these technological changes, gasoline refineries today do not simply produce a single product. Rather, they now produce a variety of intermediate components of gasoline, which the refineries then blend in a complex operation to achieve the desired characteristics for the final gasoline product.[92] Because components blended into gasolines may have multiple uses, with refineries often closely integrated with petrochemical plants,[93] and because unit shutdowns affect

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40% of crude to gasoline, the technological limit until World War II. USDOC, WAR AND POSTWAR, *supra* note 39, at 8. It also made possible processing of "straight-run" gasoline to raise its octane rating. *Id.* Catalytic cracking, which developed in the 1930s, boosted output further. *Id.*

[90] SPEIGHT, CHEMISTRY, *supra* note 37, at 567 ("It is generally recognized that the most important part of any refinery is its gasoline (and liquid fuels) manufacturing facilities; other facilities are added to manufacture additional products as indicated by technical feasibility and economic gain."). This has been true for some time. *See* ALBERT V. HAHN, THE PETROCHEMICAL INDUSTRY: MARKET AND ECONOMICS 5 (1970) ("In the U.S. the demand for motor fuel has tended to grow faster than for fuel oil or diesel fuel. Accordingly, most refineries contain catalytic cracking units which convert heavy fractions to additional gasoline . . . .").

[91] FTC, MERGERS, *supra* note 5, at 179.

[92] Blending various outputs of refineries developed early. In 1917, for example, Lewis Haney complained that gasoline "had ceased to be a homogeneous product and in its name were sold blends of heavy naphtha or 'cracked' residual products combined with more volatile elements." Haney, *supra* note 89, at 647. Yet by 1924, Huston Thompson reported without comment that "[t]he great bulk of gasoline used as a motor fuel for automobile and other internal combustion engines is a blended product. Formerly only 'natural' or 'straight run' gasoline, obtained by distilling petroleum by the application of heat at atmospheric pressure, was sold for motor fuel purposes." Thompson, *supra* note 89, at 89. The FTC also noted blending and cracking had begun to play a significant role in 1915. U.S. FED. TRADE COMM'N, REPORT ON THE PRICE OF GASOLINE IN 1915, at 21-22 (1917) [hereinafter FTC, 1915]. By World War II, the transition to "a product made by careful blending of refinery stock prepared by involved new processes and special additives developed in extensive research programs" was complete. NPC, FACTORS AFFECTING, *supra* note 61, at 51-52. By the late 1960s, in-line blending techniques were used for about half of U.S. gasoline production, a technique which a technical survey called "one of the significant new developments in the refinery industry." NPC, IMPACT, *supra* note 28, at 293. Blending is done in virtually all refineries today. J.D. Robinson & R.P. Faulkner, *The Oil Refinery: Types, Structure and Configuration*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at 1, 8. *See* D.R. Blackmore, *Gasoline and Related Fuels*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at 217, 245-46 (discussing complexity of modern blending techniques).

[93] David S. Glass, *The Petrochemical Interface*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at 149, 149.

the available blendstocks,[94] the components of the final product may vary considerably over time, even within a single refinery. The mix of components operational at any particular time at a particular plant also has an impact on the refinery's ability to operate at its full capacity.[95]

The process of improving oil production and refining began almost as soon as oil was commercially produced.[96] Cracking and coking techniques first appeared after World War I,[97] during a period in which "the field of hydrocarbons chemistry took off in a series of revolutionary discoveries."[98] The technology rapidly advanced again during and after World War II, in response to the war's demand for fuel for combat aircraft.[99] From then on, "the refining industry became a branch of the chemical industry and it was capable of transforming the complex mixtures that constitute petroleum into high-quality fuel components by controlling specific chemical reactions."[100] One significant example of technological

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94 NPC, 1990S, *supra* note 63, at 15 ("As an individual processing unit is shut down for scheduled or unscheduled maintenance, the gasoline formula may be adjusted to compensate for a shortage of that unit's blendstock.").

95 *See, e.g.*, NPC, ADEQUACY, *supra* note 59, at 25 (stating that "configuration and processing capability in units downstream of the atmospheric distillation unit may be such that the product output mix is uneconomic at full utilization of atmospheric distillation capacity").

96 1 BRADLEY, *supra* note 74, at 19 (noting "innumerable mechanical innovations that lowered business costs and reduced oil waste").

97 USDOC, WAR AND POSTWAR, *supra* note 39, at 7 ("The refinery process used to convert crude petroleum to products at the Titusville plant [the first refinery], and the only one used up to about the time of World War I, was the crude-distillation process."); MILLER & SHEA, *supra* note 37, at 26 (stating that "the introduction of the cracking process in 1912 marked the beginning of a new epoch in the chemistry and refining of petroleum . . . [and] led the way for further technical advances in refining practices"); *see also* YERGIN, *supra* note 27, at 111-12 (describing development and commercialization of cracking); 2 BRADLEY, *supra* note 74, at 1107-08 (describing development of technology).

98 RICHARD H. K. VIETOR, ENERGY POLICY IN AMERICA SINCE 1945: A STUDY OF BUSINESS-GOVERNMENT RELATIONS 28 (1984).

99 SPEIGHT, CHEMISTRY, *supra* note 37, at 536, 565; TAMINIAU, *supra* note 38, at 61 ("World War II was a trigger for the production of fuel that had an octane number of 100 and for the production of vast quantities of aviation gasoline of a high quality."). Consider one particularly dramatic example: catalytic cracking was first put into commercial operation in 1936 and refinery capacity for it was at 122,000 barrels per day in 1940. By November 1944, U.S. catalytic cracking capacity reached 1,011,650 barrels per day, a 729% increase in four years. USDOC, WAR AND POSTWAR, *supra* note 39, at 9. Automobile engine advances also spurred improvements in refining technology. MILLER & SHEA, *supra* note 37, at 26 ("The petroleum-refining industry has had to keep pace with the rapid strides in development made by the automobile engine and the changing demands of the automotive industry, and improvements in engine design and efficiency often have resulted from the ability of refiners to improve the quality of motor fuel and lubricants.").

100 TAMINIAU, *supra* note 38, at 61.

progress shows how dramatically refining changed under demand pressures. In the early 1930s, the 100 octane reference fuel "was a rare chemical costing $25 per gallon in the small quantities necessary for anti-knock testing purposes," but by 1941, "the industry [was] manufacturing millions of gallons of isooctane for use directly as aviation fuel at little more than 25 cents per gallon."[101]

The increasingly sophisticated technology gave refiners ever greater control over the refining process. As a result, refineries became increasingly capable of producing a wide range of outputs with multiple uses.[102] "[M]ajor changes" in refinery processing after World War II vastly increased output quantity and quality.[103] Refineries were able to obtain increasing amounts of gasoline and other high-value transportation fuels from each barrel of crude.[104] Today, refineries use a wide range of "downstream" processing units to process lower-quality crudes, make products with more demanding specifications, and increase yields.[105] Investment in these technologies has soared since the 1980s, with hydro-treating capacity increasing 53.6% from 1985 to 2003, thermal cracking capacity increasing 29.5% over the same period, and catalytic hydro-cracking capacity increasing 42.4%, compared to a 9% increase in atmospheric distillation capacity and a

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[101] MILLER & SHEA, *supra* note 37, at 30. Demand for higher-octane gasolines beginning in the 1930s led to innovations as well. SPEIGHT, CHEMISTRY, *supra* note 37, at 681 (discussing use of thermal reforming to improve octane). Average octane ratings rose steadily from World War II into the mid-1960s. NPC, IMPACT, *supra* note 28, at 262 (showing increase for premium from motor octane number (MON) 78 / research octane number (RON) 85 to MON 90 / RON 99 by 1965).

[102] LEFFLER, *supra* note 40, at 77.

[103] NPC, IMPACT, *supra* note 28, at 281. The NPC's assessment of technological change from 1945 to 1965 in refining concluded:

> The product specifications of all refinery products have been steadily changing since World War II to improve the performance of these products in end use. As the equipment and machinery using petroleum products have become more sophisticated, so have the treatment and finishing techniques. Technology advances have improved the operating and economic aspects, resulting in a beneficial influence on blending, as well as improvements in the uniformity of product quality. Usually, blending formulations are dictated by product volume requirements and product costs, and the treating and finishing steps are taken to assure that the blend meets specifications.

Id. at 293.

[104] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 53 ("Consumer demand for products such as gasoline and diesel has motivated investment in downstream processes that can increase the yield of these products from a given barrel of crude.").

[105] FTC, MERGERS, *supra* note 5, at 182.

15.6% increase in vacuum distillation capacity.[106] The payoff from this investment has been significant. Gasoline production grew from 142,465 barrels per day in 1900 to 4.1 million barrels per day in 1960, reaching 8.3 million barrels per day in 2005.[107] In addition, there has been dramatic progress in catalysts, substrates, and catalysis modeling as well, which has allowed improvements in "environmental performance, product quality and volume, feedstock flexibility, and energy management without fundamentally changing fixed capital stocks."[108]

As the production process became more complex, gasoline evolved as well. "Prewar [World War II] gasoline was a simple mixture of largely unprocessed stocks with basic additives for octane improvement and storage stability."[109] By the 1960s, additives had become more sophisticated and refineries produced a range of specific hydrocarbons to blend into the finished gasoline.[110] Refineries have also become more complex in an effort to reduce raw material costs, adding technology to allow processing of lower-quality fuels.[111] Refineries today are essentially solving a complex linear programming model to optimize the mix of hydrocarbon fractions produced and the blends of gasoline created.[112]

In short, refinery production is not a static process. Refineries can adjust the fraction of their output that goes to gasoline and regularly do so.[113] A more recent development is

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106 *Id.* at 201 tbl.7-3.

107 Energy Info. Admin., *U.S. Refinery and Blender Net Production of Finished Gasoline*, *available at* http://tonto.eia.doe.gov/dnav/pet/hist/mgfrpus2a.htm (last visited Apr. 12, 2007) (all figures except 1900); NPC, ADEQUACY, *supra* note 59, at C-1 (1900 figures).

108 PETERSON & MAHNOVSKI, *supra* note 76, at 44.

109 NPC, IMPACT, *supra* note 28, at 256.

110 *Id. See also* NPC, ADEQUACY, *supra* note 59, at 28 ("Demand for light products such as gasoline and diesel fuel exceed the natural quantity of these products in crude oil" and so prompt investment in conversion technology.).

111 NPC, ADEQUACY, *supra* note 59, at 28-29.

112 GARY & HANDWERK, *supra* note 61, at 243. Because of the technological changes induced by demand for higher-performance fuels by World War II, the post-war period is the most appropriate for examining long-term trends in the industry. *See also* NPC, IMPACT, *supra* note 28, at 297 (noting increasing sophistication of refinery controls as refinery complexity grew); PETERSON & MAHNOVSKI, *supra* note 76, at 44 ("Innovations in advanced process monitoring and controls have allowed refineries not only to operate more efficiently and safely but also to produce fuels to more-exacting product quality specifications in a more reliable manner—not unlike a highly automated chemical plant.").

113 PARKASH, *supra* note 82, at 119 ("The yield of products in FCC [fluid catalytic cracking] depends on the feedstock quality, type of catalyst, and operating

the operation of a network of refineries as a unit, allowing "for movements of feedstocks and blending stocks across refineries and therefore more efficient use of capacity at each refinery."[114] Regulations dictating the characteristics of outputs place additional constraints on the process, substantially increasing its complexity and making compliance with the various regulatory mandates and technical constraints a managerial "art form."[115] Moreover, crude oil price and product price variations also influence decisions about refinery operation. For example, as oil prices climbed, refinery economics changed and the ability to maximize production of the appropriate mix of high-value products became more important than maximizing volume.[116] The result was "increasingly wide variations in refinery margin" depending on whether refineries had the ability to produce the appropriate combination of

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conditions. FCC units are usually operated to maximize the yield of gasoline; however, the process is versatile and can be operated to maximize middle distillate or LPG, both of which are at the expense of gasoline."); *see also* U.S. DEP'T OF ENERGY, DOE/RG-0048, AN ANALYSIS OF REFINERS' TOTAL BARREL COSTS AND REVENUES FROM THE SALE OF PETROLEUM PRODUCTS: 1976-1979, at 23 (1980) ("If the wholesale price difference [between gasoline and heating oil] is less than about 2 cents per gallon, an economic incentive may exist to take feedstock away from the catalytic cracker and put it into heating oil. Conversely, if the difference exceeds 5 cents per gallon, an incentive may exist to take distillate away from heating oil and put it in the catalytic cracker for gasoline, up to the capacity limit of the cracker."). One regular change is the shifting of production between maximizing gasoline in the summer and maximizing heating oil in the winter. LEFFLER, *supra* note 40, at 65.

114 FTC, MERGERS, *supra* note 5, at 102.

115 LEFFLER, *supra* note 40, at 147. Leffler describes the competing constraints as follows:

> The emissions from burning gasoline cannot exceed various combinations of the four *emitants* [toxics, NO_X, VOCs, SO_X] . . . . The control mechanism sets limits on combinations of the four.
>
> At the same time the generation of the four emitants is connected in complicated ways to the gasoline characteristics [a wide range of technical criteria including RVP, oxygen content, benzene, aromatics content, olefin content, sulfur content, and the T_{50} and T_{90}] . . . . Because of their impact on the four emitants, all these properties have explicit limits, some by statute, at least in the US.
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> Finally, in order for gasoline to work well in car engines, refiners must make gasoline that meets their own performance specifications . . . .

Id.

116 P. Ellis Jones, *Introduction*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at xv, xviii ("The key to refinery economics became the addition of value—the excess of realizable value of the saleable products over the cost of crude and other feedstocks, and other economic inputs such as chemicals, catalysts, utilities, maintenance and salaries.").

products, leading to the closure of some older refineries and significant upgrades to others.[117]

This increased sophistication of refinery operation comes at a price.[118] Investments in hydrotreating in the 1970s and 1980s, for example, allowed the Gulf Coast refiners in particular to process cheaper sour crudes, but roughly trebled capital expenditures.[119] The equipment necessary to maximize the production of economically valuable products, which requires producing precisely calibrated intermediate hydrocarbons and blending them into consistent products, is considerably more sophisticated and expensive than the rudimentary distillation equipment used in the industry's early years.[120] Accordingly, gasoline's production process has become complex and capital intensive,[121] which in turn allows precise control over the product's final characteristics. Although technology has repeatedly revolutionized refining over the last 100 years, refining's modern sophistication may be nearing the limits of current technology's ability to squeeze additional capacity out of existing refineries,[122] due in part to the maturity of many refining technologies.[123]

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117 *Id.* at xviii-xix.

118 Not all refineries are equally complex, of course. NPC, 1990S, *supra* note 63, at 15 ("Of the more than 120 refineries producing gasoline in the United States, processing complexity ranges from the relatively simple topping-reforming plants to extensive coking deep conversion systems.").

119 PETERSON & MAHNOVSKI, *supra* note 76, at 62. *See also* FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 66 n.66 (noting investments to enable processing lower-quality crude).

120 *See* USDOC, WAR AND POSTWAR, *supra* note 39, at 13 (New technology developed in the 1930s "require[s] much larger capital to construct and maintain the refinery proper."); *id.* at 28 (listing the need to secure "adequate capital" to build new capacity and technology as one of the major problems of smaller refiners); MILLER & SHEA, *supra* note 37, at 31 ("The time has arrived [1941] when it is possible for the industry to obtain virtually what it desires from petroleum and its gaseous hydrocarbons by an increasing variety of catalytic and synthetic processes, which give the flexibility so desirable and necessary for profitable operations."). Leffler gives some detailed hypothetical examples that demonstrate how different refinery characteristics affect the output streams. *See* LEFFLER, *supra* note 40, at 219-21.

121 *See* WHITTEN & WHITTEN, *supra* note 81, at 137.

> Economies of scale in refining, the efficiencies in close fractional refining (rather than waste various oils, refiners tried to maximize production of the more marketable products and to offer the remainder for specialized uses), and the superior products from the refining process combined to give refiners a strong competitive advantage over small-scale distillers.

Id.

122 PETERSON & MAHNOVSKI, *supra* note 76, at 39 ("Upgrading pipes, controls, catalysts, and boosting process temperatures and pressures is no longer cost effective without major changes in the capacity or configuration of reactor vessels—changes that

Wider trends in manufacturing also affected gasoline refining and retailing. The last decades of the twentieth century saw increased attention paid to inventory control, with "just-in-time" manufacturing processes[124] cutting inventory costs in a wide range of businesses.[125] Trends in retailing, such as the rise of retail giants like Wal-Mart, also had an impact as those companies moved into gasoline retailing, bringing their buying power to bear on the price and terms of gasoline sales.[126] Refiners expanded vertically into higher-margin retailing, with service stations evolving to include convenience stores.[127] These changes, together with the closure of smaller and less efficient

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are much more expensive. 'Most of the easy, low-hanging-fruit investments have been made,' said one participant. Another concurred: 'The capacity for additional improvements is declining.' Mid-size and smaller refineries could probably still obtain 10-15 percent increases, observed a third respondent, but larger firms 'probably can't go a whole heck of a lot higher.'").

[123] *Id.* at 43 ("The petroleum refining industry relies on mature technologies and processes—many of which were developed decades ago. The increases in productivity experienced in the 1990s were achieved through incremental improvements in existing refinery equipment, processes, and practices. 'Not much is being done on the processes themselves,' said one executive of a leading operating company.").

[124] Just-in-time, or lean production cuts costs through aggressive inventory management and other techniques. *See* S. Robson Walton, *Wal-Mart, Supplier Partners, and the Buyer Power Issue*, 72 ANTITRUST L.J. 509 (2005) (describing techniques and assessing impact of Wal-Mart's cost-cutting on partners).

[125] *See id.* at 518-22 (describing cost-cutting). Just-in-time techniques have spread to the gasoline business with "better market information and transparency. With greater information about the status of a firm's supply chain and inventories, maintaining just-in-time operations and running on the edge have become less risky from a business perspective." PETERSON & MAHNOVSKI, *supra* note 76, at 42. *See also* FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 54-55 (noting trend toward reduction of inventories of gasoline to reduce costs and to free up capital for other investments); *id.* at 76 (noting impact on reducing prices by making refineries more efficient and increasing them by making the system less tolerant of unplanned outages).

[126] *See infra* note 165.

[127] Yergin describes the early evolution of the gasoline retail market as follows:

> Before the 1920s, most gasoline was sold by storekeepers, who kept the motor fuel in cans or other containers under the counter or out in back of the store. The product carried no brand name, and the motorist could not be sure if he was getting gasoline or a product that had been adulterated with cheaper naphtha or kerosene.
>
> . . . .
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> In 1920, certainly no more than 100,000 establishments sold gasoline; fully half of them were grocery stores, general stores, and hardware stores. Few of those stores were selling gasoline a decade later. In 1929, the estimated number of retail establishments selling gasoline had grown to 300,000. Almost all of them were gas stations or garages.

YERGIN, *supra* note 27, at 209.

refineries, reduced refiners' excess capacity, and so the amount of spot market, unbranded gasoline.[128] The spot market for essentially commodified gasoline had provided needed flexibility for the national market, allowing quick response to shortages. But as the spot market shrank in the 1990s, the ability to make up for shortfalls caused by even a temporary closure of a particular refinery[129] declined.

3. The Properties of Gasoline and the Market

The physical process of gasoline production is crucial to understanding the market for gasoline. Refineries produce a wide range of products, including nonfuel products from solvents to asphalt, chemical feedstocks such as benzene, and fuels including diesel, jet fuel, kerosene, liquefied petroleum gas, residual fuel oil,[130] distillate fuel oil, and motor gasoline.[131] Gasoline comes in many varieties, as it has almost from the beginning of the industry.[132] Indeed, "gasoline" is now defined in the technical literature simply as "complex mixtures of hydrocarbons having typical boiling ranges from 100 to 400ºF

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[128] A spot market is one "in which a commodity or currency is traded for immediate delivery. It is distinguished from a futures or a forward market, in which contracts for delivery at some future date are traded." THE MIT DICTIONARY OF MODERN ECONOMICS 398 (David W. Pearce ed., 3d ed. 1986).

[129] *See* PARKASH, *supra* note 82, at 384 (noting need for refineries to change product mix in response to conditions such as "a critical pump-out of service, partially coked-up furnace, catalyst bed with high pressure drop or low activity, a delayed ship causing severe ullage constraints, or a change of specifications can upset the best-laid plans" for output). The need to shift from aviation fuel to gasoline had contributed to the post-World War II shortages. YERGIN, *supra* note 27, at 410.

[130] Residual fuel oil (or "resid")

> is the viscous residuum of the refining process which strips the lighter molecules from crude oil. Because of its consistency—it sometimes cannot be pumped unless heated—resid cannot be transported long distances economically except by water . . . . The primary U.S. market for resid is as a utility and industrial fuel . . . .

BOHI & RUSSELL, *supra* note 63, at 144-45.

[131] EPA, PROFILE, *supra* note 68, at 4.

[132] As early as 1917, the FTC noted that "[t]he idea that gasoline is gasoline is erroneous." FTC, 1915, *supra* note 92, at 44. A 1958 survey identified forty types of gasoline produced by refineries. GARY & HANDWERK, *supra* note 61, at 9 (citing American Petroleum Institute survey from 1958, published in *Info. Bull. No. 11*). Today, "gasolines of many different designs have evolved to meet local needs and legislation." Blackmore, *supra* note 92, at 218; *see also* JOHN K. PEARSON, IMPROVING AIR QUALITY: PROGRESS AND CHALLENGES FOR THE AUTO INDUSTRY 83 (2001) ("Gasoline composition varies depending upon the crude oil source, refinery processes used in its manufacture, and the amount of oxygenated compounds added in the final blend.").

(38 to 205ºC) as determined by the ASTM method,"[133] leaving open the application of the term to a wide range of substances. As one refinery executive noted, "Gasoline is not gasoline anymore. It is a specialty chemical."[134]

There are many properties that differentiate gasolines from one another. These properties determine both engine performance[135] and the environmental effects of burning the particular gasoline.[136] These impacts are not simple or unidimensional. Particular characteristics of gasoline can have both positive and negative impacts on engine performance and the environment, often making the precise mix of characteristics a matter of tradeoffs. The motives for changes in gasoline characteristics vary over time. For example, the EPA seeks to reduce SO_X emissions and to improve catalytic converter performance by reducing the amount of sulfur in fuels.[137] Yet early efforts to reduce gasoline's sulfur content were market-driven. For example, in the 1880s, the Lima, Ohio oil field produced sulfur-contaminated oil that yielded products so odiferous that they were virtually impossible to sell,[138] and in the post-World War II period, sulfur was "an important contributor to engine wear and deposits."[139]

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133 GARY & HANDWERK, *supra* note 61, at 9 (citing American Petroleum Institute survey from 1958, published in *Info. Bull. No. 11*). *See also* J.G. Calvert, J.B. Heywood, R.F. Sawyer & J.H. Seinfeld, *Achieving Acceptable Air Quality: Some Reflections on Controlling Vehicle Emissions*, 261 SCIENCE 37, 42 (1993) ("Gasoline is a complex mixture containing hundreds of different HCs; its physical and chemical properties are difficult to describe with a few parameters."); Blackmore, *supra* note 92, at 217 (discussing meaning of the term "gasoline").

134 PETERSON & MAHNOVSKI, *supra* note 76, at 21 (quoting a "technology and services executive").

135 GARY & HANDWERK, *supra* note 61, at 14 ("The Reid vapor pressure (RVP) and boiling range of gasoline governs ease of starting, engine warm-up, rate of acceleration, loss by crankcase dilution, mileage economy, and tendency toward vapor lock."); LEFFLER, *supra* note 40, at 130-31.

136 Data from a study before the widespread use of boutique fuels found major differences in emissions from different forms of gasoline. A 1993 article, for example, reported:

> Recent data . . . indicate that the highest exhaust emission fuels had some combination of T_{50} (the temperature at which 50% of the fuel evaporates) values greater than 100ºC, T_{90} (the temperature at which 90% of the fuel evaporates) values exceeding 171ºC, or sulfur content greater than 300 parts per million by weight. . . . According to a 1992 survey, 20% of commercial fuels exceeded these distillation cutpoints and 40% of commercial fuels exceeded the sulfur cutpoint.

Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 40.

137 NPC, ADEQUACY, *supra* note 59, at 43.

138 GIDDENS, *supra* note 37, at 3.

139 NPC, IMPACT, *supra* note 28, at 262.

Similarly, controlling evaporation from storage tanks first became an industry priority as a cost-cutting measure,[140] only later becoming an environmental measure.

One major characteristic of gasoline is its volatility, measured in terms of Reid Vapor Pressure (RVP) or the Drivability Index (DI).[141] "Overall, lower RVP appears to be the major contributor to lowered VOC [volatile organic compounds] emissions resulting from the use of RFG [reformulated gasoline]."[142] But too low an RVP can cause incomplete combustion in the engine, leading to higher HC emissions due to unburnt fuel.[143] Gasoline with a higher RVP improves starting in cold conditions, but, at high temperatures and altitudes, can cause vapor lock, which degrades engine performance.[144] Optimizing the volatility of a gasoline blend thus involves tradeoffs over several performance characteristics and consideration of the altitude and temperatures of the area where the gasoline will be used. Since at least the 1930s, refiners have optimized their products' volatility for different temperature and pressure conditions, and a number of other characteristics as well.[145] Different

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140 *Id.* at 258.

141 "The Reid vapor pressure is approximately the vapor pressure of the gasoline at 100ºF (38ºC) in absolute units (ASTM designation D-323)." GARY & HANDWERK, *supra* note 61, at 15. *See also* Blackmore, *supra* note 92, at 228 (discussing volatility issues). The Driveability Index is calculated from "three specified distillation points plus an oxygen content measurement in some forms of the calculation." NPC, ADEQUACY, *supra* note 59, at 93.

142 NAT'L ACAD. OF SCI., OZONE-FORMING POTENTIAL OF REFORMULATED GASOLINE 142 (1999) [hereinafter NAS, OZONE-FORMING POTENTIAL].

143 Blackmore, *supra* note 92, at 228. Too low an RVP, however, and "the vapour pressure in the fuel tank can fall to a dangerously low level under cold ambient conditions whereby it falls below the upper flammability limit of the gasoline, thereby posing a risk of fire during refueling." *Id.* at 225; *see also id.* at 228-29 (discussing impact of volatility on driving performance and emissions).

144 GARY & HANDWERK, *supra* note 61, at 11.

145 As early as the 1930s, refiners began to introduce "seasonally balanced" gasolines with characteristics that varied with location and season, making them more volatile in winter to help starting, and less volatile in the summer to boost mileage. GIDDENS, *supra* note 37, at 478; LEFFLER, *supra* note 40, at 131; NPC, IMPACT, *supra* note 28, at 256 (volatility optimization). Customers seek a range of gasoline characteristics.

> In general, customers will be looking for good performance under all weather conditions (power, smoothness (driveability), cold starting, fuel economy), for reliability (no engine damage, no undesirable combustion noise such as knock, cleanliness and non-corrosion of the components) and for environmental acceptability (not only legislated exhaust and evaporative emissions, but also low odour levels, and the ability to meet regular emission checks).

gasolines are generally defined in terms of desired properties rather than by their particular components. But the definition of the optimal mix of characteristics has changed significantly over time, as evolving production techniques gave refiners greater control over gasoline composition.[146] For example, "front end volatility" of gasolines increased after World War II into the 1960s because the higher volatility "improved performance characteristics markedly."[147] Today, of course, a primary concern is reducing volatility to reduce vehicle emissions.[148]

Since World War II, gasolines have often contained, in addition to their various hydrocarbon components, a variety of additives designed to improve some aspect of their performance.[149] In particular, additives that control engine "knock" by increasing octane have played an important role.[150] Perhaps the most important innovation was the Ethyl

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Blackmore, *supra* note 92, at 217.

[146] *See* NPC, IMPACT, *supra* note 28, at 261-62 ("Following World War II, motor gasoline changed from a relatively simple mixture of petroleum fractions into a complex product made by careful blending of many intermediate refinery stocks. . . . [T]he refiner is able to exercise close control over the final product to give it desired properties.").

[147] *Id.* at 263. These improvements include "starting easier, warmup is quicker, there is less crankcase dilution and, to a lesser extent, an improvement has been made in cylinder deposits and engine wear." *Id.*

[148] *See infra* note 514 and accompanying text.

[149] Blackmore, *supra* note 92, at 238 (discussing increasing need for additives for product differentiation, maintaining engines, and preventing corrosion and deposits from mandated oxygenates); NPC, FACTORS AFFECTING, *supra* note 61, at 52 (noting that in the 1970s, "[s]pecial detergent or dispersant additives are now available to help maintain a clean carburetion system, resulting in improved engine performance, better mileage in city driving, reduced carburetor maintenance and reduced exhaust pollutants"); NPC, IMPACT, *supra* note 28, at 256 ("Additives now [1967] are used not only for octane improvement and stability, but also to reduce carbon deposits, clean carburetors, prevent carburetor icing, prevent corrosion, reduce spark plug fouling, and for many other quality improvements."); *id.* at 263 ("Prior to 1950, the number of different additives used in gasolines was relatively small."); YERGIN, *supra* note 27, at 549 ("[P]urpose [of additives] was to carve out brand identification for a product, gasoline, that was, after all, a commodity that was more-or-less the same, whatever its brand name. In a period of a year and a half, in the mid-1950s, thirteen of the top fourteen marketers began to sell new 'premium' gasolines, racing hard to outdo one another in extravagant claims.").

[150] GARY & HANDWERK, *supra* note 61, at 13. Anti-knocking ability is measured in terms of octane numbers. As engines increased in their compression ratios, higher octane-number gasoline became necessary. MILLER & SHEA, *supra* note 37, at 29. "The type of hydrocarbons present in gasoline governs its anti-knock value, and therefore this property of motor fuel is controllable in cracked and synthesized gasoline." *Id.* at 30. The octane number serves as an index to relate the gasoline in question to the standard of a mixture of normal heptane (octane equal to zero) and isooctane (octane equal to 100). *Id.*; *see also* Blackmore, *supra* note 92, at 221 (describing knocking problem in depth).

Corporation's introduction of anti-knock gasoline in the 1920s, which forced companies without contracts for Ethyl's additives to develop their own high-performance fuels.[151] Lead, for example, was added to gasoline for many years to improve its octane rating[152] and, more recently, methyl tertiary butyl ether (MTBE) was added to reduce the environmental impact of combustion and boost octane.[153] In short, products labeled "gasoline" initially varied substantially from retailer to retailer.[154] Early retail gasoline competition focused on quality claims[155] as consumers gradually learned to distinguish differences relevant to performance.[156] Some states attempted quality regulations, but these initial efforts were based on an imperfect understanding of gasoline quality.[157] Similarly, today

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[151] GIDDENS, *supra* note 37, at 287-92.

[152] MILLER & SHEA, *supra* note 37, at 30. The discovery of lead's anti-knock properties had "radical repercussions for the oil industry . . . [and] became one of the components of the dominant design in the search (in the era of ferment) to increase the quality of fuel." TAMINIAU, *supra* note 38, at 55. *See also* Arnold W. Reitze Jr., *The Regulation of Fuels and Fuel Additives Under Section 211 of the Clean Air Act*, 29 TULSA L.J. 485, 497-98 (1994).

[153] LEFFLER, *supra* note 40, at 141-45. *See* NPC, ADEQUACY, *supra* note 59, at 82-89 (overview of MTBE use). Of course, both were eventually removed from U.S. gasolines because of their overall negative environmental impacts. *See* NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 107 (lead phased out to protect catalytic converters); *infra* note 525.

[154] For example, a 1935 analysis concluded that

> almost any gasoline could operate satisfactorily the automobile of 1920, and many fuels were then evaluated more in psychological and esthetic ways than in terms of performance. But today [1935] the automobile gasoline must be made so that its properties will conform to the requirements of a high-speed high-compression motor . . . . In order to fill these and other new economic needs the industry began to treat the crude oil in special ways to produce products of higher quality and a greater variety of properties.

MILLER & SHEA, *supra* note 37, at 27 (quoting Frederick D. Rossini, *Chemical Constitution of the Gasoline Fraction of Petroleum*, REFINER AND NAT. GASOLINE MFR., June 1935, at 255). Early refineries produced kerosene of such variable quality that the very name of the Standard Oil Company was chosen to convey the "standard quality of the product." YERGIN, *supra* note 27, at 40. Of course, variable quality in kerosene was particularly dangerous—"[i]f the kerosene contained too much flammable gasoline or naphtha, as sometimes happened, the purchaser's attempt to light it could be his last act on this earth." *Id.*

[155] GIDDENS, *supra* note 37, at 180-81 (Early competition between Standard (Indiana) and Wadhams Oil Company of Wisconsin was over quality. Wadhams argued gas from cracking was inferior, Standard argued its gas was uniform in quality. The main issue was which worked better under cold conditions.).

[156] *Id.* at 182 (Light-gravity gas started easier but had greater tendency to vapor lock and gave less mileage. Motorists soon recognized this.).

[157] *Id.* at 179 (States regulated gasoline quality and these laws "were based upon gasoline obtained directly from crude oil" and refined products processed with cracking, etc. could not satisfy the definitions (which specified a gravity of at least 63 degrees).).

many gasolines are blended with ethanol, initially thought to improve environmental quality, but now largely seen as ineffective.[158]

Over time, however, the consistency of gasoline converged in several key respects.[159] From the consumer's point of view, the most important was the gradual standardization of octane ratings; three roughly similar grades of gasoline are now offered by most U.S. gasoline retailers.[160] Although some gasoline retailers attempted to differentiate their products through the use of particular additives[161] or unusual octane ratings,[162] from the 1920s to the 1980s, gasoline steadily became more of a commodity in which price competition dominated competition through product differentiation.[163] Not

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[158] *See* Jonathan H. Adler, *Clean Fuels, Dirty Air*, *in* ENVIRONMENTAL POLITICS: PUBLIC COSTS, PRIVATE REWARDS 19, 28-37 (Michael S. Greve & Fred L. Smith, Jr. eds., 1992) (reviewing the politics of the oxygenate provisions in the CAA Amendments of 1990).

[159] NPC, 1990S, *supra* note 63, at 15 ("With the exception of the additives package, which is typically unique from brand to brand, gasolines are generally interchangeable."); *id.* at 30 (stating that "most current gasolines are truly interchangeable products"); *see also* NPC, ADEQUACY, *supra* note 59, at 95 (noting development of ASTM standards for gasoline specifications and efforts by refiners to use "internal specifications" to assure quality).

[160] LEFFLER, *supra* note 40, at 137.

[161] Mobil, for example, promoted the inclusion of detergents in its gasoline starting in the 1950s. *See* United Dairy Farmers, http://www.udfinc.com/mobil/ (last visited Apr. 12, 2007) ("Mobil has long recognized that gasoline detergent additives are necessary for modern vehicles to stay in top operating condition. In fact, Mobil was the first gasoline marketer to use detergents, back in 1954, 40 years before the U.S. government began to require their use. Since that time, we've continued our leadership position in gasoline detergency. In 1985, Mobil was the first to use detergents that cleaned fuel injectors. We continue to use state of the art detergent additives in all of our gasoline grades."). Exxon told consumers, "[p]ut a Tiger in your Tank." *See Tiger*, Wikipedia, http://en.wikipedia.org/wiki/Tiger (last visited Apr. 12, 2007) (describing Exxon's use of tiger mascot). Amoco sold unleaded gasoline long before gasoline retailers were required to do so and marketed the absence of lead as an advantage. *See* Leslie H. Moeller, Nick Hodson & Brad Wolfsen, *The Superpremium Premium*, STRATEGY+BUSINESS, Winter 2004, *available at* http://www.strategy-business.com/press/16635507/04401.

[162] Dirlam & Kahn, *supra* note 33, at 831 (describing how Sun Oil competed in the 1950s by "offering higher than standard octane gasoline at standard prices" and so "giving the customer more for his money"); James B. McNallen, *A New Concept in Gasoline Marketing*, 22 J. MKTG. 273 (1958) (discussing Sun's marketing strategy).

[163] Jones, *supra* note 116, at xxi ("In the period up to the late 1970s there was an element of performance competition amongst the major oil companies, but since that time this element of competition has largely disappeared and, in respect of petroleum fuels at least, it has become much more of a commodity market meeting industry standard specifications. Where companies have sought to distinguish their fuels in recent years it has rarely been on the basis of performance . . . ."); *see also* Vernon T. Clover, *Price Influence of Unbranded Gasoline*, 17 J. MKTG. 388, 393 (1953) (noting that a study of independent gasoline retailers in the 1950s found that "[i]ndependents, as compared to standards, offer little in the way of services, and put little stress upon

surprisingly, as the product became more of a commodity, refining became a low-margin business,[164] and any effort to raise prices caused the price leader to lose market share.[165] As refiners' attempts to reduce competition failed, the gasoline market increasingly approached the economics textbook ideal. Thus, market forces helped bring about a relatively steady decline in the real price of gasoline—aided, of course, by the decline of real crude oil prices that occurred throughout most of this period.

The crucial point for our purposes is that gasoline is a complex commodity, the design of which presents refiners with a large number of tradeoffs.[166] Gasolines differ in terms of their environmental impacts and their engine performance. With gasoline composition largely unregulated through the 1980s,[167] market pressures during that decade commodified gasoline, pushing it toward a more-or-less standard set of characteristics about which consumers cared (e.g., octane), broadening and deepening the market for gasoline.[168] Refiners remained free to

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attractive buildings and facilities, and uniformed employees," instead stressing prices below the standards).

164 *See, e.g.*, Walter Pfeiffer, *Refining: Let the Good Times Roll* (Paper Presented at CERAWeek 2005), *available at* http://www.accenture.com/Countries/Canada/Research_And_Insights/RefiningLetGoodTimesRoll.htm (last visited Apr. 12, 2007) ("Over the last 20 years conventional wisdom has been that refining is capital intensive and low margin. The industry has been trapped in a period of limited demand growth, overcapacity and low profitability, coupled with repeated boom-and-bust cycles. It has become viewed as more of a necessity, rather than an attractive business in which to invest and grow . . . ."). Pfeiffer forecasts better times ahead, however. *Id.*

165 Further evidence of the commodification of gasoline is the development of new forms of marketing gasoline to develop alternative revenue streams. As early as the 1920s, Standard Oil of Indiana was treating its service stations as vehicles for the sale of a broad array of products, giving managers quotas for its entire range of products from furniture to lubricants. GIDDENS, *supra* note 37, at 283 ("By the late 1920's Standard service stations had evolved into stores for the sale of petroleum products instead of simply being gasoline filling stations."). Grocery stores are increasingly using gasoline sales as a loss leader today. *See* Penelope Patsuris, *Wal-Mart's Next Victims*, FORBES, Nov. 10, 2004 (describing Wal-Mart's move into gas sales); *Report: Gas Group Fumes Over Giant Eagle Discounts*, PITT. BUS. TIMES, Mar. 14, 2005, *available at* http://www.bizjournals.com/pittsburgh/stories/2005/03/14/daily7.html (describing grocery store use of fuel discounts to gain market share).

166 For example, hydrotreating gasoline to remove sulfur also reduces octane by approximately ten numbers in "FCC gasoline" (that made with fluid catalytic-cracking units). NPC, ADEQUACY, *supra* note 59, at 45.

167 The major exception was the mandatory phaseout of lead in the 1970s and 1980s. *See infra* notes 496-502 and accompanying text.

168 Market pressures during the 1980s were particularly effective as the industry had excessive domestic refining capacity through the mid-1990s as a result of the distortions introduced by MOIP and 1970s price controls/allocation system. *See* NPC, ADEQUACY, *supra* note 59, at 21.

alter other gasoline characteristics to maximize profits, producing gasoline blends that varied with refinery equipment and crude supplies. Since then, however, environmental regulations and engine performance demands have complicated the market by introducing new requirements.[169]

4. The Impact of Distribution Systems

Gasoline was originally transported by tank wagons and rail cars.[170] The "most revolutionary development" in transportation was the 1929 conversion of an oil pipeline into a gasoline pipeline running from Bayonne, New Jersey to Pittsburgh, Pennsylvania.[171] "With a carrying charge far below railroad freight rates, gasoline could now be shipped into the Middle West via the Ohio River and the Great Lakes and have a profound competitive effect upon the price of gasoline from Wood River, Whiting, and other Mid-Continent refineries."[172] Pipeline capacity rapidly expanded in the 1930s. Capacity grew from 1,289 miles in 1930 to over 8,000 miles by 1940.[173]

By the 1980s, the pipeline networks and the rest of the transportation system[174] had grown to allow refiners to ship across wide territories,[175] although significant gaps remained.[176]

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169 NPC, OBSERVATIONS, *supra* note 13, at I-18 ("As product specifications become more restrictive, the ability to utilize all the flexibility and volume capacity inherent in the refining system can be diminished."); PETERSON & MAHNOVSKI, *supra* note 76, at xiv ("As demand for petroleum products has grown, their quality and performance have changed substantially as a result of environmental regulations and motor vehicle performance requirements.").

170 GIDDENS, *supra* note 37, at 46-48 (describing early distribution methods).

171 *Id.* at 466.

172 *Id.* at 466-67.

173 1 BRADLEY, *supra* note 74, at 825.

174 NPC, 1990S, *supra* note 63, at 23 ("As gasoline moves from each refinery through the complex maze of transportation modes, through terminals and bulk plants to the consumer, it may move into many tanks and vessels owned and operated by different companies."); PETERSON & MAHNOVSKI, *supra* note 76, at 23 ("In response to the changing geography of consumption, a complex network of refined-products pipelines has evolved.").

175 FTC, MERGERS, *supra* note 5, at 210 ("Pipelines are the leading method used for bulk transport of refined products within the United States; transportation by water is also important."); PETERSON & MAHNOVSKI, *supra* note 76, at 23 ("The East Coast and the Midwest, while having relatively few refineries given the size of their population, obtain approximately 40 and 20 percent, respectively, via pipeline and water carriers from Gulf Coast mega-refineries. The Northeast also relies on a large increment of refined products (17 percent in 1999) imported from abroad, giving that region a measure of additional market liquidity.").

176 PETERSON & MAHNOVSKI, *supra* note 76, at 23 ("California, Nevada, and parts of Arizona are largely walled off from the rest of the country by both geography and stringent local environmental regulations.").

"[S]hipments by pipeline increased from 236 billion ton-miles in 1979 to 299 billion ton-miles in 2001."[177] As gasolines became commodities, this system allowed shipments to be treated as interchangeable[178] and refiners routinely engaged in product exchanges to reduce transportation costs and solve temporary shortages.[179]

Today the United States has a "complex set of facilities" that distribute gasoline and other fuels which "includes a network of geographically dispersed pipelines, marine vessels, and occasionally rail cars" and which "is made even more complex by the number of different product variations that must be transported to the marketplace."[180] Most large petroleum markets are supplied primarily by local refineries because "[t]he fundamental transportation and flexibility advantage of moving crude oil versus a variety of products generally favors local refiners serving local markets."[181] Distribution systems are critical to the competitiveness of a local market, however, as they link markets and allow shipments in and out as local demand and supply conditions vary. "In some cases a pipeline may have more control over the pricing and volume of products entering a market than do the refiners supplying the pipeline."[182]

Unfortunately, however, "[a]ccess to refined product pipelines . . . varies widely among different regions in the U.S."[183] The amount of refinery capacity and the interconnection of an area with other areas are important determinants of whether or not market pressures can produce a response to temporary shortages.[184] For example, almost half of U.S. refining capacity is concentrated on the Gulf Coast,[185] while 95% of East Coast

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[177] FTC, MERGERS, *supra* note 5, at 210.

[178] NPC, 1990S, *supra* note 63, at 23 (stating that the "preponderance of shipments" of gasoline are "interchangeable").

[179] *Id.* at 23 ("The interchangeability of base motor gasolines is further demonstrated by the product exchanges between refiners in different locations. It is typical for a refiner in one location to trade or exchange surplus product to another refiner located in a different state. . . . Unique additive packages, specified by each company, are often added at the terminal upon truck loading in order to achieve unique product quality and marketing differentiation.").

[180] NPC, ADEQUACY, *supra* note 59, at 101.

[181] *Id.* at 22.

[182] FTC, MERGERS, *supra* note 5, at 189.

[183] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 80.

[184] *Id.* at 69.

[185] *Id.* at 81.

refineries sit in Pennsylvania, New Jersey, and Delaware.[186] New England, on the other hand, has no refineries or pipelines,[187] and California remains isolated by its special fuel formulations and lack of pipelines.[188]

As might be expected, "refinery capacity [also] varies widely among different regions of the U.S."[189] Refined products are often not produced where they are used, so they must be transported to the market. These transportation costs limit the extent to which any particular refinery can sell its gasolines in each location and define the extent of market power each will have in particular areas.

The product mix is also crucial to determining the cost of transportation. When different products are sent through a pipeline, for example, the interface between the two products where some mixing occurs must be sold as the lower-quality product, producing a loss in value.[190] Boutique fuels make this even more difficult.[191]

A low degree of connectivity to the broader market has been crucial in determining the success of some refiners. For example, "[a] critical asset of many smaller refiners is their location in interior markets where a lack of pipeline access protects them from competition from large coastal refineries."[192] Extending a pipeline into a small refiner's territory is a "real threat."[193] Thus, these higher-cost producers survive only because they are insulated from competitive pressures by their relative isolation from the broader market and the costs and regulatory obstacles associated with entering those markets.

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[186] *Id.* at 84.

[187] *Id.* at 85.

[188] *Id.* at 87.

[189] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 79.

[190] NPC, ADEQUACY, *supra* note 59, at 105.

[191] *Id.* ("As the number of different products increases and batch sizes decrease, quality control become more difficult and the effective capacity of the pipeline system decreases."); *see also id.* at 108 (For each new fuel specification, "there will be distribution system modifications required.").

[192] PETERSON & MAHNOVSKI, *supra* note 76, at 18-19; *see also* NPC, ADEQUACY, *supra* note 59, at 29 ("In some situations, local markets are isolated from direct product supply routes and are therefore more expensive to supply from distant refining centers."); FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 52 ("A small refinery's cost disadvantages from small-scale operation may be offset if it is located near an area of crude oil production or strong gasoline consumption, so that transportation costs are low, or if it is able to serve a niche market.").

[193] PETERSON & MAHNOVSKI, *supra* note 76, at 67.

C. Understanding the Market for Gasoline

This brief overview of the non-regulatory aspects of gasoline markets paints the following picture: Gasoline has a broad range of characteristics produced from a substance that itself varies significantly, using equipment that varies from location to location. Its production remains subject to various constraints imposed by the crude, the equipment, and the characteristics of the final product demanded by consumers. Market pressures produced a commodity fuel from this mix of unique inputs, equipment, and outputs, at least with respect to the characteristics about which consumers have a preference (e.g., octane, RVP). Refiners were able to create this commodity by using other aspects of gasoline composition (e.g., the particular combination of hydrocarbon fractions blended into a particular batch) because the differences among these characteristics were invisible to, and so irrelevant for, consumers. Refiners were also able to continually expand output from refineries through technological progress, again making use of the ability to use a variety of blendstocks without changing the consumer-demanded characteristics of the gasoline. The price of being able to do so, however, was increasing the complexity of refineries to give them the flexibility to process quite different crudes into gasolines with the appropriate consumer-demanded characteristics.

Without the impact of either economic or environmental regulation of refining, the market for gasoline was likely headed toward fewer, larger, more complex refineries producing a product with sufficiently commodified characteristics that consumers primarily differentiated among gasolines by price. In the absence of regulation, therefore, we would expect to see a national market for gasolines, with regional variations in composition designed to promote uniform performance under a range of local conditions. The limit to such a market would likely be transportation costs. Those, in turn, would likely have been derived primarily from the extent of the pipeline and tanker network. Because businesses in other markets have prospered by solving similar logistical problems,[194] an unregulated gasoline market would likely have led to logistical innovations, extending the market's size. This

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[194] *See* MICHAEL BERGDAHL, WHAT I LEARNED FROM SAM WALTON: HOW TO COMPETE AND THRIVE IN A WAL-MART WORLD 126-27 (2004) (describing Wal-Mart's logistics savings).

conclusion stems from the above analysis and the almost uninterrupted trends toward such a market, despite the radical shifts in regulatory policy since World War II, which are described in the next section.

How competitive would gasoline markets be in the absence of regulation? Counterfactuals are always difficult to prove, but it seems most likely that markets would have tended toward the competitive end of the spectrum for two reasons. First, from the consumer's perspective, gasoline has moved steadily toward commodity status, particularly during the comparatively unregulated early period and the brief return to relatively unregulated status during the 1980s. During this period (and into the 1990s), refineries became more efficient and competitive.[195] Second, although the capital intensity of modern refineries makes entry more costly than it would be in a less capital-intensive industry, capital intensity alone is not a sufficient barrier to entry to prevent the development of competition where opportunities for profit exist. The industry would likely have attracted new entrants. Indeed, when excess capacity declined in the 1980s, additional capacity in existing refineries quickly eliminated the higher than usual returns that the industry briefly enjoyed during the late 1980s.[196] Moreover, as economic deregulation occurred in the 1980s, new firms did enter the refining industry by buying existing refineries.[197] We now turn to the impact of regulatory policy and the question of whether it produced negative regulatory externalities that fragment the market.

II. REGULATORY IMPACTS

Energy markets have historically been subject to numerous regulations from a wide range of federal and state agencies. One analysis of U.S. policy through the 1970s concluded that the dominant theme was a "drift toward government control" of the oil industry, perhaps best explained "by the tendency to presume that any situation defined as a problem must have a solution, and that a solution is, *ipso facto*,

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195 NPC, ADEQUACY, *supra* note 59, at 30 (using financial data collected by the Energy Information Administration to demonstrate increased competitiveness).

196 *Id.* at 32 (returns to capital rose to 13% in 1988-1989 before declining to 4% in 1990-1998 as new capacity came online).

197 For example, Valero, the largest U.S. refiner today, bought its first refinery in 1981. Valero Energy Corp., *Valero Through the Years*, http://www.valero.com/About+Valero/History/ (last visited Apr. 12, 2007).

worth pursuing."[198] These regulations have had a major impact on gasoline markets, if not always the impact intended. Although the focus shifted from economic regulation to environmental regulation after the 1981 decontrol of oil prices, the depth of the interaction between the government and the market continued. In this section, we describe the major economic and environmental regulations that shaped the gasoline market.

A. *Economic Regulatory Activity and Gasoline Markets*

U.S. energy policy reflects numerous twists and turns, falling into five distinct periods, each characterized by a different approach to government intervention.

1. The Early Years

The regulatory story of the refining business, and of the oil business more generally, begins with Standard Oil and its opponents' efforts to defeat the company's alleged monopolistic advantage.[199] Indeed, one of the abiding themes of American regulatory policy—fear of monopoly—was present virtually from the start of the oil industry. The recurrence of government intervention aimed at preventing monopoly bred "an unusually virulent and mutual distrust between government and the oil industry" that has persisted ever since.[200]

There is extensive literature on Standard Oil and the evidence on whether the company harmed or helped consumers remains decidedly mixed.[201] For example, despite playing the villain to the trust-busters' hero, Standard Oil actually contributed positively toward the creation of a national market in gasoline. The company took the lead in creating a standard form of gasoline. Indeed, John D. Rockefeller chose the name

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[198] BOHI & RUSSELL, *supra* note 63, at 14-15.

[199] Standard Oil Co. v. United States, 221 U.S. 1 (1911); *see also* GIDDENS, *supra* note 37, at 124-25 (describing issuance of opinion by Supreme Court). The attack was led by Ida M. Tarbell, whose series in *McClure's* was later published as a 554-page, two-volume work with 242 pages of appendices including copies of contracts, maps, and reproductions of letters. David M. Chalmers, *Introduction* to IDA M. TARBELL, THE HISTORY OF THE STANDARD OIL COMPANY at xiv-xv, xxii (David M. Chalmers ed., Dover Publ'ns, Briefer ed. 2003) (1966).

[200] VIETOR, *supra* note 98, at 34.

[201] *See* 1 BRADLEY, *supra* note 74, at 1070-1105 (summarizing Standard Oil case and analyzing welfare effects).

"Standard Oil" in part to convey the image of a standardized product, a key marketing advantage in the early years of the petroleum industry, when many refined products varied widely in quality.[202] Standard Oil also played an integral part in establishing a national market for petroleum products by building infrastructure to help move oil and refined products around the nation.[203] By 1910, a truly national gasoline market had begun to emerge, ironically weakening Standard Oil's market power just as the antitrust-based assault on the company reached its climax.[204] On the other hand, there is little doubt that Standard Oil and its successors repeatedly attempted to cartelize the industry. Indeed, the trend toward consolidation was apparent by the end of the Civil War, only a few years after the first oil well began producing.[205] Such efforts are unsurprising. After all, the dream of monopoly profits casts a tempting lure and there is no reason to expect the oil industry to be any better able to resist this lure than other firms.

Anti-monopoly efforts give government involvement in gasoline markets a lengthy pedigree. In the Standard Oil cases, the result was a famous court-ordered breakup in 1911,[206] followed by various antitrust actions seeking additional remedies when the newly-separated Standard companies provided less vigorous competition for one another than antitrust authorities thought optimal.[207] Despite these aggressive antitrust efforts, before the outbreak of the First World War, U.S. refining was "expanding and profitable."[208]

By the end of World War I, a second regulatory concern had appeared: national security. The Great War highlighted

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[202] *See id.* at 1093.

[203] *Id.* at 1089-94 (summarizing Standard Oil's contributions).

[204] WHITTEN & WHITTEN, *supra* note 81, at 147 ("At the peak of Standard's power, the trust controlled over 90 percent of crude oil production and refining capacity. By the time the firm was dismembered under court order—the manifestation of the public's fear and ignorance—Standard controlled less than 70 percent of production and refining, and the percentages were falling.").

[205] *Id.* at 10.

[206] Standard Oil Co. v. United States, 221 U.S. 1 (1911).

[207] The breakup was insufficient to end the "problem," however, as the new companies created continued to be owned by overlapping shareholder groups. 1 BRADLEY, *supra* note 74, at 1087. Public suspicions of the oil companies continued, fueled by observations that the newly independent Standard companies did not invade one another's territories. *Id.* at 1089. Thus, although formal coordination had been ended, antitrust regulators feared that informal coordination among the Standard companies was continuing to restrain competition and keep prices above the competitive level.

[208] 2 *id.* at 1110.

the military importance of oil supplies[209] and wartime price controls caused supply problems.[210] Responding to these concerns, the federal government deemphasized its antitrust activity as regulatory attention shifted to maximizing production for the war effort.[211] Because national security concerns often run counter to antitrust policies, federal energy policy can appear bipolar as it cycles between them.[212]

A third regulatory motive appeared during World War I as energy companies recognized that influencing government policy was potentially lucrative. Wartime price controls put many refiners into financial difficulties, prompting some to seek government assistance.[213] Rent-seeking by oil interests began in earnest as the wartime experience created new players in energy regulation debates in the form of oil trade associations organized to lobby for industry favors in Washington.[214]

A related desire to prevent "excessive competition" presented yet another justification for regulation after the war. The post-war boom saw oil production and use soar.[215] Domestic oil discoveries increased, and although these made the United States a net exporter of petroleum by 1923,[216] increased supplies exerted consistent downward price

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209 *Mining Laws of 1872 and 1989: Hearing Before the Subcomm. on Mineral Resources Development and Production of the S. Comm. on Energy and Natural Resources*, 101st Cong. 35 (1990) ("The 1920 Mineral Leasing Act . . . was passed in 1920 after the United States had fought the great war in which oil powered ships and other vehicles had played a vital role."); CARL J. MAYER & GEORGE A. RILEY, PUBLIC DOMAIN, PRIVATE DOMINION: A HISTORY OF PUBLIC MINERAL POLICY IN AMERICA 169 (1985) (Oil lands policy after the war "met the needs of a powerful official constituency, the American military.").

210 1 BRADLEY, *supra* note 74, at 28.

211 HAWLEY, *supra* note 54, at 10.

212 VIETOR, *supra* note 98, at 33.

213 2 BRADLEY, *supra* note 74, at 1111.

214 HAWLEY, *supra* note 54, at 10 ("The newly organized trade associations remained as a prominent part of the postwar economy. Business leaders, especially those who had worked in Washington, had caught a new vision of what could be done by economic planning and business-government cooperation. A new breed of public administrators, skilled in the techniques of wartime control, were more prone to reject competitive values and stress the goal of a planned economy."). Of course, national security and military concerns continue to surface in energy policy debates today, and often touch on a wide range of related issues. *See* Jon Schutz, *An Analysis of the 2001 National Energy Policy: Is a Domestic Production-Based Oil Policy Appropriate for the United States?*, 12 PENN ST. ENVTL. L. REV. 307 (2004) (surveying U.S. dependence on foreign oil and energy security issues).

215 GIDDENS, *supra* note 37, at 172 (crude consumption up from 240,000,000 barrels in 1912 to 412,000,000 barrels in 1918).

216 BOHI & RUSSELL, *supra* note 63, at 20.

pressure.[217] Oil producers worried that too much competition in production kept prices low,[218] while conservationists worried that excessive consumption would deplete stocks.[219] Oil-producing states tried to regulate production to prevent technical inefficiencies from dissipating the resource through over-drilling, and made an effort to keep prices higher for mineral rights owners by restraining production.[220] These efforts had limited success,[221] although the development of legal doctrines such as pooling held out the promise of a solution to the problem of wastefully rapid production.[222]

Demand for gasoline continued to grow through the 1920s, rising from 2,747,000,000 gallons per year to 15,051,000,000 gallons per year between 1918 and 1929, primarily due to increased automobile use.[223] Refined product imports soared from 3,000 barrels per day in 1918 to 82,000 barrels per day in 1929.[224] Although the United States remained the chief oil producer, foreign discoveries began to create a world-wide crude industry and many of the major oil companies took steps to limit competition. For instance, the 1928 "As Is" agreement aimed to preserve existing international market shares; the "Red Line" agreement that same year limited competition over Middle Eastern production; and various patent pools restricted competition between the chemical and petroleum industries.[225] Nevertheless, without enforcement powers, these arrangements typically failed to prevent competition from resurfacing.[226]

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217 1 BRADLEY, *supra* note 74, at 88.

218 *Id.* at 88-89 (describing industry concern with overproduction of crude in mid-1920s).

219 HAWLEY, *supra* note 54, at 27.

220 *See* 1 BRADLEY, *supra* note 74, at 78-131 (comprehensive survey of state conservation legislation).

221 VIETOR, *supra* note 98, at 22 (explaining that waste in oil fields was a real problem in the 1910s-1920s; state boards had been unsuccessful in reigning in production).

222 *See* 1 BRADLEY, *supra* note 74, at 200-11 (describing mandatory pooling and unitization rules). Bradley makes a convincing case that there were private alternatives to mandatory pooling and unitization and that these were blocked in part by antitrust laws. *See id.* at 211-17.

223 GIDDENS, *supra* note 37, at 213.

224 1 BRADLEY, *supra* note 74, at 716 tbl.13.1.

225 VIETOR, *supra* note 98, at 23, 26-28.

226 *Id.* at 28 ("[D]espite the elaborate administrative procedures and interlocking joint-ventures designed to implement these agreements, their effectiveness was limited by the absence of sovereign authority. Only prorationing within the United States proved to be durable, comprehensive, and enforceable.").

These four cornerstones—monopoly, national security, rent-seeking, and restraining "excessive" competition—laid the foundation for energy policy throughout the twentieth century and into the twenty-first. Often contradictory, they yielded ever-shifting coalitions that brought each policy to the fore at different times and contributed to the general incoherence of energy regulatory policy by providing a wide range of policy targets in different directions. Nonetheless, on the eve of the Great Depression, despite the shifting attentions of the federal and state governments, the market for gasoline was well on its way to becoming a national market. Transportation costs[227] and crude prices were falling, while demand for gasoline continued to skyrocket. Refiners were competing on quality, driving gasoline toward commodity status,[228] and new technologies were boosting gasoline yields from crude.[229] The monopoly problem was held in check by vigorous competition and the ease of entry; America was a leading oil producer, temporarily vitiating the national security concerns; states were groping toward legal mechanisms like unitization to solve the technical problems of wasteful production, if not the economic problem of increasing supply; and regular new discoveries limited the ability of the incumbents to rent-seek by undermining collusion.

2. The New Deal

When the Great Depression suffocated the economy of the Roaring Twenties, oil prices fell dramatically.[230] They were hit particularly hard because of the supply boom caused by the discovery of substantial reserves in East Texas in 1930.[231] More than 5,000 new wells were drilled there between 1930 and 1932 and the East Texas field alone met one-third of U.S. demand.[232] Refinery capacity greatly exceeded the Depression-reduced demand, with the capacity-to-demand ratio at 1.48.[233] Despite the Depression, technological progress continued and began to have an important impact by the end of the 1930s, improving

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227 *See supra* notes 170-72 and accompanying text.

228 LEFFLER, *supra* note 40, at 77.

229 *See supra* note 112 and accompanying text.

230 YERGIN, *supra* note 27, at 254.

231 HAWLEY, *supra* note 54, at 212.

232 VIETOR, *supra* note 98, at 23.

233 BOHI & RUSSELL, *supra* note 63, at 296 tbl.8-8.

gasoline quality, as an "octane race" developed.[234] In oil and refined products, as elsewhere, Franklin Roosevelt's administration sought recovery through measures promoting higher, more stable prices, bringing the "excessive competition" policy to the forefront.

Existing state regulatory schemes offered one means of raising oil prices, but these schemes were too porous, allowing the so-called "hot oil" to leak out of regulated channels into commerce, undercutting prices.[235] "This bootleg oil was secretly siphoned off from pipelines, hidden in camouflaged tanks that were covered with weeds, moved about both in an intricate network of secret pipelines and by trucks, and then smuggled across state borders at night."[236] In 1932, oil prices plummeted further, falling from $1.05 per barrel to $0.25 per barrel, and Texas and Oklahoma declared martial law in the oil fields in an attempt to stop hot oil.[237] Even when the states were successful in raising prices and limiting domestic production, foreign oil imports threatened to undermine their efforts, sparking demands for tariffs to protect domestic producers.[238] The Roosevelt administration severely limited imports of both crude and refined products in September 1933.[239]

The federal government moved to assist the states in restricting hot oil[240] by including a provision in the National Industrial Recovery Act (NIRA) giving the president authority to ban hot oil,[241] and imposing a tariff on crude oil imports of twenty-one cents per barrel in 1932.[242] The Roosevelt administration took several additional steps, including promulgating an industry-designed Oil Code under the National Recovery Administration (NRA), which limited

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[234] GIDDENS, *supra* note 37, at 600; *see also id.* at 482 (Despite the Depression, Standard expanded to upgrade equipment to produce more high-grade gasoline.); 2 BRADLEY, *supra* note 74, at 1134 ("On the eve of hostilities, the U.S. refining industry was prospering with the automobile age. Markets were expanding, and technological advances abounded.").

[235] HAWLEY, *supra* note 54, at 213; YERGIN, *supra* note 27, at 255-56.

[236] YERGIN, *supra* note 27, at 255.

[237] VIETOR, *supra* note 98, at 23.

[238] GIDDENS, *supra* note 37, at 461 (mid-continent and Gulf Coast producers wanted a tariff of $1 per barrel in 1929).

[239] 1 BRADLEY, *supra* note 74, at 721.

[240] *Id.* at 99-103 (describing hot oil provisions of the NIRA).

[241] HAWLEY, *supra* note 54, at 213.

[242] VIETOR, *supra* note 98, at 92. In an attempt to head off the tariff, several producers agreed to voluntary cuts in imports of 25% and more. GIDDENS, *supra* note 37, at 462.

competition and created a production quota for each state.[243] The production quota, as amended in 1934, allocated crude among refineries,[244] further restricting competition. As with other industries' codes, the rules included policies that enabled the industry to take steps to limit competition and so promote higher prices.[245]

The Supreme Court struck down the NRA system and its hot oil provision in 1935,[246] but federal intervention had established a framework in the oil industry that survived the demise of the NRA itself. Congress quickly passed the Interstate Transportation of Petroleum Products Act (also known as the Connally Hot Oil Act),[247] banning transmission of hot oil in interstate commerce and lending federal assistance in stopping the leakage.[248] Together with "suggested" federal production limits, this created an informal system that effectively enforced the "suggested" quotas set out by the federal government and proved sufficient to coordinate production even without mandatory federal controls.[249] A congressional investigation later concluded that the various oil controls formed "a perfect pattern of monopolistic control over oil production, the distribution thereof among refiners and distributors, and ultimately the price paid by the public."[250] It also encouraged the oil industry to look to Washington for aid.[251] The addition of a tariff on foreign oil in 1932 limited the ability of the growing number of foreign oil producers to compete on price with domestic producers in the U.S. market,[252]

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243 YERGIN, *supra* note 27, at 255-56.

> Theoretically, [these quotas] were justified as conservation measures, but in reality the rate of withdrawal bore little relation to what a geologist might regard as the rate necessary to minimize waste. The state allowables, in fact, rarely deviated from the monthly estimates of the Federal Bureau of Mines, estimates that in effect merely stated how much crude oil would be needed to meet demand for gasoline at the existing price level.

HAWLEY, *supra* note 54, at 217-18.

244 GIDDENS, *supra* note 37, at 517.

245 2 BRADLEY, *supra* note 74, at 1120-27.

246 *See* Panama Refining Co. v. Ryan, 293 U.S. 388 (1935) (striking hot oil provision); Schechter Poultry Corp. v. United States, 295 U.S. 495 (1935) (striking NIRA); *see also* 1 BRADLEY, *supra* note 74, at 107-08 (describing impact of these cases).

247 Pub. L. No. 74-14, 49 Stat. 30 (codified at 15 U.S.C. § 715 (2000)).

248 YERGIN, *supra* note 27, at 255.

249 *Id.* at 257. *See also* HAWLEY, *supra* note 54, at 216-17 (describing debates over federal role).

250 *Quoted in* HAWLEY, *supra* note 54, at 219.

251 1 BRADLEY, *supra* note 74, at 96-98.

252 YERGIN, *supra* note 27, at 258.

while declining production from the East Texas oil field helped limit hot oil.[253] Although crude tariffs began to fall at the end of the 1930s, the relatively high refined-product tariffs stayed in place, protecting domestic refiners from foreign competition.[254] In effect, a little more than twenty-five years after the decree breaking up Standard Oil, the federal government created a more effective oil cartel than Standard Oil ever was.

Antitrust concerns reemerged in the late 1930s, with an FTC investigation finding evidence of "a wide variety of price-fixing, market-sharing, exclusive dealing, and production-restricting arrangements" in many industries, including refining.[255] The Madison Oil cases in 1937-1938 led to the convictions (later overturned) of sixteen corporations and thirty individuals accused of conspiring to fix prices through a buying arrangement in which major companies agreed to purchase the surplus gasoline of specified independent refiners to keep it off the market.[256] (The defendants argued they were merely continuing activities which the NRA had encouraged.[257]) Antitrust activity was sufficiently vigorous in the 1930s and early 1940s that when Attorney General Tom Clark reviewed the list of proposed names for industry representatives to the National Petroleum Council in 1946, he found that more than half of the executives on the list had been convicted personally, pled nolo contendere, or headed companies convicted or under indictment for antitrust violations.[258]

In the early 1940s, efforts to prepare for war refocused attention on national security issues.[259] A "Petroleum Industry War Council" was set up with seventy-eight oil company executives to coordinate working with the government, and there was "an unprecedented degree" of government control

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[253] GIDDENS, *supra* note 37, at 542.

[254] 1 BRADLEY, *supra* note 74, at 722-23.

[255] HAWLEY, *supra* note 54, at 166.

[256] United States v. Socony-Vacuum Oil Co., 310 U.S. 150 (1940). *See also* HAWLEY, *supra* note 54, at 374, 433 (new trials ordered in eighteen cases and all charges dismissed in eleven).

[257] HAWLEY, *supra* note 54, at 374.

[258] VIETOR, *supra* note 98, at 35-36.

[259] Antitrust concerns resurfaced in the "Mother Hubbard" case, which the Justice Department brought in 1940 against the American Petroleum Institute and twenty-two of its largest corporate members. *Id.* at 34. The case was suspended during the war, and resumed in 1946, and then dismissed in favor of several suits against smaller groups of defendants. *Id.* The clear message of this case was "that its every action was subject to question by the Attorney General of the United States." *Id.*

over the industry.[260] As they had in World War I, the demands of war production dramatically affected the petroleum industry.

> Normal methods of transporting crude and products were disrupted by the submarine attacks along our East Coast. Future military requirements for petroleum products were indefinite. For example, the initial goal for 100 octane [for aircraft] gasoline was set at 120,000 B/D late in 1941, a staggering figure considering that production at that time was somewhat less than 40,000 B/D. Three years later, the requirement for 100 octane gasoline was more than 600,000 B/D.[261]

Refineries broke records for production and new facilities were built to satisfy the demand for aviation fuel, lubricants, and toluene (used in bombs).[262] Standard of Indiana alone, for example, had a daily capacity for 1,150,800 gallons of 100 octane aviation gasoline in 1944, more than the entire industry had before the war.[263] Once again, technological progress in refining was rapid and regulators emphasized coordination of production over competition, encouraging coordinated efforts among refiners to meet the military's needs for fuel.[264]

The period from the Depression to the end of World War II saw gasoline markets buffeted by the constant cycling among government policy aims. Concern over ruinous competition swung to antitrust vigilance only to have national security issues trump both. These inconsistent energy policies had a threefold effect. First, just as they had in World War I, the demands of wartime production produced rapid technological innovation which, in turn, spurred better quality that helped commodify gasoline. Second, the growth in domestic and international crude supplies, which produced the "ruinous" competition that the NRA oil code sought to prevent, kept downward pressure on crude prices. This pressure on prices masked industry rent-seeking to some degree, since the rents could be funded by having refined product prices fall more slowly than crude prices. Third, the artificial limits on U.S.

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[260] GIDDENS, *supra* note 37, at 607; *see also* 1 BRADLEY, *supra* note 74, at 235-39, 243-48 (discussing World War II-era regulation).

[261] NPC, IMPACT, *supra* note 28, at 324; *see also* 2 BRADLEY, *supra* note 74, at 1136-39 (describing crash program to boost aviation fuel output).

[262] GIDDENS, *supra* note 37, at 609, 615.

[263] *Id.* at 619.

[264] 2 BRADLEY, *supra* note 74, at 1138-39 (discussing government coordination of refining "as though all [plants] were components of one huge refinery" and use of regulation and subsidies to accomplish that end).

crude production kept crude prices above world levels, creating conditions that produced the post-war Mandatory Oil Import Program to restrict the importation of cheaper foreign crude oil.

World War II led to improved refinery technology and, applying that technology to peace-time needs, the market for gasoline advanced significantly. After the war, much of the federal petroleum regulatory bureaucracy was "dismantled."[265] With gasoline quality improved, gasoline production ready to soar, and demand for gasoline poised to explode, had there been no further interventions, it seems likely that a truly national and competitive gasoline market would have emerged.

3. From World War II to Price Controls

The end of World War II unleashed tremendous demand for gasoline as the lifting of wartime rationing and the post-war boom put Americans on the road in record numbers.[266] Demand for other oil-based fuels also surged as the United States shifted from a coal-based to an oil-and-gas-based energy economy.[267] Despite shifting refineries from war production to automobile gasoline, this surge in demand meant there was little excess refinery capacity in the United States,[268] as can be seen from the fall of the ratio of operating refining capacity to domestic consumption from 1.48 in 1930 to 1.03 in 1950.[269] The creation of the General Agreement on Tariffs and Trade (GATT) in 1947 cut tariffs on both crude and refined products,[270] boosting imports and making the United States a net importer of oil for the first time.[271] Prices soared, more than doubling between 1945 and 1948.[272] Within a few years, however, the high prices induced so much entry by new producers[273] that refinery capacity increased beyond demand,

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265 1 *id.* at 248.

266 NPC, IMPACT, *supra* note 28, at 255-56; YERGIN, *supra* note 27, at 409.

267 VIETOR, *supra* note 98, at 3.

268 NPC, IMPACT, *supra* note 28, at 255-56; YERGIN, *supra* note 27, at 409.

269 BOHI & RUSSELL, *supra* note 63, at 296 tbl.8-8.

270 1 BRADLEY, *supra* note 74, at 724.

271 JAMES EVERETT KATZ, CONGRESS AND NATIONAL ENERGY POLICY 13 (1984); YERGIN, *supra* note 27, at 395.

272 YERGIN, *supra* note 27, at 409. Not surprisingly, this led to "more than twenty Congressional investigations" and accusations of an oil company conspiracy to force prices up. *Id.*

273 Over $2 billion in refining expansion and improvement went into production between 1946 and 1952. 2 BRADLEY, *supra* note 74, at 1151.

creating "an intensely competitive industry, with the individual refiners working diligently, as new equipment [was] installed, to find ways of increasing efficiency and reducing operating cost."[274] Gasoline markets continued to deepen, prices continued to fall, and product quality continued to improve as competition drove refiners to innovate.

Internationally, producing countries began to move into refining in an effort to boost their share of the revenue from their oil,[275] and the ever-growing stream of cheap foreign oil began to roil domestic oil politics.[276] "Before foreign oil became available, the state prorationing agencies had managed output in order to avoid such circumstances. But once cheap oil was available anywhere in the world economy, it was irresistibly drawn into the market vacuum that prorationing had created in the United States."[277] The major oil companies invested heavily in foreign sources, tanker fleets, shipping facilities, and coastal refineries, bringing cheaper crude to their U.S. refineries, and thus gaining a major cost advantage over independent refiners reliant on higher-cost U.S. sources of crude.[278] By January 1949, imports were growing at an annual rate of 25%.[279] By 1957, imports as a percentage of rising demand reached 17%, up from 11% just eight years earlier.[280] Independent domestic refiners, particularly those located away from easy access to foreign crude, were left with only the more expensive domestic crude supplies. These refiners worried, correctly, that they would lose market share to the refineries with access to the cheaper foreign crude as those refineries

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[274] NPC, IMPACT, *supra* note 28, at 255-56; *see also* YERGIN, *supra* note 27, at 409. Differential tariffs encouraged imports of heavy fuels, such as residual oil, and discouraged imports of lighter fuels, such as gasoline, biasing U.S. refinery production toward the lighter end. VIETOR, *supra* note 98, at 101 (The tariff on gasoline was fifty-one cents per barrel but only five cents for resid; as a result, resid imports rose 136% while imports of more valuable distillate declined 18% in 1953.); *id.* at 113 (Some importers began bringing in even more "unfinished oils," a category that was not covered and was stuff that needed more refining.).

[275] YERGIN, *supra* note 27, at 436 (noting Venezuela's move into refining to capture downstream revenues); *id.* at 518 (organization that became OPEC formed in 1959 and a key decision was to move into downstream industries like refining).

[276] VIETOR, *supra* note 98, at 91 (stating that imported oil available at half the price of U.S. oil "caused a major disruption" in energy markets).

[277] *Id.* at 115.

[278] BOHI & RUSSELL, *supra* note 63, at 110 ("Import patterns by firms were already changing at the time mandatory controls were instituted [in 1959]. A minority of refineries were importing crude oil; a shrinking majority were not.").

[279] VIETOR, *supra* note 98, at 95.

[280] *Id.* at 105 tbl.5-5.

exploited their cost advantage to extend their market penetration into the independent refiners' territories.[281] Thus, domestic oil producers feared free trade in oil, turning their attention to rent-seeking.[282] Domestic crude-oil price controls were reintroduced from 1950 to 1953.[283] At the same time, tax incentives for refinery projects, nominally motivated by national security concerns, produced a boom in refinery expansion and construction, especially among small refiners.[284]

Heavy reliance on foreign oil returned national security concerns to the U.S. energy debate.[285] The massive wartime collaboration between the refining industry and the government continued after the war on a slightly smaller scale.[286] The Suez Canal crisis in 1956, for example, strengthened those favoring a more interventionist policy toward oil by highlighting the vulnerability of foreign supplies.[287] The 1950s and 1960s also saw "huge investments" in refining drive down gas prices through "hard competition."[288] In part, this reflected the rise in domestic crude production that the quotas had produced, a 29% increase between 1959 and 1969.[289]

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[281] *Id.* at 125 (Arguing for protection, "the inland refiners asserted that if imports were limited to the real importers, their cost advantage would allow them to penetrate the markets of inland refiners and drive them out of business. The right to trade quotas to real importers in exchange for domestic oil was a paper transaction . . . .").

[282] *Id.* at 3 (Conflict in the 1945 to 1958 period shifted from stimulating supply to protecting market share as market went to super surplus conditions.).

[283] 1 BRADLEY, *supra* note 74, at 250-52.

[284] 2 *id.* at 1156-58.

[285] BOHI & RUSSELL, *supra* note 63, at 139 ("Import controls, and their administration, were ostensibly designed to enhance the national security, however defined. In general, this goal required maintenance of a larger domestic petroleum industry than would otherwise exist, and one secure from attack.").

[286] The Secretary of the Interior convened the National Petroleum Council. NPC, IMPACT, *supra* note 28, at 324; VIETOR, *supra* note 98, at 38 (stating that the function of the National Petroleum Council was for industry and government to talk and for industry to discuss policy among itself). And, after the Korean War broke out, the federal government formed the Petroleum Administration for Defense. NPC, IMPACT, *supra* note 28, at 324; VIETOR, *supra* note 98, at 41 (During the Korean War, the government sought to replicate World War II organization of the oil industry with the Petroleum Administration for Defense that reported to the Secretary of Interior.). *See also* 1 BRADLEY, *supra* note 74, at 253-57 (describing Korean War-era planning agencies).

[287] BOHI & RUSSELL, *supra* note 63, at 41; YERGIN, *supra* note 27, at 536 ("The Suez crisis of 1956 highlighted concerns about national security. The price fall that followed the crisis further increased the clamor among independents for protection in the form of tariffs or quotas.").

[288] YERGIN, *supra* note 27, at 548.

[289] *Id.* at 539.

The federal government first attempted to encourage domestic production on national security grounds through voluntary programs, including a voluntary quota system begun in 1957.[290] The voluntary quotas failed for several reasons.[291] Some companies did not cooperate because they had disproportionately large foreign oil holdings and some refused because they feared antitrust prosecutions.[292] New importers fought controls, even voluntary ones, because their imports would be frozen at low levels since they had just begun to import, some going so far as to build coastal refineries "in an effort to establish themselves as legitimate importers before the regulatory die was cast."[293] The price differentials between foreign and domestic crude, caused by state-level prorationing rules limiting domestic production, continually attracted new competitors into the oil import business, undermining the voluntary quota system.[294]

Economic conditions also weakened the voluntary system. "The recession of 1958 did in the voluntary program. While oil demand dropped substantially, imports increased further, and the political pressure for mandatory controls was becoming irresistible."[295] In particular, powerful Texas and Oklahoma politicians like Senate Majority Leader Lyndon Johnson, House Speaker Sam Rayburn, and Oklahoma Senator

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[290] When the voluntary plan was announced, with a goal of cutting imports from 1,266,700 barrels per day (the 1957 level) to 1,031,000 barrels per day, fourteen of twenty-two importers agreed, one refused on the advice of antitrust counsel, five sought adjusted quotas informally, and two invoked the plan's formal process to receive a higher quota. BOHI & RUSSELL, *supra* note 63, at 45-47.

[291] 1 BRADLEY, *supra* note 74, at 732-33 (discussing reasons for failure).

[292] YERGIN, *supra* note 27, at 537; VIETOR, *supra* note 98, at 112 (citing Sun Oil as one example of a company that refused to participate in the voluntary quota system because of antitrust implications).

[293] VIETOR, *supra* note 98, at 109. Moreover, politically it would have been impossible to give the major oil companies a cartel controlling imports. *Id.*

[294] BOHI & RUSSELL, *supra* note 63, at 24-25. The "new importer" problem was serious.

> The growth in imports by these firms, partly due to niches created in the market by limitations on the more visible major firms, made them impossible to ignore even while they were difficult to police on a voluntary basis. Newcomers for the most part were not constrained by the unofficial sanctions that could be imposed on large, multinational, established firms. They were less affected by public or industry opinion. Moreover, some were not involved in domestic production and thus did not even have the incentive to restrain imports that would follow from sharing production losses within the United States if collective restraint on imports failed.

Id. at 35.

[295] YERGIN, *supra* note 27, at 537.

Robert Kerr pushed hard to restrict imports to benefit U.S. oil producers.[296] Although the Eisenhower administration was ideologically opposed to government intervention in the market, it yielded to the political realities of oil politics and implemented controls—giving the United States "centralized decision making and free market rhetoric."[297]

The mandatory quotas which began in 1959 became "the single most important energy policy in the postwar era," one which quickly "accumulated policy goals outside of promoting energy security."[298] The quota system, known as the Mandatory Oil Import Program (MOIP), was in effect from March 1959 to April 1973. It effectively constrained refiners only until late 1972.[299] MOIP produced "a decade of stasis in policy," locking in a regulatory approach which ignored the decade's major changes in energy supply and demand.[300] MOIP brought rent-seeking to new heights.

> A roll call of the special interest groups in energy policy would find most of them the recipient of at least some favored treatment: small refiners, inland refiners, Northern Tier refiners, major oil companies, oil producers, petrochemical companies, northeastern utilities and other identifiable and isolatable consuming interests,

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[296] *Id.* at 538. Oil-state senators, who supported MOIP, also delivered other benefits to big companies and support for MOIP was the price for those benefits, such as overseas tax credits and depletion allowance overseas. VIETOR, *supra* note 98, at 134. Louisiana Senator Russell Long made this point clear to the oil companies, saying:

> I believe your industry would make a great mistake not to realize that; as far as the government is concerned, as far as the fair treatment you are entitled to expect from your government is concerned, the people who will be your advocates are people who are very much interested in domestic oil. . . . It is very much to your advantage to have a very healthy domestic industry and do everything within your power to cooperate to that end.

Id.

[297] BOHI & RUSSELL, *supra* note 63, at 15. "Quotas are inherently discriminatory. The criteria by which government allocates import licenses are not based on impersonal market forces (unless the licenses are auctioned); licenses are allocated subjectively in a way that is usually influenced by political considerations and the fact that allocation necessarily benefits some and harms others." *Id.* at 263-64.

[298] VIETOR, *supra* note 98, at 115; *see also id.* at 84 ("Schemes surfaced to use the program to the special benefit of some segments of the refining industry and some domestic producers and marketers; to promote economic development of certain areas and enhanced air quality; and to aid various special consumer groups.").

[299] WILLIAM C. LANE, JR., THE MANDATORY PETROLEUM PRICE AND ALLOCATION REGULATIONS: A HISTORY AND ANALYSIS 4 (1981).

[300] VIETOR, *supra* note 98, at 115; NPC, FACTORS AFFECTING, *supra* note 61, at 37 (describing MOIP as the "principal element of government policy affecting the petroleum refining industry").

> deep water terminal operators, Island interests, West Coast consumers, and so forth.[301]

The costs of the import quota regime were largely borne by "the undifferentiated portion of the consuming public."[302] MOIP also produced one of the most ironic unintended consequences of any federal program—the program spurred Venezuela to convene the first meeting of the organization that eventually became the Organization of Petroleum Exporting Countries (OPEC).[303]

Under the mandatory system, the federal government granted refiners permits to import crude oil, holding the total amount imported below the amount that would have been imported in a free market.[304] Established importers got 80% of their historic imports, with the amount to be gradually reduced until it was proportionate to the amounts new importers received, eventually putting all importers on the same level, at least theoretically.[305]

As a result, domestic crude prices were higher than they would have been in the absence of the quota system and the right to import the cheaper foreign crude became valuable.[306] The "historical" allocations also attempted to address the equitable concern that "[r]efinery location, capital decisions, marketing arrangements and production and supply patterns," all of which had been disrupted by the voluntary controls, "would be more dramatically altered by mandatory controls."[307] In particular, MOIP shifted refinery construction from larger to smaller,[308] rewarding each new refinery with a quota. Ultimately, the mandates hindered the refining industry response to changes in market conditions: "The quota

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[301] BOHI & RUSSELL, *supra* note 63, at 16. The distribution of gains from the award of quotas created "tensions" in the administration of the program. *Id.* at 45. "Those receiving the gains complained when newcomers were permitted to enter the field because the gains would be spread over more firms or because the total gains would be reduced. Those on the outside were anxious to receive a share of the windfall and pressed for participation." *Id.*

[302] *Id.* at 17; *see also* VIETOR, *supra* note 98, at 141 (stating that import controls were estimated to cost consumers about $3.3 billion in 1968, while Arabian crude sold at $1.25 per barrel, and domestic oil at $3 per barrel).

[303] 1 BRADLEY, *supra* note 74, at 764.

[304] LANE, *supra* note 299, at 4.

[305] VIETOR, *supra* note 98, at 122.

[306] LANE, *supra* note 299, at 4; VIETOR, *supra* note 98, at 120 (stating that quotas had "a tangible dollar value").

[307] BOHI & RUSSELL, *supra* note 63, at 110.

[308] 2 BRADLEY, *supra* note 74, at 1172.

discouraged the expansion of domestic refinery capacity, altered refinery location within the United States, altered the mix of the final products, encouraged investment in cracking capacity, and discouraged investment in capacity to handle high-sulfur feedstocks."[309]

A full account of MOIP lies beyond the scope of this article,[310] but the program introduced distinctive features in gasoline markets that require some discussion.[311] An important effect was that the administrative allocation of valuable import rights inevitably led to interest groups exerting tremendous political pressures in hopes of sharing in the allocations.[312] Of course, as these groups organized politically,[313] politics intertwined with a variety of technical questions, the resolution of which would reward some interests and punish others no matter how they were answered.[314] For example, petrochemical companies sought their own import quotas for feedstocks, arguing that their plants faced unfair competition from petrochemical plants aligned with quota-possessing refineries.[315] This raised definitional questions about what

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[309] BOHI & RUSSELL, *supra* note 63, at 294-95. *See also* 2 BRADLEY, *supra* note 74, at 1163 (MOIP affected "virtually all major aspects of refinery operation—entry, plant siting, plant size, merger and acquisition policy, product mix, and, of course, profitability.").

[310] MOIP is described in detail in BOHI & RUSSELL, *supra* note 63, at 66-82. *See also* 1 BRADLEY, *supra* note 74, at 738-50; 2 *id.* at 1160-81.

[311] 2 BRADLEY, *supra* note 74, at 1172 (noting that between 1954 and 1958, ten refiners with a capacity over 10,000 barrels per day were built, while in the next twelve years only nine such refineries were built).

[312] YERGIN, *supra* note 27, at 538-39 (Under MOIP, "there were continuing fights over allocations, struggles over interpretations, searches for loopholes, and the ever-more-intense hunt for exceptions and exemptions."); BOHI & RUSSELL, *supra* note 63, at 139 ("Other interests understandably coveted the wealth thus transferred and sought to divert the import control program to achieve still other ends and different distributive effects. Once the subsidy-wealth-transfer character of quotas was recognized, it became increasingly difficult for the authorities to deny other 'worthy' causes entry into the program."); VIETOR, *supra* note 98, at 135 ("Nearly every sector of the industry supported the Program in principle, but it was every firm for itself in carving-up the pie.").

[313] BOHI & RUSSELL, *supra* note 63, at 115 (The small refiners, for example, formed the American Petroleum Refiners Association in 1962 to protect their interests in the quota program.); VIETOR, *supra* note 98, at 131 (Specialized trade organizations formed to fight over resid imports.). *See infra* notes 338-43 (discussing residual fuel oil imports).

[314] *See* Andrew P. Morriss & Susan E. Dudley, *Defining What to Regulate: Silica and the Problem of Regulatory Categorization*, 58 ADMIN. L. REV. 269, 286-87 (2006) (discussing role of interest groups in regulation).

[315] BOHI & RUSSELL, *supra* note 63, at 167 ("When the petrochemical companies were included in the quota structure in 1966, they simply joined the group of other refiners who had enjoyed the subsidy benefits of import quotas from the beginning of the program. The great stake of the petrochemical companies in the long

constituted a petrochemical plant compared to a refinery, since the two were technologically indistinguishable. The question had no easy answer.[316] Granting the quotas rewarded independent petrochemical producers; denying them advanced integrated refinery-petrochemical operations.

The result was special interest lobbying on a grand scale. "However intricately wrought and carefully articulated the rationales for each action, the impression was inescapable that the mandatory quota program was being treated as a source of unappropriated funds available for a variety of putative public purposes."[317] Ultimately, the interest-group maneuvering led to a program so complex that "[f]ew other regulatory schemes in America's history can match the Mandatory Oil Import Program for labyrinthine complexity, or for the distortion of markets and interest-group dissension that it caused."[318] By 1968, MOIP had metamorphasized far beyond its initial goals, with "special allocations for asphalt refiners, electric utilities, heating oil importers, petrochemical companies, and finally, for crude oil quotas into foreign trade zones from which refined products would presumably be exported."[319]

Not surprisingly, MOIP roiled refining in the United States. The system favored smaller refiners, giving them a disproportionate share of import rights.[320] Yet these refiners

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run was the extent to which they would lose their market share to petrochemical production by oil and gas companies."). *See also* 1 BRADLEY, *supra* note 74, at 745.

[316] BOHI & RUSSELL, *supra* note 63, at 164 ("Other administrative problems arose out of the technical difficulty of defining a petrochemical plant as distinct from a refinery, and of defining feedstocks for inclusion within the program [for allocations of quotas for petrochemical plants].").

[317] *Id.* at 178-79.

[318] VIETOR, *supra* note 98, at 119; *see also* YERGIN, *supra* note 27, at 538-39.

[319] VIETOR, *supra* note 98, at 139.

[320] LANE, *supra* note 299, at 4-5. The quota system incorporated a "sliding scale" that favored smaller refiners.

> The basis for the different incremental levels of quotas was the amount of refinery runs by firm, not by plant. It was advantageous, then, for refinery ownership to be fragmented. This policy had predictable effects. First, it reduced the value of a small refinery as a merger prospect for an established refining firm. Second, it provided incentives for the formation of "concubine" relationships with large firms which could acquire informal control, but not integrated ownership, of small firms without losing the preferential quota of the small firm. The history of the program contains charges of concubinage but the extent of its existence is unknown. Finally, the sliding scale encouraged small refineries, or preserved their existence, by the additional revenues obtained through the sale of import tickets.

were often the least technologically sophisticated. The small-refiner bias also failed to reward those oil companies that had invested heavily in foreign supplies, tanker fleets, and coastal refineries in anticipation of a growing reliance on imports. Moreover, MOIP's small-refiner bias discouraged consolidation of refinery ownership, preventing larger companies from buying out these smaller refiners, which could have increased efficiency. Refiners were allowed to trade their import quotas, which many inland and independent refiners did, using them to gain access to domestic crude owned by rivals.[321] In many respects, therefore, the program was simply a transfer of wealth from the large, integrated oil companies to the smaller, inland refiners.[322]

Under MOIP, some inland refiners received a particular bonus.[323] Because every refiner received a quota, even refineries with no ability to actually import oil were given quotas.[324] (Had this not been done, coastal refineries likely would have displaced inland refineries, as their cost advantage

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BOHI & RUSSELL, *supra* note 63, at 115-16. The eleven real importers "objected strenuously" to this program. VIETOR, *supra* note 98, at 125. "They had to participate in it since their own quotas were insufficient to supply their coastal refineries," and Atlantic Refining calculated that the profits from quota exchanges were $135 million by 1964. *Id.* This continued under its successor program in the 1970s. *See* EPA, PROFILE, *supra* note 68, at 11 (noting that the Crude Oil Entitlements Program "had encouraged smaller refineries to add capacity throughout the 1970s").

321 BOHI & RUSSELL, *supra* note 63, at 74-75 (summarizing the trading rules); *see also* 1 BRADLEY, *supra* note 74, at 738-39 (describing trading). As Bohi and Russell note, "[t]he exchange process was merely a veil covering the transfer to inland refiners of some of the benefits of importing cheap foreign oil. No productive function was changed in maintaining the facade that something was actually happening." BOHI & RUSSELL, *supra* note 63, at 77.

322 VIETOR, *supra* note 98, at 114 (Quotas would clearly be subsidy to inland refiners, who could not refine the oil they were allowed to import.).

> [R]efineries located inland traded their import tickets to those companies with refineries located on the coast in return for access to domestic sources of crude owned or controlled by the coastal refiners. Companies with coastal refineries tended to be the larger, integrated companies. Thus, one result of the [quota system], and the trading system that evolved under it, was that smaller, inland refiners tended to depend on exchange arrangements with major oil companies for access to crude.

LANE, *supra* note 299, at 5. *See also* VIETOR, *supra* note 98, at 133 ("Independent refiners grew dependent on the Program from which they drew 'tickets,' knowing that without them they could not long compete with larger, integrated refiners running cheap foreign crude.").

323 VIETOR, *supra* note 98, at 125 (The quota exchanges among inland refiners and coastal refiners were "the fundamental redistributive choice of the whole mandatory program. [They were] primarily a response to political pressure from domestic refiners, justified by a perverse obeisance to free enterprise.").

324 BOHI & RUSSELL, *supra* note 63, at 71.

from using imports would have enabled them to expand at the expense of inland refineries.[325]) The "Northern Tier" refiners using Canadian oil also got a special bonus.[326] These refineries received quota allocations in the initial distribution, when Canadian oil was labeled foreign, and then an exemption from the quota system for Canadian oil as a result of Canadian complaints.[327]

Yet these refineries did not lose the quotas they had received to allow them to import the Canadian oil, giving them what became known as the "double dip."[328] Although the double dip was "an obvious fluke," it was not remedied because of the political power these refineries mustered in its defense.[329] Although the Northern Tier refineries' historical quotas were reduced faster than those of other refiners—to partially compensate for the double dip—this did not entirely eliminate the special treatment.[330]

The quota system also discouraged construction of new refinery capacity in the United States.[331] While the total amount allowed to be imported increased as refinery capacity increased, there was "no direct mechanism" to provide the "access to foreign crude oil supplies necessary to the operation of new refinery capacity in the United States."[332] In addition, oil companies began lobbying for and receiving exemptions for refineries in various U.S. territories outside the continental United States to serve the U.S. market.[333] Not surprisingly, the

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[325] *Id.* at 72.

[326] The special access to Canadian oil alone boosted growth in this region. *See id.* at 297 tbl.8-9 (refinery capacity growth in Montana, Minnesota, North Dakota, and Wisconsin—a total of 19.6 (thousand barrels per day) in 1930, 66.5 in 1950, 157.4 in 1955, 214.1 in 1960, 287.7 in 1965, and 345.4 in 1970).

[327] Two months after MOIP began, however, it was modified to allow land imports without quotas in order to assist Canadian oil exporters. VIETOR, *supra* note 98, at 129. It also helped Venezuelan exports to eastern Canada, since the western Canadian oil that MOIP would have kept out of the U.S. market would have otherwise displaced Venezuelan exports to eastern Canada. 1 BRADLEY, *supra* note 74, at 739-40.

[328] BOHI & RUSSELL, *supra* note 63, at 129.

[329] VIETOR, *supra* note 98, at 129. For example, in May 1960, the Department of the Interior considered a rule change to eliminate the loophole, but North Dakota politicians intervened and Interior abandoned the revision. *Id.* One oil company that competed with the double-dip refiners waged a five-year war against the provision, but was unable to stop Minnesota Senator Hubert Humphrey from preserving it. *Id.* at 130.

[330] *Id.*

[331] 2 BRADLEY, *supra* note 74, at 1171-72.

[332] NPC, FACTORS AFFECTING, *supra* note 61, at 7.

[333] BOHI & RUSSELL, *supra* note 63, at 51. In particular, refineries were built in the United States Virgin Islands and Puerto Rico as a direct result of the quota

ratio of domestic refining capacity to domestic petroleum consumption, which was 0.98 in 1960, fell during MOIP to 0.81 in 1970.[334]

A further impact involved the diversion of crude imports to uncontrolled products. Controls on crude were useless without controls on refined products, inasmuch as uncontrolled finished imports would simply substitute for U.S. refining of foreign crude unless their importation was also controlled. The original program design thus forbade imports of refined products outside the quota system.[335] This proved impossible to sustain, however.[336] Refiners with existing plants outside the United States that were refining for the U.S. market lobbied for allowances for imports of those plants' products. They argued that restricting such imports "could virtually eliminate the market served by those refineries, with predictable serious consequences for the firms."[337] Moreover, some refined products were exempt, encouraging their production outside the United States.[338] For instance, residual fuel imports (or "resid"), a heavy fraction of crude oil, soon entered outside the quota system. This exemption "altered the product mix capability of domestic refineries and created a special dependence on imports of heavy fuels."[339] Predictably, U.S. production of resid fell after 1960 from 332,200,000 barrels of production with

program exemption for oil imported to those jurisdictions on economic development grounds. *Id.* at 297 ("Imports of products from Puerto Rico and the Virgin Islands received special treatment under the quota system. Consequently, refineries were encouraged to locate in these islands for reasons other than those the free market would dictate."); 1 BRADLEY, *supra* note 74, at 743-46 (describing increase in refined-product exports from Puerto Rico); VIETOR, *supra* note 98, at 136-37 (describing Puerto Rico exemption); YERGIN, *supra* note 27, at 539 ("[T]he building of substantial refining capacity in the American Virgin Islands and Puerto Rico because of special exemptions to the quotas that were granted to refineries there on economic development grounds.").

[334] BOHI & RUSSELL, *supra* note 63, at 296 tbl.8-8.

[335] 1 BRADLEY, *supra* note 74, at 737.

[336] Unrestricted fuel oil imports were allowed into the East Coast (PADD I region), and "clean-product imports" were allowed due to program incentives. NPC, ADEQUACY, *supra* note 59, at 20.

[337] BOHI & RUSSELL, *supra* note 63, at 110.

[338] NPC, FACTORS AFFECTING, *supra* note 61, at 7. The factors enumerated as providing incentives for offshore location included: "to accommodate revisions in U.S. import quota restrictions;" "logistical considerations," such as better harbors for tankers elsewhere; "[t]o minimize the risks associated with acquiring crude oil supplies," because foreign refineries often have greater access to foreign crude supplies; "[t]o avoid environmental delays" because regulations are "less severe" in some foreign locations; and "[t]o minimize overall costs" due to higher tax rates in the United States. *Id.* at 33.

[339] BOHI & RUSSELL, *supra* note 63, at 298 & tbl.8-10.

233,200,000 barrels of imports, a ratio of 1.42, to production of 257,500,000 barrels with 557,800,000 barrels of imports, a ratio of 0.46, in 1970.[340] Overall, the quota program "encouraged, through relatively cheap imports, northeastern utilities and other consumers to favor heavy fuel oil and encouraged domestic refineries to alter their output mix toward the lighter products,"[341] particularly boosting Caribbean refineries' production of resid.[342] Further reinforcing the quota-driven nature of resid use, resid consumption declined after these programs ended, with natural gas and distillates taking its place.[343]

Combined, these effects piled distortion upon distortion as interest groups competed for special favors in the political marketplace. Consider just one example of the dynamics of MOIP: When Canadian oil was exempted under the overland exemption, not only did it create the "double dip," but it provoked complaints from Mexico that its oil was disadvantaged. To mollify Mexico, and with the assistance of the State Department,[344] one of the most vivid of the MOIP distortions began: the "Brownsville U-Turn" or "Mexican Merry-Go-Round." Despite the lack of an overland connection between Mexican oil fields and U.S. markets, a "crevice" in the import regulations was used to bring Mexican oil into the United States as "overland" oil exempt from import quotas.[345]

> Mexican crude was moved by tanker from its producing regions to the U.S. port of Brownsville, Texas, on the Mexican border, unloaded in [customs] bond and then shipped into Mexico in trucks, which made a U-turn, and promptly reentered the United States. On reentry, the crude was taken out of bond, duty was paid on it, and it officially entered the United States under the overland exemption. Because a market for only a fraction of the Mexican oil existed in Brownsville, most of it was reloaded upon tankers and shipped to East Coast U.S. ports as "domestic" oil.[346]

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340 *Id.*

341 *Id.* at 299.

342 *Id.* at 159 ("The increase in resid imports provided a wider market for foreign crude and made possible the further development of Caribbean refinery capacity. The unbalanced demand for resid led domestic refineries to be built with additional processing to minimize resid output, so that lighter products were more expensive to produce.").

343 FTC, MERGERS, *supra* note 5, at 65.

344 BOHI & RUSSELL, *supra* note 63, at 133.

345 *Id.* at 132.

346 *Id.*; *see also* YERGIN, *supra* note 27, at 539.

Such strategies boosted Mexican exports to the United States from 7,000 barrels per day to over 40,000 barrels per day.[347] Venezuela also was given a special deal on resid imports because it too was upset by the Canadians receiving the overland exemption.[348] As noted earlier, this transformed the U.S. refinery output away from resid.[349]

Making gasoline a political issue also undermined the security of investments in refining capacity. For example, when oil companies raised the price of gasoline in February 1967, an unnamed administration official was quoted as saying that the government would flood the country with imported gasoline if the prices were not rolled back. Some were.[350] Such threats undoubtedly discouraged investment.[351] This is clear from the decline of U.S. capacity relative to U.S. demand.

> In the years [leading] up to 1960, refinery capacity exceeded domestic product consumption, with the excess available to process crude oil for export. After 1960, the deficit in refinery capacity steadily widened. From 1960 to 1970, refinery capacity increased a total of 25.2 percent while domestic product consumption grew by 52 percent, or more than twice as fast. Thus, the United States became increasingly dependent on product imports. When U.S. crude production declined after 1970, and high-sulfur foreign crude could not be used, the dependence on product imports was exacerbated.[352]

Overall, the MOIP-induced "decade of stasis in policy"[353] meant that "[b]usiness and government were preoccupied with the tactical issues of administering [policy]: import quotas and 'prorationing' for crude oil."[354] MOIP seriously distorted refiners' supply of crude. "Without controls, cheaper foreign oil would have forced down domestic oil prices and driven marginal producers out of business."[355] MOIP's microeconomic impacts included preventing the international majors with access to foreign oil from gaining as much market share as they would have without MOIP and allowing "several dozen,

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[347] 1 BRADLEY, *supra* note 74, at 741.

[348] Venezuelan oil, which had a low specific gravity, produced a disproportionate amount of resid per barrel and could not compete with Middle Eastern oil on the open market. VIETOR, *supra* note 98, at 130; *see also* 1 BRADLEY, *supra* note 74, at 741.

[349] *See supra* notes 340-42.

[350] BOHI & RUSSELL, *supra* note 63, at 140.

[351] *Id.* at 296-97.

[352] *Id.* at 296.

[353] VIETOR, *supra* note 98, at 115.

[354] *Id.* at 3.

[355] *Id.* at 115.

relatively inefficient independent refiners to stay in business."[356] Moreover, MOIP encouraged the migration of refinery capacity to foreign locations.[357]

Because of declining U.S. crude production and growing U.S. energy demand, the increase in quota exemptions after 1970 helped devalue the quotas and ultimately made the system "meaningless" in terms of constraining imports.[358] The increasing number of exempted imports eroded support among oil producers while the costs of the program became higher and more obvious as time passed.[359] MOIP was formally abandoned in April 1973.[360] When the quota system changed in 1973,[361] and the major companies no longer found trading for import quotas necessary, it disadvantaged MOIP's beneficiaries. For example, both the double dip and the Canadian exemption encouraged refinery location along the northern border of the United States. When the quota program ended, "these refineries could not compete with other domestic refineries better located to receive U.S. crude oil or imported feedstocks. Then, with the reduction and prospective elimination of Canadian crude oil exports, these refineries, and the markets they served, faced especially severe problems."[362] The small refiners sought a new crude oil allocation system to ensure their continued access to oil,[363] discussed in the next subsection.

The gasoline market was thus under two sets of countervailing pressures between the Korean War and the Arab oil embargo. The first set, from market pressures, pushed the industry toward technological innovations, standardized products, and efforts to expand market share. The second set, driven by the economic regulations imposed by the federal

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356 *Id.* at 145.

357 BOHI & RUSSELL, *supra* note 63, at 295 ("[S]ome of these [foreign refineries] were given access to U.S. markets. Consequently, domestic refinery capacity began to lag behind final product demand. To meet demand, importers increasingly sought to switch away from crude oil and toward finished products, and this switch was approved by import control authorities who foresaw domestic shortages if it was not allowed. The result was that the mandatory quota program discouraged investment in domestic refining and encouraged investment in foreign refining.").

358 LANE, *supra* note 299, at 6.

359 BOHI & RUSSELL, *supra* note 63, at 2.

360 Proclamation No. 4210 (Apr. 18, 1973), 38 Fed. Reg. 9,645 (Apr. 19, 1973).

361 The quota system was eroded by the combination of declining U.S. production, which necessitated increasing imports, and the proliferation of exemptions and exceptions to the quotas for various interest groups that expanded the amount of crude imported. *See* LANE, *supra* note 299, at 6.

362 BOHI & RUSSELL, *supra* note 63, at 297.

363 LANE, *supra* note 299, at 5-6.

government, allocated resources to smaller, generally less efficient refineries and limited foreign competition to domestic producers. The result was to partially offset the market's incentives for larger scale refineries and to create incentives for importing exempt refined products rather than crude oil. Indeed, even before the embargo in 1973, "the United States was experiencing an unprecedented shortage of refined petroleum products" partly because of a lack of domestic refining capacity.[364] Over time, however, the gains from subverting the crude oil import allocation scheme gradually eroded the effectiveness of the program, making the petroleum market in early 1973 freer than it had been since at least 1959. However, the combination of price controls imposed by the Nixon administration in an effort to control inflation and the Arab oil embargo in 1973 created conditions under which opponents of liberalizing energy markets were able to regroup.

4. Price Controls and the Arab Oil Embargo to Decontrol

By the 1970s, the cumulative impact of the various exemptions and special provisions had eroded MOIP and oil imports had risen sharply.[365] Although the Nixon administration initially considered scrapping the quota system entirely and replacing it with a tariff,[366] the oil industry's negative political reaction torpedoed those plans.[367] However,

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[364] KATZ, *supra* note 271, at 13.

[365] YERGIN, *supra* note 27, at 589 ("The Mandatory Oil Import Program . . . was laboring under mounting strain, creating controversies and gross disparities among companies and regions. Its loopholes and exceptions were very lucrative to those who had figured out how to capitalize on them, and all too visible.").

[366] VIETOR, *supra* note 98, at 142. Nixon appointed a task force, headed by Phillip Areeda, to examine the quota system. It got 10,000 pages of comments from more than 200 firms, associations, etc., and position papers from two dozen scholars, etc. *Id.* "In effect, the Task Force staff of economic liberals seized control of the review process and neither the Interior Department nor the White House could recapture it." *Id.* The program had also been intensely criticized during the 1969 Senate hearings. *Id.* at 141.

[367] YERGIN, *supra* note 27, at 589. Oil consumers wanted looser controls to cut prices; domestic oil interests wanted to keep prices up; and majors who had fought the system when it was implemented

> had by now generally reconciled and adjusted themselves to the system, and were content with it. Prices were protected for their domestic production, and the companies had devised distribution systems outside the United States to dispose of their foreign oil. Many of them, therefore, were alarmed at the prospect of change and argued against it.

Id.

after 1970, "rising world prices and general relaxation of controls progressively eliminated the protective effect of the quota."[368] Instead, the administration's anti-inflation policy,[369] based on a series of price control "phases," overtook the quota system as the primary economic regulation of the petroleum industry.[370]

Oil was at the heart of the Nixon price controls, with crude and refined product price increases in 1970 prompting the administration to investigate oil companies, Nixon himself to denounce them, and relaxation of the MOIP quota restrictions.[371] Phase I of the Nixon price controls, which ran from August 1971 until November 1971, was intended to break expectations of price increases[372] and freeze the nominal price of gasoline and other refinery products and domestically produced crude.[373] Of course, such rules had no impact on world markets and so the uncontrolled international price of gasoline and crude oil diverged sharply from the controlled domestic prices, severely disadvantaging firms selling gasoline domestically made from imported oil. The cost advantage imported oil had held was now reversed.

Phase II of the price controls lasted from November 1971 until January 1973, and limited wholesale price increases to no more than 3% annually.[374] Multiproduct firms, including refineries, were given some flexibility through "Term Limit Pricing" (TLP) agreements, which allowed them to meet the Phase II rules by keeping the average of prices across products

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368 BOHI & RUSSELL, *supra* note 63, at 268.

369 LANE, *supra* note 299, at xviii (attempts to control inflation preceded the Arab oil embargo and included price controls on oil and oil products).

370 VIETOR, *supra* note 98, at 120 (Nixon "acceded to market pressures by gradually liberalizing its controls until 1973, by which time they were irrelevant anyway."); BOHI & RUSSELL, *supra* note 63, at 208 (noting that inflation had become a concern in the mid-1960s).

371 1 BRADLEY, *supra* note 74, at 466.

372 BOHI & RUSSELL, *supra* note 63, at 210. *See* 1 BRADLEY, *supra* note 74, at 467-68 (describing Phase I).

373 LANE, *supra* note 299, at 8. In particular, imported crude-oil price increases could not be passed on to consumers of gasoline because cost increases in imports could be passed through only if the imported product was kept in its initial form and inventoried and accounted for separately from any domestic materials. *Id.* Since the foreign crude oil was refined (a change in form) and impossible to keep segregated from domestic source oil in most refineries (the inventory and accounting rules), the cost increases in foreign oil could not be passed on to consumers. *Id.*; *see also* BOHI & RUSSELL, *supra* note 63, at 213.

374 LANE, *supra* note 299, at 9; *see also* BOHI & RUSSELL, *supra* note 63, at 215 (describing Phase II); 1 BRADLEY, *supra* note 74, at 469-71 (same).

within the guidelines rather than each individual price.[375] Unfortunately for refiners, the TLP agreements could not include gasoline, home heating oil, and residual oil, so refiners wishing to recoup the increased costs of imported oil had to do so through price increases for their other refined products.[376] For example, diesel fuel, although chemically equivalent to home heating oil, was allowed in TLP agreements, resulting in plentiful diesel supplies and shortages of home heating oil.[377] The Nixon administration refused to allow gasoline and home heating oil price increases out of fear of a political backlash.[378] The TLP rules further distorted relative prices, discouraging gasoline production. Thus, even before the Arab oil embargo in 1973, price controls were having a major impact on gasoline markets by keeping prices artificially low and discouraging gasoline production. Moreover, the differences in price for crude from different sources created political pressure for a government program to allocate access to cheap crude.[379] "Conditions had been created [by Nixon programs] wherein there was no market incentive to raise domestic production, no incentive to reduce consumption, and no incentive to increase imports."[380] Shortages began to appear in late 1972 and early 1973.[381] Although this led Nixon to suspend the quota program in April 1973,[382] the formal elimination of quotas had little effect because events and the Nixon administration's approach "had rendered the quota program ineffective before it was replaced"[383] and the elimination of quotas did not connect the distortions introduced by the price controls.

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[375] LANE, *supra* note 299, at 9.

[376] BOHI & RUSSELL, *supra* note 63, at 215; LANE, *supra* note 299, at 11.

[377] BOHI & RUSSELL, *supra* note 63, at 216. *See* 1 BRADLEY, *supra* note 74, at 469 (describing TLP provisions).

[378] LANE, *supra* note 299, at 11-12. Oil companies that sought price increases were "almost invariably . . . turned down and encouraged to take [their] price increase among [products governed by TLP agreements]. Several oil companies were told that a price increase for a 'visible' product would require public hearings and lead to protracted delays." *Id.* at 11 (quoting W.A. Johnson, *The Impact of Price Controls on the Oil Industry, How to Worsen an Energy Crisis*, *in* ENERGY: THE POLICY ISSUES 99 (G. Eppen ed., 1975)).

[379] BOHI & RUSSELL, *supra* note 63, at 223 ("The government was moving toward a system a mandatory allocations of petroleum products even before the oil embargo.").

[380] *Id.* at 218.

[381] 1 BRADLEY, *supra* note 74, at 668.

[382] BOHI & RUSSELL, *supra* note 63, at 218.

[383] *Id.* at 219.

When war broke out between Israel and her Arab neighbors in October 1973, approximately 17% of U.S. oil supplies derived from Arab sources.[384] The Organization of Arab Petroleum Exporting Countries (OAPEC) halted exports to the United States and several other countries in retaliation for their support of Israel, causing severe supply disruptions.[385] Although a bill creating an import allocation system was already moving toward passage in Congress before the embargo,[386] the supply disruptions caused by the embargo "gave impetus to the movement for an allocation system and added a new rationale for such a system: the distribution of crude oil and refined products during a period of supply disruption."[387]

Responding to the pressures for a new allocation program, Congress adopted the Emergency Petroleum Allocation Act (EPAA) in 1973[388] and the initial set of rules implementing it went into effect in January 1974.[389] "The legislation was originally drafted to deal with the problems smaller refiners, independent marketers and others had been experiencing in obtaining supplies prior to the embargo [and] . . . many of its provisions still reflected its more limited initial purpose."[390] It was available, however, and so Congress quickly adopted this square peg to fill the round hole that world events presented. Nixon seized on allocation as a

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384 RICHARD B. MANCKE, PERFORMANCE OF THE FEDERAL ENERGY OFFICE 1 (1975) [hereinafter MANCKE, PERFORMANCE]. The embargo "reduced Arab oil supplies from 20.8 million barrels per day in October to 15.8 million barrels per day by December." LANE, *supra* note 299, at 30. Additional production from other countries eased the shortage in the early months of 1974. *Id.* at 31.

385 MANCKE, PERFORMANCE, *supra* note 384, at 1. The embargo consisted of rolling production restraints that cut supply more each month and a total ban on export of oil to the United States, the Netherlands, Portugal, South Africa, and Rhodesia. YERGIN, *supra* note 27, at 613. Actual reductions in supply were smaller than they would have been without substitution of non-Arab supplies to the nations cut off. There were 20.8 million barrels per day sold in early October. *Id.* at 614. At the lowest point during the embargo, non-OAPEC sales were 15.8 million barrels per day, for a gross loss of 5 million barrels per day. *Id.* But because other producers increased production, the net loss was only 4.4 million barrels per day, or about 9% of total world production in the "free world" before the embargo. *Id.* The impact was worse than this suggests, however, because demand was growing at 7.5% per year. Moreover, during the cutbacks, information on substitution was not yet completely available and so the loss seemed larger. *Id.* The embargo was almost a complete surprise to U.S. policymakers, who, as a result, were unprepared for it. *Id.* at 608-09.

386 1 BRADLEY, *supra* note 74, at 487.

387 LANE, *supra* note 299, at xix; 1 BRADLEY, *supra* note 74, at 487 (embargo "hastened" allocation controls).

388 Pub. L. No. 93-159 (Nov. 27, 1973).

389 39 Fed. Reg. 1924 (Jan. 15, 1974).

390 LANE, *supra* note 299, at 38-39.

response to the politics of the situation, perhaps in part to undercut his potential Democratic rival in the 1972 presidential elections, Washington Senator Henry Jackson, who had promoted allocation during 1973.[391]

To coordinate the response to the embargo, the government established the Federal Energy Office (FEO), which after a "glamorous, hyperactive six-month existence" became the Federal Energy Administration (FEA).[392] "[T]he newly created Federal Energy Office began introducing an almost unimaginably complicated and wide-ranging set of regulations for allocating both crude oil and refined products. All assessments of the period agree that, viewed *in toto*, these allocation regulations aggravated consumer suffering stemming from the embargo."[393] Unfortunately, the FEO/FEA actions generally distorted the markets for oil products even more, rather than mitigating the problems. For example, the FEO pressured refiners to produce more home heating oil at the expense of gasoline production because it feared a shortage of the former.[394] But the FEO had overestimated demand for heating oil[395] and underestimated demand for gasoline and so its pressure exacerbated gasoline shortages and produced a surplus of heating oil (supplies of heating oil in February 1973 were 38% higher than they had been in February 1972).[396]

The FEO adopted an allocation system for crude, which was "meant to distribute supplies evenly around the country."[397] Instead, "it assured, perversely, that gasoline could not be shifted from an area already well-supplied to one where it was needed."[398] Federal allocations of gasoline to regions were not matched to demand because they were based on regional usage from before the shortages and did not take into account changes in regional population and driving patterns due to higher prices and jawboning efforts by the government.

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391 1 BRADLEY, *supra* note 74, at 671-73.

392 MANCKE, PERFORMANCE, *supra* note 384, at 2.

393 Richard B. Mancke, *The American Response: "On The Job Training"?*, *in* OIL DIPLOMACY: THE ATLANTIC NATIONS IN THE OIL CRISIS OF 1978-79, at 27, 33 (1980) [hereinafter Mancke, *American Response*].

394 LANE, *supra* note 299, at 43; MANCKE, PERFORMANCE, *supra* note 384, at 8.

395 LANE, *supra* note 299, at 46 (noting that price increases in heating oil, however, reduced demand more than regulators anticipated and the result was a glut of heating oil and a shortage of gasoline).

396 MANCKE, PERFORMANCE, *supra* note 384, at 9.

397 YERGIN, *supra* note 27, at 617.

398 *Id.*; *see also* MANCKE, PERFORMANCE, *supra* note 384, at 11.

Erroneous allocations ranged from 63% of projected needs in New Hampshire and Virginia to 122% in Wyoming.[399] In short, the federal response to the embargo eliminated the market's ability to adjust, substituting an administrative allocation system that worsened the crude supply disruptions.

Nevertheless, the federal government failed to learn from the embargo experience that markets were a superior means of adjusting to supply shocks. Instead, each new problem provoked additional, quixotic regulations designed to "fix" the problems caused by the prior set. As a result of the difficult political dynamic that produced them,[400] the quotas and controls introduced in response to the Arab oil embargo grew ever more complicated.[401]

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[399] LANE, *supra* note 299, at 48-49; MANCKE, PERFORMANCE, *supra* note 384, at 11.

[400] Yergin gives a clear explanation of the problem, which is worth quoting at some length:

> The massive reallocation posed a very considerable logistical problem. Even under calm and relatively predictable circumstances, managing an integrated oil system was a highly complex matter. Supplies of varying qualities from various sources had to be linked into the transportation system and then moved to refineries that had been designed to handle those specific oils. Free will was not an option when it came to assigning crude oils. The "wrong" crudes could do considerable damage to the innards of a refinery, as well as reducing efficiency and profitability. And once the crude supplies were run through the refinery and turned into a number of products, they then had to be moved into a distribution system and linked with a "market demand" that wanted that particular balance of products—this amount of gasoline, that amount of jet fuel and heating oil.
>
> And to make matters even more difficult, the companies still had to figure out what their oil supplies actually cost, so that they did not sell at a loss or invite attack for excessive profit margins. The costs for oil royalties, extent of government participation, buyback prices, volumes—all these were changing week by week, and were further complicated by leapfrogs and retroactive increases by the various exporting governments. "It was impossible to know whether a calculation made on the basis of all the known facts on one day would not be overturned by a rewriting of those facts a month later," said an executive from Shell.

YERGIN, *supra* note 27, at 622. In addition to the confusion created by the ever-shifting regulations on energy pricing and imports, the Nixon White House repeatedly reorganized its energy policy team during 1972-1973. KATZ, *supra* note 271, at 17-19 (describing various reorganizations and terming them "in chaos" by May 1973). The piecemeal approach to energy issues in general meant that energy matters were scattered among sixty government agencies, "each operating with little or no communication with the others." *Id.* at 31. Congressional efforts to produce a unified national policy failed to produce legislation. One analyst concluded that Congress "was whipsawed by regional concerns, conflicting special interests, and contradictory advice from various experts." *Id.* at 34.

[401] See U.S. FED. ENERGY ADMIN., A COMPLIANCE GUIDE FOR DOMESTIC CRUDE OIL PRICING FOR PRODUCERS AND FIRST PURCHASERS (1977) [hereinafter FEA,

Phase III of the Nixon price controls began in January 1973 and allowed companies to self-administer price controls.[402] However, after gasoline prices rose 7.4% by March (increases that were within the Phase III guidelines), greater controls were re-imposed on oil products.[403]

Price controls also increased the demands for a non-market allocation system. For example, after April 1973, Phase III of the price controls included "Special Rule No. 1"[404] that barred the twenty-three largest oil companies from raising prices above their January 11, 1973 level.[405] Among other things, Special Rule No. 1 created a disincentive for the large companies under it to import crude oil.[406] This, in turn, disadvantaged the smaller, inland refiners who had grown dependent on trading import permits under MOIP for access to the oil fields controlled by the major oil companies closer to their refineries.[407] They were "forced into direct competition with the majors for domestic sources of crude."[408] Some of these inland refiners then "joined the rising chorus of those demanding a government allocation system."[409]

Even the bureaucracy became overwhelmed by the complexity of the price controls, and Phase III failed to tame inflation adequately.[410] Phase III was followed by "Phase III½," a sixty-day price freeze intended "to provide an opportunity for Federal price regulators to rethink and redesign the Phase III price controls" that lasted from June 12, 1973 to September 7, 1973.[411] The freeze meant that oil companies were charging

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COMPLIANCE GUIDE], for an excellent introduction to the complexity of petroleum-pricing rules.

402 BOHI & RUSSELL, *supra* note 63, at 217; *see also* 1 BRADLEY, *supra* note 74, at 471-74 (describing Phase III).

403 BOHI & RUSSELL, *supra* note 63, at 217.

404 38 Fed. Reg. 6283-84 (Mar. 8, 1973).

405 LANE, *supra* note 299, at 14-15; *see also* 1 BRADLEY, *supra* note 74, at 472-74 (describing Special Rule No. 1).

406 LANE, *supra* note 299, at 14-16 (giving full account of Special Rule No. 1's impact). In short, since Special Rule No. 1 did not apply to smaller firms, which were "for all intents and purposes, free of controls" because the Phase III rules were not adequately enforced, these firms were able to buy at controlled prices and sell at uncontrolled prices. *Id.* at 15. Because smaller firms were able to sell product at whatever price the market would bear, they could outbid large firms for supplies.

407 *Id.* at 17; BOHI & RUSSELL, *supra* note 63, at 219.

408 BOHI & RUSSELL, *supra* note 63, at 219.

409 LANE, *supra* note 299, at 17.

410 BOHI & RUSSELL, *supra* note 63, at 220.

411 LANE, *supra* note 299, at 18; *see also* 1 BRADLEY, *supra* note 74, at 474 (describing Phase III½).

different customers different prices for the same goods. "Inequities and inefficiencies were created, harming some sectors and helping others, but confusing all."[412] It also meant that imported oil costs could not be passed on to consumers.[413] In September 1973, dissatisfaction with the Phase III½ freeze drew 1,000 heating oil distributors and 2,000 gasoline dealers to Washington for protest demonstrations.[414]

Phase IV followed, introducing a regulatory distinction between new and existing sources of domestic crude and allowing higher prices for the former in an effort to boost supply.[415] By the spring of 1974, multiple groups clamored for federal allocation of oil and refined product supplies: "independent refiners wanted access to domestic crude; nonbranded independent gasoline marketers wanted allocation of gasoline; New England fuel oil marketers and consumers sought an allocation program for heating oil; and farmers wanted a propane allocation program."[416] While the oil price controls were supposed to end in 1974 along with the other "temporary" price controls, the Arab oil embargo's price pressure led to an extension into the Mandatory Petroleum Price Regulations which continued the "temporary" controls after the end of price controls generally.[417]

With the Energy Policy and Conservation Act (EPCA) of 1975,[418] Congress revised the EPAA scheme in an incoherent

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> The freeze increased demands for an allocation program. As the freeze period came to an end, gasoline dealers recognized that they would soon be able to sell the gasoline in their tanks at substantially higher prices. Many simply shut their stations or severely restricted sales. Gas station closings and the resulting shortages at the end of October seemed to underline the need for a system of mandatory allocation for petroleum products.

LANE, *supra* note 299, at 33-34.

412 BOHI & RUSSELL, *supra* note 63, at 221.

413 *Id.* at 220.

414 *Id.* at 223.

415 *Id.* at 221; *see also* 1 BRADLEY, *supra* note 74, at 474-78 (describing Phase IV).

416 LANE, *supra* note 299, at 25; VIETOR, *supra* note 98, at 248 (Independent Refiners Association of America and its customers, forty-seven associations of 70,000 gas station operators, all favored extension of controls in the 1970s.).

417 LANE, *supra* note 299, at 19; VIETOR, *supra* note 98, at 238 ("The price freeze eventually gave way to a series of price controls that finally expired in 1974—except for the oil industry."); *see also* Emergency Petroleum Allocation Act of 1973, Pub. L. No. 93-159, 87 Stat. 627 (1973).

418 Energy Policy and Conservation Act, Pub. L. No. 94-163, 89 Stat. 871 (1975). EPCA was set to expire on October 1, 1981, ending all oil price controls at that time, U.S. CONG. BUDGET OFF., THE DECONTROL OF DOMESTIC OIL PRICES: AN OVERVIEW 5 (1979) [hereinafter CBO, OVERVIEW], because the Ford administration

omnibus energy bill that "included provisions both to reduce and to raise the price of oil."[419] EPCA essentially incorporated the Phase IV program, including classifications for pricing purposes,[420] which were intended to prevent "windfall" profits to domestic oil producers.[421] But EPCA modified the Phase IV two-tier system, turning it into a three-tier system: old oil (from domestic wells that began producing before 1973); new oil (from wells that began producing during or after 1973); and uncontrolled oil (oil from the Alaskan North Slope, the Naval Petroleum Reserve, and "stripper"[422] oil).[423] Old oil's price was set relatively low; new oil's price was higher; and uncontrolled oil sold at the market price.[424] Not surprisingly, the profits available from reclassifying oil into the market-price categories from the controlled price categories produced a number of

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traded an immediate price rollback on crude oil prices for authority to end the program after forty months and to end the controls on refined products sooner if Congress did not object and for larger price increases during the forty months. KATZ, *supra* note 271, at 58-59 (describing compromise); LANE, *supra* note 299, at 54; *see also* LANE, *supra* note 299, at 105-06 (explaining compromise).

419 KATZ, *supra* note 271, at 57.

420 LANE, *supra* note 299, at 104; *see also* 1 BRADLEY, *supra* note 74, at 494-97 (describing law's implementation); BOHI & RUSSELL, *supra* note 63, at 228 ("principle feature" of EPCA in December of 1975 "was the retention of at least standby price and allocation controls on the industry for five years and the broadening of the crude oil controls to include new oil, released oil, and stripper-well oil"). "Lower tier" (or "old") oil was the amount of oil produced from a property during the corresponding month of 1972. LANE, *supra* note 299, at 104. It could be sold at "the highest posted price for that grade of crude at that property on May 15, 1973, plus $1.35," giving a range from $3.50 to $7.00 per barrel. *Id.* at 104-05. "Upper tier" oil was "new, released and stripper—all produced domestically—plus imported crude." *Id.* at 105. "New" oil was the excess over the 1972 base production level or oil from a new property. *Id.* Released oil was the result of an incentive that allowed a barrel of old oil to become new for each barrel of new oil produced from a property. *Id.* Stripper crude came from wells producing ten barrels or less per day. *Id.* Upper-tier crude could be sold at market price. *Id.*

421 LANE, *supra* note 299, at 113.

422 "Stripper" oil came from wells producing ten or fewer barrels per day of petroleum and petroleum condensates, including natural gas liquids, during the preceding calendar year. SUBCOMM. ON OVERSIGHT AND INVESTIGATIONS OF THE COMM. ON INTERSTATE AND FOREIGN COM., U.S. HOUSE OF REPRESENTATIVES, 96TH CONG., THE CASE OF THE BILLION DOLLAR STRIPPER: THE EVASION OF PRICE CONTROLS ON DOMESTIC CRUDE OIL BY RESELLERS 2 (1980) [hereinafter BILLION DOLLAR STRIPPER].

423 CBO, OVERVIEW, *supra* note 418, at 5-6. The various definitions had many subtleties and complexities, described in some detail in *id.* at 5-8. *See also* MANCKE, PERFORMANCE, *supra* note 384, at 18 (concise, clear explanation of pricing structure); FEA, COMPLIANCE GUIDE, *supra* note 401, at 7-34 (describing how to classify oil).

424 For example, in 1979 the old, new, and uncontrolled prices were $5.86, $13.06, and $18.50 per barrel, respectively. CBO, OVERVIEW, *supra* note 418, at 6-7. The first two prices are wellhead prices; the latter is at the refinery gate and so includes transportation costs.

successful schemes to do so.[425] In addition, the price differentials created an incentive to maximize production of upper-tier oil from a reservoir rather than to maximize total production.[426] Refiners' cost structure depended on the mix of crude types that they refined. High-cost crude dependent refiners were able to pass along their costs only if the market allowed, while lower-cost refiners could sell all they produced.[427] Accordingly, capacity utilization rates among refiners varied widely.[428] Analysts concluded that EPCA created problems "infinitely worse" than the quota system it replaced.[429]

EPCA also "implemented far-reaching controls affecting energy supply and consumption patterns which reinforced and prolonged the distortions of the system."[430] The program proved so complex to administer that there were hundreds of formal amendments and "interpretative modifications" made to the regulations between 1974 and 1978. "[N]early all of these changes were in response to pleas for relief from particular industry groups, or political pressures from the Congress."[431]

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425 BILLION DOLLAR STRIPPER, *supra* note 422, at 2 (noting that when the price of stripper oil grew rapidly in January 1979, "a significant and growing discrepancy began to appear in data reported to the DOE. Refinery receipts of stripper oil, which had closely tracked production for several years, suddenly began to exceed production. On a sustained basis this is, of course, a physical impossibility.") One method of doing so was to resell the oil through a number of entities, obscuring its origins. *Id.* at 5. Eventually, enforcement actions were brought against a number of firms for millions of dollars of false certifications. *See Cost to Consumers*, *supra* note 26, at 42-43.

426 LANE, *supra* note 299, at 111 ("In some instances, techniques to maximize production from a unitized reservoir might be foregone in favor of techniques that maximized production which could be sold at upper-tier crude prices.").

427 BOHI & RUSSELL, *supra* note 63, at 222-23.

428 *Id.* at 225.

429 VIETOR, *supra* note 98, at 252.

430 KATZ, *supra* note 271, at 31. The extent to which the pricing system required far-reaching controls can be seen from considering just one set of consequences. Refiners differed in the proportion of old and less-controlled crude they processed. To prevent those processing a higher proportion of old and cheaper crude from earning higher profits,

> the FEO had to enforce differential ceilings on the prices refiners could charge for their products. The method was to allow each refiner a specified markup over its full unit production costs. Even within well-defined geographical markets, the price controls on old crude led to intercompany differences of as much as 12¢ per gallon in retail gasoline prices.

MANCKE, PERFORMANCE, *supra* note 384, at 19. Once the embargo-related shortages passed, to prevent those with lower costs from underselling their competitors, the government required these refineries to sell some of their cheaper oil to their competitors at controlled prices. *Id.* at 20.

431 LANE, *supra* note 299, at 57. *See also DOE's Enforcement of Alleged Pricing Violations by the Nation's Major Oil Companies: Hearing Before a Subcomm. of*

These frequent changes produced considerable uncertainty about the rules.

> By late 1975 it was still no exaggeration to state that in large segments of the industry there was uncertainty as to actual current costs and legal prices, about possible retrospective gains or liabilities when regulations were sorted out and finally applied, and about whether or not operations were or were not in compliance with regulations as they eventually would be interpreted.[432]

The allocation program attempted to equalize the cost of crude and equalize oil supplies so that all refineries operated at the same percentage of their operating capacity.[433] Refineries with supplies over the national average were required to sell, at their weighted average cost, the excess to those with supplies under the national average.[434] This created a number of perverse incentives. For example, any refiner who found additional supplies on the world market at prices above its average cost would be forced to sell the extra oil to its competitors at a discount.[435] (This "extra" oil's marginal cost would have to have been above the average cost of the rest of

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the Comm. on Government Operations, 97th Cong. 4 (1981) ("The regulations implementing [the petroleum price and allocation] controls were quite complex, addressing as they did a very complex industry. The sheer magnitude of this industry is such that even a seemingly trivial type of violation of these complex regulations can result in apparent violations in the hundreds of millions of dollars." (statement of James B. Edwards, Sec'y, Dep't of Energy)); YERGIN, *supra* note 27, at 660 (describing complexity and cost of regulations in 1970s).

[432] BOHI & RUSSELL, *supra* note 63, at 229. This was a problem throughout the program. Transfer pricing rules led to risk for oil importers, for if they bought at high spot-market prices, they risked prosecution for violating rules if they could have bought comparable oil under contract at lower prices, and so "many oil companies continued to refrain from participating in the spot market." Mancke, *American Response*, *supra* note 393, at 34.

[433] BOHI & RUSSELL, *supra* note 63, at 226.

[434] LANE, *supra* note 299, at 40; VIETOR, *supra* note 98, at 246; *see also* MANCKE, PERFORMANCE, *supra* note 384, at 15-16 (providing a clear, concise discussion of the inter-refinery allocation problem). A particularly vivid example is the case of Sohio, operating in Ohio. Sohio had a huge price advantage over its competitors from its Alaskan crude supplies (which received preferential treatment under DOE regulations). Forced by DOE regulations to pass this price advantage on to its customers, Sohio undersold its competition and increased its market share in Ohio. The independents sought a regulatory correction with an ad hoc lobby group, the "Ohio Independents for Survival." Their lobbying precipitated a general rules change that favored the independents. LANE, *supra* note 299, at 171-72. Other lobbying groups also formed to attempt to secure changes in DOE rules to their advantage. *Id.* These efforts "diverted substantial amounts of managerial and entrepreneurial time and attention away from marketplace problems and toward political problems . . . [and] created constituencies for the continued existence of particular aspects of the controls, and in many cases for the controls themselves." *Id.* at 172.

[435] LANE, *supra* note 299, at 41.

the refinery's oil because the average cost included the price-controlled domestic oil.) Price ceilings set under EPCA proved difficult to calculate precisely, given their relationship to the market price for foreign crude and its market share in the United States, necessitating multiple adjustments.[436] The net effect penalized refiners who had taken steps to resolve the shortages for the benefit of those that had done nothing.[437] In economic terms, the 1970s allocation program was a step backward from MOIP, which had at least allowed the price of quotas to be set in the marketplace, whereas the FEA set the prices under the new program.[438]

The regulations also created incentives to operate inefficient refineries simply to get the entitlements to crude oil that owning a refinery produced: "the result was the bringing out of mothballs any piece of 'refining junk' that could be found—leading to the return of hopelessly inefficient 'tea kettle' refineries of the kind that had not been seen since the flood of oil in the East Texas field in the early 1930s."[439] Further modification of the program gave the small refiners additional entitlements based on a sliding scale in an attempt to reduce the cost advantage the larger, more efficient refiners had.[440] As a result, smaller, less efficient refiners profited at the expense of larger, more efficient refiners, and additional new, inefficient firms entered the refinery industry.[441]

The price control regulations did not allow passthroughs of capital costs even to the same extent that they allowed passthroughs of higher crude-acquisition costs, discouraging refiners from investing in the technology needed to process

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[436] *Id.* at 107.

[437] *Id.* at 41.

[438] BOHI & RUSSELL, *supra* note 63, at 227.

[439] YERGIN, *supra* note 27, at 660; *see also* FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 51 (During the 1970s, "government controls on crude oil prices and allocation favored small refineries, which provided incentives for companies to open and operate small, inefficient refineries, including many that produced little or no gasoline.").

[440] LANE, *supra* note 299, at 134. Under the "sliding scale," refiners got 11.1% of the first 10,000 barrels per day of capacity and then smaller percentages of capacity above that. For example, if a refinery had capacity above 300,000 barrels per day, it received only 3.7% of the capacity above that amount. VIETOR, *supra* note 98, at 125. Over time, the sliding scale became even steeper, rising to 22% for the first 10,000 barrels per day by the end of the program. *Id.* at 126.

[441] Between 1974 and 1980, sixty-five of the sixty-seven new refineries built had a total capacity below 45,000 barrels per day and sixty of these had a total capacity below 30,000 barrels per day. LANE, *supra* note 299, at 134-35.

high-sulfur crudes.[442] Moreover, smaller refineries were less likely to have the ability to process high-sulfur fuel or to maximize production of lead-free gasoline. This reinforced the negative impact of the quota system and discouraged investment in processing high-sulfur crude.[443] "Accordingly, most new refinery capacity brought on stream after the adoption of the small refiner subsidies was in the form of small refineries designed to operate on low-sulfur crude oil and to produce a relatively undesirable slate of products."[444] These refiners earned their owners economic rents from the allotments, but contributed little to broadening and deepening the gasoline market. To some extent, such refiners actually hindered the development of the market, for their existence denied the more efficient producers crude they could have used to expand into new regional markets and subsidized the creation of protected pockets within the national market.

Because the new refinery could receive its own allocation of the cheaper oil, building a new refinery became preferable to expanding an existing one.[445] The gains were substantial. Economic analysts calculated that the annual value of the cheaper oil allocations reached $17 billion in

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[442] BOHI & RUSSELL, *supra* note 63, at 295; LANE, *supra* note 299, at 138. In Senate testimony, a DOE official elaborated on how regulations had discouraged investment in refining:

> First, the most serious aspect of the problem is that seven years of price controls and general regulatory uncertainty have inhibited investment in the refinery expansions and improvements needed to make unleaded gasoline, or to make gasoline-range material out of heavy and high sulfur domestic crude oils. . . . Second, price controls have discouraged refinery improvements that increase efficiency, since they require that the full amount of such cost savings be passed on in the form of lower product prices. Third, the regulations do not reflect the fact that during the period of controls cost increases relative to the production of gasoline have been much greater than for other products. . . . Finally, the regulations take a snapshot of each refiner's prices as of May 15, 1973, and allow it to add certain costs to that price, no matter how that company's relative pricing or competitive circumstances have changed in the meantime.

Id. at 139-40 (quoting John F. O'Leary, Deputy Sec'y, Dep't of Energy, Statement Before the Senate Committee on Energy and Natural Resources (Dec. 11, 1978)).

[443] BOHI & RUSSELL, *supra* note 63, at 295.

[444] LANE, *supra* note 299, at 135-36.

[445] PETERSON & MAHNOVSKI, *supra* note 76, at 36 ("Despite falling demand, between 1975 and 1981 the construction of small, simple refineries was further stimulated by federal crude oil supply controls, which gave unusual supply advantages to small refineries.").

1979.[446] As economists Kenneth Arrow and Joseph Kalt dryly noted in a 1979 analysis,

> The prospect of a transfer of $17 billion per year induces political competition for its acquisition among producers, refiners, and consumers. The entitlements program is an outcome of this process of competition and is the mechanism by which eventual ownership of the windfall gains that arise under crude oil price controls is resolved.[447]

Predictably, "the *Federal Register* became more important than the geologist's report."[448] It also meant that there were now vested interests in controls where there had not been before, and so weakened opposition to the EPAA within the oil industry.[449]

Once crude shortages no longer existed, the allocation program was used to address the disparities in access to crude. When crude was limited, "disparities in crude costs . . . had not been a problem because supplies had been tight and product could be sold at whatever price a firm could charge under the regulations." Once supplies were more abundant, however, "those with higher than average crude costs feared that they would be forced out of the marketplace."[450] The "entitlements" program granted refiners "the right to refine one barrel of price controlled crude oil during a given month," allocated in such a way as to give each refinery a proportionate share of the price-controlled gasoline but with a bias toward small refiners, who received more entitlements than their proportionate share would justify.[451] This provided a tremendous cost advantage for small refiners, as much as ten cents per gallon of gasoline.[452]

The Arab oil embargo spurred a 65% rise in real gasoline prices from 1972 to 1976 (21% when adjusted for the general rate of inflation).[453] These prices pulled non-Arab oil

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446 KENNETH J. ARROW & JOSEPH P. KALT, PETROLEUM PRICE REGULATION: SHOULD WE DECONTROL? 11 (1979).

447 *Id.*; *see also* LANE, *supra* note 299, at 28 ("It was government forces in effect during the previous two years that had not permitted market forces to operate in the petroleum industry. Thus, the allocation program was a direct consequence of the price control program.").

448 VIETOR, *supra* note 98, at 238.

449 BOHI & RUSSELL, *supra* note 63, at 227.

450 LANE, *supra* note 299, at 128.

451 *Id.* at 129-31. The allocation formulas were complex and are described in detail in *id*. at 128-30.

452 *Id.* at 133.

453 BERNARD A. GELB, THE CONF. BOARD, INFO. BULL. NO. 38, U.S. ENERGY PRICE AND CONSUMPTION CHANGES IN THE MID-1970'S, at 4 (1978).

and refined products into the United States from outside sources.[454] Price controls on domestically produced crude oil—designed to prevent "windfall profits" to oil producers—instead resulted in windfalls for refiners because the demand for the cheaper, domestic oil greatly exceeded the price-controlled price. For example, refiners could include the price of gasoline they purchased for resale in the calculations of their average price, which determined the price at which they could sell all their gasoline. Thus, refiners selling gasoline at a controlled price below the market price had an incentive to purchase gasoline at any price, including prices above market price, to bring their average up to the market price.[455] In general, the regulations lowered the price of crude to domestic refiners, increasing their market share at the expense of foreign refiners, but also increasing the average operating costs of domestic refiners.[456] They boosted the market share of nonbranded gasoline from 10.4% in 1973 to 18.4% in 1979.[457]

When President Carter took office, his administration's initial policy goal was aimed at finding a way to decontrol domestic oil prices "so that consumers could react to correct price signals."[458] However, Carter's attempts to reform energy policy quickly mired in special interest politics.[459]

The Carter administration attempted "'voluntary' wage and price guidelines, . . . backed by moral suasion, publicity, and the denial of Federal contracts to firms that violated them. At least initially, this was taken to include denial of the right to bid on Federal oil leases,"[460] which induced compliance by the major oil companies. These "voluntary" guidelines were in effect between October 1978 and December 1980.[461] Like the mandatory regulations, these guidelines proved "quite complex

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[454] MANCKE, PERFORMANCE, *supra* note 384, at 7.

[455] LANE, *supra* note 299, at 143.

[456] *Id.* at 147.

[457] *Id.* at 158.

[458] YERGIN, *supra* note 27, at 663. *See also* 1 BRADLEY, *supra* note 74, at 503-10 (describing Carter's "phased decontrol" strategy).

[459] YERGIN, *supra* note 27, at 663 (When the Carter administration tried to reform energy policy, it got "a firsthand education in how special interests operate in the American system, including liberals, conservatives, oil producers, consumer groups, automobile companies, pro- and anti-nuclear activists, coal producers, utility companies and environmentalists—all with conflicting agendas.").

[460] LANE, *supra* note 299, at 57.

[461] FRANK CAMM, CHARLES E. PHELPS & P.J.E. STAN, RESOURCE ALLOCATION UNDER THE COWPS PRICE GUIDELINE: THE CASE OF FIXED PROPORTIONS, at v (1981).

in practice."[462] There is at least some evidence that these controls caused refinery-level shortages.[463] Because price controls did not account for the interrelationships of products produced by refineries, they caused shortages in non-controlled products.[464]

The Carter administration was also hampered by the Iranian hostage crisis, which doubled spot-market prices by February 1979.[465] The loss of lighter Iranian crudes forced refineries to use heavier crudes, reducing gasoline yields.[466] The allocation program had "fallen into disuse" because a market surplus had rendered it moot, but these new shortages brought it back into play. By 1979, small refiners were again making extensive use of the program.[467]

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[462] *Id.* at 3.

[463] *Id.* at viii ("Some casual empirical evidence supports the belief that the COWPS controls were in fact the determinate cause of refinery-level shortages in 1978-1980.").

[464] *Id.* at vi. The economic analysis is relatively complex, and described in detail in the above cited report. Briefly, the analysis can be summarized as follows:

> If and only if the productive technology of the firm embodies certain types of fixed proportions (as appears to be the case for refiners), then complying with [Council on Wage and Price Stability (COWPS)] guidelines *can* lead to a shortage of refined product from any given refiner. If the COWPS constraint becomes so binding that the profit-maximizing refiner cannot charge market-clearing prices for its products at *any* level of output, then it will select the output that leads to the highest COWPS-allowed profits and will charge less than market prices. This, of necessity, leads to rationing of the product by the refiner among its customers and is a prima facie condition of shortage. Importantly, this theory shows how rationing of products can occur for products that were totally uncontrolled by the DOE, such as diesel fuel, heating oil, jet fuel, and other products. And indeed, there was nonprice rationing for each of these products by some refiners during the shortages, rationing that cannot logically be attributed to the DOE price controls on refiners.

Id.; *see also id.* at 42 (noting shortages in jet fuel that occurred during a labor strike at a major airline and while the DC-10 fleet was grounded by the FAA, "a time when aggregate demand for fuel was unusually low").

[465] YERGIN, *supra* note 27, at 688. Oil was cut off for sixty-nine days starting at Christmas 1979; it returned at a permanently lower production rate. Paul Kemezis, *The Permanent Crisis: Changes in the World Oil System*, *in* OIL DIPLOMACY: THE ATLANTIC NATIONS IN THE OIL CRISIS OF 1978-79, at 3, 4 (1980). Iran, at the time of the crisis, was the source of approximately 15% of internationally traded oil. Mancke, *American Response*, *supra* note 393, at 29. Iran was also the source of 9% of U.S. oil imports and 3% of U.S. consumption before revolution. *Id.* at 31; *see also* YERGIN, *supra* note 27, at 702 (When Carter ordered a freeze on Iranian assets and ban on Iranian oil imports in the wake of the seizure of the hostages in the American embassy and Iran retaliated with a ban on exports to the United States, it disrupted supply channels and forced reallocation of oil.).

[466] YERGIN, *supra* note 27, at 692.

[467] LANE, *supra* note 299, at 69.

When President Ronald Reagan decontrolled oil prices in January 1981,[468] the rationale for operating small, inefficient refineries dissipated and the number of refineries declined quickly and dramatically.[469] The Reagan administration, unlike other post-World War II administrations, did not intervene to protect small refiners.[470] Although the number of refineries fell from 324 in 1981 to 202 in 1991, the average capacity rose substantially from 65,300 barrels per day in 1983 to 80,900 barrels per day in 1993 and 112,500 barrels per day in 2003.[471]

With deregulation, the oil industry went through "a wholesale corporate reorganization from which no major company was immune."[472] Twenty-three small refiners shut down in 1981 alone.[473] Add to this falling real prices and the rise of institutional investors interested in rapid returns, and the oil companies were forced to become leaner and more profitable quickly, sparking inter-company battles and a wave of consolidations.[474] The shift from a regulatory program that encouraged the proliferation of refineries focused on domestic crude sources and kept small, less efficient refineries open, to a market-place that punished inefficiency led many refineries to close in the 1980s.

5. Impacts on the Market for Gasoline

The post-World War II economic regulation of the oil industry flowed from the belief that such a vital commodity required government involvement. From there, "the drift of policy was inexorable . . . because at each step the decision was marginal—only a little more control was involved—and the benefits from the entire enterprise appeared substantial."[475] But the regulatory scheme in place from the Korean War

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[468] Exec. Order No. 12,287, 46 Fed. Reg. 9909 (Jan. 30, 1981).

[469] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 51 ("After the government controls were eliminated in 1981, a large number of small, inefficient refiners exited over the course of a number of years.").

[470] KATZ, *supra* note 271, at 159 ("Citing free market arguments, administration spokesmen stated after deregulation that no special treatment for the refining industry was needed and that if the industry shrank as it adapted to decontrol, the government should not meddle.").

[471] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 51-52.

[472] YERGIN, *supra* note 27, at 726.

[473] 2 BRADLEY, *supra* note 74, at 1237.

[474] YERGIN, *supra* note 27, at 726-28.

[475] BOHI & RUSSELL, *supra* note 63, at 15.

through 1981 failed to achieve its goals. Instead, it took crude away from efficient refiners and allowed "refiners manufacturing *lower* proportions of the products in short supply to use *higher* than normal proportions of the available crude," shifted crude from the coasts, "where supplies were short, . . . [to] the midwest, where supplies were [already] plentiful," and established "the precedent of bailing out refiners that had come to depend on the spot market for a large proportion of their crude supplies, reducing whatever incentive they might otherwise have had to stockpile oil for such contingencies in the future."[476] Moreover, the regulatory system repeated its mistakes from one crisis to the next.[477]

At virtually all times, but particularly during the 1960s and 1970s, economic regulations induced significant distortions in the market for gasoline. The decline of the U.S. refining industry's world share is closely tied to American energy policies, policies which included such disincentives for efficient investment as the 1970s price controls' requirement that larger domestic refineries sell imported oil to competitors at below cost. Combined with other nations' interest in developing their own refining industries, economic regulation contributed to American refiners' inability to meet the growing demand for gasoline, both in the United States and the world.

Although these regulatory efforts ultimately had no more chance of success than King Canute's legendary command to the sea had of stopping the tides, they had two long-term impacts for our purposes. First, gasoline imports, as opposed to crude oil imports, became more important in the American gasoline market.[478] Before World War II, most crude oil refined and consumed in the United States was produced

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[476] LANE, *supra* note 299, at 89; *see also* KATZ, *supra* note 271, at 150 ("[S]pecial programs passed by Congress to protect independent refiners required domestic producers to subsidize the refiners' importation of foreign crude.").

[477] LANE, *supra* note 299, at 100-01 ("The most striking conclusion to emerge from this analysis is the fact that most of the 'mistakes' made by the government in handling the Arab embargo were repeated during the Iranian disruption six years later. This result cannot be attributed merely to the change of administrations or the turnover of administrative personnel. The same 'mistakes' were made because the same groups were affected by the regulations and responded politically in the same ways.").

[478] Gasoline imports became important in the 1970s. NPC, FACTORS AFFECTING, *supra* note 61, at 4. Imports grew from "a net negative in the early 1950s to a peak of about 7% of domestic demand in the late 1980s" and have since fluctuated between 2% and 6%. NPC, ADEQUACY, *supra* note 59, at 21-22.

domestically.[479] Indeed, throughout World War II, the United States had the vast majority of advanced refineries, with "[a]pproximately 60 percent of the total world crude-distillation and 65 percent of thermal cracking capacity" at the end of the war.[480]

Second, the pervasive economic regulation had a more subtle, but in our judgment, more debilitating effect. By making the pages of the *Federal Register* and *United States Code* more important to the oil industry than developing new technologies for recovering and refining petroleum, regulations convinced oil men, politicians, and bureaucrats that "kings" could command the tides of the oil business. Regulators never recognized that the burdens of their regulatory structures were bearable only because the industry was simultaneously expanding production outside the United States, developing new technologies to improve refinery productivity, and growing crude supplies so rapidly that the real price of crude continued to fall. The parasitic regulatory burden thus went largely unnoticed as it merely siphoned off portions of the gains from technical and economic improvements.[481] The widespread use of "regulatory trading," in which oil was traded to allow its reclassification and resale at a higher price (at least quasi-legitimately), during periods of allocation controls is indicative of the destruction allocation programs caused.[482]

Whether these regulations served the real economic interests of their supporters at the expense of the general welfare[483] or, more benignly, whether they reflected a

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[479] USDOC, WAR AND POSTWAR, *supra* note 39, at 2 ("At the present time the country's more than 450 refineries are supplied with crude oil by almost 425 thousand domestic producing wells and a relatively small volume of crude oil from foreign sources." (citation omitted)).

[480] *Id.* at 6. The next largest shares were in the Netherlands, West Indies, and the Soviet Union, "each having approximately 10 to 15 percent as much crude-distillation capacity as the United States." *Id.*

[481] The same is true of some current environmental regulations of fuel composition. *See, e.g*, NPC, ADEQUACY, *supra* note 59, at 37-38 ("The fact that product prices actually declined in spite of increased [regulatory] costs suggests that the direct cost increase was more than offset by other efficiency gains within the industry. Without increased environmental costs, prices would be lower."). Imports have been growing "significantly" in recent years, primarily from Europe. NPC, OBSERVATIONS, *supra* note 13, at I-2. Although imports are small overall, they account for 25% of gasoline supplies in PADD I. *Id.* at I-9.

[482] 1 BRADLEY, *supra* note 74, at 681-82, 685-710 (describing history of regulatory trading in detail).

[483] YERGIN, *supra* note 27, at 660 (noting that the direct costs alone of the federal energy regulatory system "measured simply in terms of expenditures by

combination of incompetence and ignorance among policy makers, we cannot say. The key point is that energy policy in this period involved major interventions running counter to the long-term market trends in gasoline, propping up inefficient, smaller refineries, and diluting the competitive pressures for securing supplies and technological innovation. Despite the massive scale of these interventions, they reversed the long-term trends only briefly, during the immediate aftermath of the Arab oil embargo in the mid-1970s. Their distortions so pervaded the refining industry, however, that the industry in 1981 bore little resemblance to what it would have been in their absence. Most importantly, these distortions' cumulative impact restricted the growth of a national market in gasoline by protecting isolated markets from competition, punishing firms that engaged in market-expanding behavior such as securing cheap, foreign crude supplies, and deterring investment in U.S. refineries.

By 1980, oil and refined gasoline were internationally traded commodities, abundantly and cheaply available from primarily non-U.S. sources. The failure to adapt to that fact itself distorted the U.S. refining industry. The legacy of oil regulation was a narrower, shallower national gasoline market than would have evolved in the absence of forty years of import and price controls. Refineries were smaller, less technologically sophisticated, and more concentrated on the Gulf Coast than they would have been in the absence of regulation.[484] The gravity of these distortions was not fully felt in the 1980s, however, because economic conditions kept gasoline demand below 1978 levels well into that decade.[485] Indeed, the problem's impact is still mitigated today by the East Coast importing gasoline from Europe, a solution possible only because Europe relies heavily on diesel passenger vehicles, which produces a gasoline surplus.[486] If the diesel

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government agencies and by industry on regulatory matters—added up to several billion dollars in the mid-1970s").

484 2 BRADLEY, *supra* note 74, at 1163, 1226-28.

485 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 19 ("U.S. gasoline consumption fell significantly between 1978 and 1982, and remained lower during the 1980s than it had been in 1978, despite lower crude oil and gasoline prices during the late 1980s. Those reduced prices resulted in part from substantially reduced U.S. gasoline consumption and decreased worldwide petroleum consumption due to increased price sensitivity and an economic recession.").

486 NPC, OBSERVATIONS, *supra* note 13, at I-9 to -11.

market grows in the United States, as some forecast it will,[487] supplies of diesel are not likely to be available from European refineries.

These regulatory factors, in turn, exacerbated the burden of the environmental regulations that followed. Competition in the gasoline market pushed refiners to adopt increasingly sophisticated and expensive techniques to convert larger percentages of crude oil feedstocks into the most valuable end products (transportation fuels like gasoline)[488] and to control the consistency of the products they produced. With diverse inputs and a wide range of possible refinery outputs, refineries became increasingly sophisticated and costly to build. The increased capital costs created a trend toward larger refineries.

Even before the EPA directly regulated gasoline composition, pre-existing regulatory and market forces had virtually ensured that all but the most carefully designed environmental regulation would fragment the market. American refining capacity was insufficient to meet the U.S. demand for gasoline, requiring substantial imports of gasoline and leaving little excess capacity within the United States. Furthermore, the potential for expanding existing refineries was constrained by cost and the need for locations near oil pipelines and ports. Although these same forces had produced a national market for commodified gasoline, that market remained vulnerable in ways that policy makers appear to have ignored.

B. *Environmental Regulations and Gasoline Markets*

1. Fuel Formulation

Although the federal government has long had authority to regulate various aspects of motor fuels,[489] and it has

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[487] *See* John Peter, *Plotting Diesel's Stake in North America*, DIESEL FORECAST (2005) ("The Big 3 domestic manufacturers are already well established in Europe's diesel market where nearly 50 percent of all light-duty vehicles are diesel powered. And they would like nothing more than to add light-duty diesels to their respective powertrain portfolios in North America.").

[488] GARY & HANDWERK, *supra* note 61, at 1 (The highest-value products from refining crude oil today are transportation fuels (gasoline, jet fuel, diesel) and light heating oils and the primary goal is to convert "as much of the barrel of crude oil into transportation fuels as is economically practicable.").

[489] *See* Air Quality Act of 1967, Pub. L. No. 90-148, 81 Stat. 485, 504 (1967) (giving Department of Health, Education and Welfare the authority to regulate fuels

exercised that authority by requiring registration of fuels and additives,[490] state and federal regulators imposed only one important fuel formulation requirement before the late 1980s: requiring the removal of lead additives. Beginning in the late 1980s, however, the EPA and state and local governments began to intervene more, increasing their efforts after the passage of the Clean Air Act Amendments of 1990 (1990 CAAA).[491] These fuel requirements added a set of constraints to refinery operation and transportation of fuels.[492] This section analyzes the major fuel formulation requirements.

As noted earlier, lead had been added to gasoline to boost octane since the 1920s.[493] Price controls on tetraethyl lead produced shortages in 1946, which in turn spurred a federal octane ceiling to reduce demand. When price controls were abolished in late 1946, the shortage ended. Lead shortages reappeared in the early 1950s when Korean War-era price controls were imposed. The federal government considered a plan, supported by small refiners, to regulate octane levels to reduce demand. The plan was abandoned, however, because the need for different octane levels in different regions due to climatic conditions made it too complex. Instead, the government rationed tetraethyl lead until 1952.[494]

Beginning in the 1950s, technological improvements gradually reduced the amount of lead added to gasoline,

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and fuel additives); Clean Air Act of 1970, Pub. L. No. 91-604, 84 Stat. 1676, 1694 (1970) (allowing fuel additive testing) and *id.* at 1698-1700 (allowing regulation of additives that could impair emissions-control equipment).

490 Reitze, *supra* note 152, at 486-87, 491-97.

491 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 69 ("As a result of the proliferation of unique fuel requirements, differing fuel specifications apply in different parts of the country at various times of the year."). The EPA uses the term "boutique fuels" in a very limited way, including only "clean fuel program[s] designed and enforced under state authority to reduce motor vehicle emissions and improve air quality; and [a]pproved by the [EPA] under the authority of Section 211(c)(4)(c) of CAA Amendments of 1990; and, [i]ncluded in an EPA-approved state [clean air] Implementation Plan (SIP)." U.S. ENVTL. PROT. AGENCY, TASK FORCE ON BOUTIQUE FUELS, REPORT TO THE PRESIDENT 5 (2006) [hereinafter EPA, TASK FORCE]. This excludes a wide range of state mandates for "bio-fuels," among other things, and so understates the extent of fuel formulation regulation.

492 Jones, *supra* note 116, at xxi (noting importance of issue of "providing products to the high specification now required by our customers, by the public and pressure groups and by regulators (both domestic and, increasingly, supra-national)"). Research into ways to provide products that meet required specifications "at an acceptable cost" has been important in recent years. *Id.* at xxii.

493 *See supra* notes 149-52.

494 This paragraph is based on 2 BRADLEY, *supra* note 74, at 1150-56.

primarily through improved catalyst use.[495] When Congress set automotive emissions standards with the Clean Air Act Amendments of 1970, it "assumed that the automobile manufacturing industry would meet those standards by installing catalytic converters in the exhaust stream."[496] Lead would have harmed the catalysts in these converters, and so the 1970 Amendments authorized the EPA to order gasoline refiners to alter gasoline formulations to protect the catalytic converters.[497] The EPA acted almost immediately to begin the process of removing lead from gasoline.[498]

In 1972, in addition to protecting catalytic converters, the EPA also initiated rulemaking based on lead's health effects.[499] Not surprisingly, small refiners were again the beneficiaries of special treatment, winning an exemption from the rule until January 1, 1977 "in recognition of [their] special lead-time problems,"[500] and then receiving an additional partial extension from Congress through October 1, 1982.[501] As a

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[495] Bing Zhou, Ray Balee & Rebecca Groenendaal, *Nanoparticle and Nanostructure Catalysts: Technologies and Markets*, 2 NANOTECH. L. & BUS. 222, 223 (2005).

[496] Thomas O. McGarity, *MTBE: A Precautionary Tale*, 28 HARV. ENVTL. L. REV. 281, 294 (2004) [hereinafter McGarity, *MTBE*].

[497] The authority was phrased broadly, however, allowing the EPA to control the use of additives on environmental grounds generally. *See* 42 U.S.C. 7574(c)(1)(A) (2000).

[498] In 1971, the newly formed EPA announced that it was considering restrictions on lead as an additive. Regulation of Fuel Additives, 36 Fed. Reg. 1486 (proposed Jan. 30, 1971). In 1972, the agency proposed regulations, Fuels and Fuel Additives, 37 Fed. Reg. 11,786 (proposed June 14, 1972), and in 1973, the EPA exercised its Clean Air Act § 211(c)(1)(A) authority to require a series of lead additive reductions beginning January 1, 1975 to a final level of no more than 0.5 grams per gallon by January 1979. Control of Lead Additives in Gasoline, 38 Fed. Reg. 33,734 (1973). Refiners challenged the EPA's actions and lost, Amoco Oil Co. v. EPA, 501 F.2d 722 (D.C. Cir. 1974), although the challenge resulted in a less-restrictive phaseout schedule. 2 BRADLEY, *supra* note 74, at 1252-53. This relaxation resulted from the delay in investment needed to convert refineries to unleaded production caused by the regulatory uncertainty resulting from the litigation. In addition, unleaded production reduced the volume of gasoline produced from each barrel of crude, and the government feared shortages. *Id.* at 1254-55; Mancke, *American Response*, *supra* note 393, at 34 ("Higher operating costs, stemming from larger crude oil requirements and the multimillion-dollar capital investments needed to modify a large refinery to produce unleaded gasoline, entail that unleaded gasoline is substantially more expensive to manufacture than leaded gasoline.").

[499] Regulation of Fuels and Fuel Additives, 37 Fed. Reg. 3882 (Feb. 23, 1972). The final rule was issued in January 1973. 38 Fed. Reg. 1254 (Jan. 10, 1973). Although the lead additive makers challenged the EPA's actions, the en banc D.C. Circuit upheld the rule. Ethyl Corp. v. EPA, 541 F.2d 1 (D.C. Cir. 1976) (en banc).

[500] 38 Fed. Reg. 33,734, 33,740 (1973).

[501] Clean Air Act Amendments of 1977, Pub. L. No. 95-95, § 223, 91 Stat. 685, 764 (codified as amended at 42 U.S.C. § 7545(g) (2005)).

result, between 1979 and 1982, there appeared "a small subindustry of 'blenders,'" firms created "to take advantage of the small refiner exemptions," which "would purchase inexpensive, low-octane gas from foreign markets and blend in just enough high-octane leaded gas to stay within the small-refiner exemption."[502]

Removing lead produced "a desperate search for ways to maintain the octane level of [refiners'] gasoline pool."[503] The prevailing solution was to "crank up the severity of the cat reformer, making higher octane reformate," but this reduced the volume of gasoline produced and pushed refiners to look for lead substitutes that would boost octane.[504] Some refiners resorted to an alternative additive to boost octane, methylcyclopentadienyl manganese tricarbonyl (MMT), previously approved by the EPA.[505] However, under the 1977 Clean Air Act Amendments, "which may well have been enacted with MMT in mind," refiners were not allowed to market gasolines for catalytic converter-equipped vehicles that were not substantially similar to the gasolines used to certify the vehicle, hampering MMT use.[506] In late 1978, the EPA restricted refiners' use of MMT[507] but a few months later, it approved the use of methyl tertiary-butyl ether (MTBE) as an octane-boosting additive, a decision with important consequences, discussed below.[508]

The interaction of the environmental regulation with the 1970s economic regulations also caused problems for refiners. Pricing rules did not allow refiners to fully pass through to consumers the additional costs of producing unleaded gasoline, and so "[b]ecause th[e] premium was less than the added costs associated with producing unleaded gasoline, most oil companies chose to go slow in expanding

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502 Thomas O. McGarity, *Radical Technology-Forcing in Environmental Regulation*, 27 LOY. L.A. L. REV. 943, 950 (1994) [hereinafter McGarity, *Radical Technology-Forcing*].

503 LEFFLER, *supra* note 40, at 141.

504 *Id.*

505 McGarity, *MTBE*, *supra* note 496, at 296; *see also* Reitze, *supra* note 152, at 506-07.

506 McGarity, *MTBE*, *supra* note 496, at 296.

507 *Id.* The agency is currently reviewing the safety of MMT. *See* U.S. Envtl. Prot. Agency, Comments on the Gasoline Additive MMT (methylcyclopentadienyl manganese tricarbonyl), http://www.epa.gov/otaq/regs/fuels/additive/mmt_cmts.htm (last visited Apr. 12, 2007).

508 McGarity, *MTBE*, *supra* note 496, at 297.

their unleaded gasoline capacity."[509] As a result, there were periodic shortages of unleaded gasoline in the 1970s,[510] prompting the EPA to slow down the lead phaseout.[511]

The lead ban revealed the fragility of refining infrastructure. Regulations raising costs combined with price controls to reduce the economic returns to refining, lowering the incentive to invest in capacity. In virtually every instance, small refiners lobbied for and received special treatment (for a time), further harming the development of an efficient refining sector. As had happened with earlier regulatory constraints, a combination of external events and policy responses mitigated the problem. Lower-than-expected demand and delays in the lead phaseout both ameliorated the capacity crunch,[512] and the EPA used an innovative quasi-market mechanism to reduce the compliance costs of the lead phaseout, allowing refineries to trade lead credits,[513] and so bought off the small refiners.

A second formulation requirement began in the late 1980s. Through 1987, regulators had not seen volatility in gasoline as an air quality problem. But when the summer of 1988 delivered "some of the worst ozone excursions on record," research fingered high-volatility gasoline as a contributing culprit.[514] States began the trend toward fuel controls to address the ozone issue.[515] Before the 1990 Amendments, California refiners led a push toward "cleaner" fuels out of concern that the state would mandate a mixture of 85% methanol and 15% gasoline,[516] and ultimately introduced a wide range of fuels built around the addition of MTBE.[517]

In 1989, following state actions, the EPA set upper RVP limits for summer gasoline nationwide,[518] and then

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509 Mancke, *American Response*, *supra* note 393, at 35.

510 *Id.*

511 McGarity, *Radical Technology-Forcing*, *supra* note 502, at 949.

512 U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN., ANNUAL REPORT TO CONGRESS, VOLUME THREE: PROJECTIONS 57, DOE/EIA-0173 (1979).

513 2 BRADLEY, *supra* note 74, at 1258-59 (describes trading).

514 NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 108. One problem was that the EPA allowed vehicles to be certified with lower volatility gasoline than was used in practice, leading to higher emissions than anticipated. *See* Reitze, *supra* note 152, at 515-16.

515 Reitze, *supra* note 152, at 516 (describing efforts of Northeast States for Coordinated Air Use Management, an eight-state coalition, and a subgroup of the coalition to impose volatility requirements in 1989).

516 McGarity, *MTBE*, *supra* note 496, at 305-06.

517 *Id.*

518 NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 109.

"substantially expanded" its involvement after the passage of the 1990 Amendments, which mandated the federal reformulated gasoline (RFG) program.[519] Unfortunately, in 1990, gasoline formulation was known to affect "performance criteria, notably volatility, octane quality, good startability, and driveability, but little was known about the effects of fuel composition on vehicle emissions."[520]

As "a relatively minor and late-arriving aspect of a multi-year effort to amend" the Clean Air Act that reached fruition in 1990,[521] Congress also required adding oxygenates to gasoline in order to reduce emissions in carbon monoxide nonattainment areas.[522] The requirement, apparently resulting from a coalition of farm-state senators, was passed without consideration of the environmental impacts of any of the additives, including MTBE.[523]

> As the new bill was being debated on the floor of the Senate, Senators Tom Harkin (D-Iowa), Tom Daschle (D-S.D.) and Bob Dole (R-Kan.) introduced an amendment under which refiners would have to reduce the ozone forming potential of the gasoline sold in the nine most seriously polluted ozone nonattainment areas by 15% while adhering to a 2.7% oxygen requirement and keeping aromatics below 25%.[524]

This measure, seemingly designed to boost demand for ethanol, raised the level of government involvement in fuel design to new heights. The later discovery of MTBE's serious environmental problems led Congress to substitute ethanol as the oxygenate of choice.[525]

The 1990 Amendments allowed the EPA to impose a baseline set of requirements for gasoline, including mandating reformulated gasoline in nine geographical areas to help meet federal standards for ground level ozone.[526] The first set of RFG requirements was applied in 1995, with a second, tighter phase following in 2000. The EPA initially required the RFG

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[519] *Id.*

[520] PEARSON, *supra* note 132, at 83.

[521] McGarity, *MTBE*, *supra* note 496, at 306.

[522] 42 U.S.C. §§ 7512(a)-(b), 7545(m) (2000).

[523] McGarity, *MTBE*, *supra* note 496, at 309; *see also* Reitze, *supra* note 152, at 526-28 (describing interest group maneuvering over oxygenates).

[524] McGarity, *MTBE*, *supra* note 496, at 309.

[525] Reitze, *supra* note 152, at 528 (noting that rulemaking ultimately had "a tilt away from a fuel neutral approach to one that carved a place for ethanol").

[526] The 1990 amendments specified a wide range of characteristics of "base" gasoline. 42 U.S.C. § 7581(4) (2000).

formulations in nine metropolitan areas, although others were added later.[527] States were allowed to add more areas to the RFG program, although the EPA could delay "opt-ins" if RFG supplies were insufficient.[528] In 1992 and again in 1996, California promulgated its own regulations, which were even more stringent than the EPA's requirements.[529]

The initial specification for RFG gasoline required an oxygen content of at least 2% by weight, a benzene content of no more than 1% by volume, no lead or manganese, a year-round average NO_X emission level of a 1990 summer baseline gasoline, and reduced toxic air pollutant and volatile organic compound emissions.[530] The federal RFG program set different targets for northern and southern states, reflecting "the historical industrial practice where southern gasoline had lower RVP than northern gasoline to compensate for higher ambient temperatures."[531] Thus, the federal RFG requirements produced three fuels: a "northern" RFG; a "southern" RFG; and uncontrolled gasoline used outside the areas where states or the EPA mandated one of the RFG gasolines.

These regulatory requirements produced several changes in gasoline refining. The 1989 standard was primarily met by reducing the butane content of gasoline, which required compensating for the resulting loss of octane by increasing catalytic cracking and alkylation of gasoline.[532] The 1992 RVP standards were met by increasing downstream processing of gasoline and blending lower RVP components with higher octane.[533] Both of these steps required "large capital investments."[534]

Even implementing a comparatively simple regulatory program like this required some sophisticated regulations. For

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[527] 42 U.S.C. § 7545. The initial nine were Baltimore, Chicago, Hartford, Houston, Los Angeles, Milwaukee, New York City (including suburbs in other states), Philadelphia, and San Diego. Reitze, *Fuels*, *supra* note 152, at 524 n.307.

[528] 42 U.S.C. § 7545(k)(6)(A)-(B).

[529] *See* California Air Resources Board, *The California Reformulated Gasoline Regulations*, *available at* http://www.arb.ca.gov/fuels/gasoline/gasoline.htm#Programs (last visited Apr. 12, 2007) (summarizing state program).

[530] *See* Reitze, *supra* note 152, at 532-36 (describing initial regulations).

[531] NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 116-17.

[532] EPA, PROFILE, *supra* note 68, at 91. Because n-butane also raises the average octane, however, a substitute was needed to maintain the blend's octane level. Needless to say, refineries also found themselves with seasonal surpluses of n-butane. GARY & HANDWERK, *supra* note 61, at 8-9.

[533] EPA, PROFILE, *supra* note 68, at 91.

[534] *Id.*

example, one concern was that the blendstocks removed from the RFG fuels would be used in gasolines for non-RFG areas, increasing the volatility of gasolines there and causing new problems. As a result, the EPA adopted "antidumping" rules to prevent the gasoline components not used in RFG from being blended into gasolines outside the RFG mandated areas.[535] These rules used baselines individualized for each refiner.[536] Moreover, the 1990 CAAA oxygenate requirements necessitated waivers in part because of limited time to build the "new oxygenate production, storage, and transportation facilities," as well as the constraints on the ability to buy oxygenates for storage.[537]

A second set of constraints on refiners came from the EPA's order under the 1990 Amendments to dramatically reduce the sulfur content in transportation fuels, including gasoline.[538] These restrictions reduced the permissible sulfur content in highway diesel.[539] Combined with the shift in crude supplies to heavier sour (e.g., higher in sulfur) crudes, this required refiners producing fuel for the U.S. market to make substantial capital investments.[540]

Beginning in 1998, the EPA imposed additional requirements on fuels. In that year, the EPA began requiring refiners to use a more complex model of fuels' emissions properties known, appropriately, as the "Complex Model."[541] Furthermore, after 1990, the EPA regulated deposit control additives in fuel. "The details of the regulations and procedures did not emerge for several years, and led to an interim stage of certification of four types of detergent additive: polyalkylamines, polyetheramines, polyalkylsuccinimides and polyalkylaminophenols."[542] The key is that as the regulations

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535 NPC, 1990S, *supra* note 63, at 13 ("It is illegal to dump undesirable gasoline components from RFG into conventional gasoline for other areas of the country. Starting January 1, 1995, refiners, blenders, and importers will be required to comply with regulations that will prohibit any increase in VOC, NO_x, CO, or TAP emissions over 1990 levels in gasoline sold outside the RFG program cities."); *see also* Reitze, *supra* note 152, at 536-37.

536 Reitze, *supra* note 152, at 536; 40 C.F.R. § 80.91 (2006).

537 NPC, 1990S, *supra* note 63, at 6.

538 Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 42 (Reducing sulfur content both lowers sulfur-oxide emissions and makes catalytic reduction of HCs, CO, and NO_x more efficient.).

539 Reitze, *supra* note 152, at 507-12. 40 C.F.R. § 80.195 contains the gasoline sulfur requirements.

540 *See supra* note 172.

541 Blackmore, *supra* note 92, at 248 (describing model).

542 *Id.*

became more complex, the EPA's involvement in fuel design steadily increased. Moreover, boutique fuel requirements are not simply a matter of the government specifying a particular set of gasoline characteristics. The technique used to add one required ingredient may affect the completed fuel's characteristics in other dimensions.[543]

In the oxygenate regulations, the EPA initially allowed the use of both ethanol and MTBE. After refiners had invested considerable capital in MTBE facilities, however, the chemical's negative environmental impacts became widely recognized and its use was phased out.[544] This left refiners with both significant stranded investments in MTBE[545] facilities and shortages of ethanol.[546]

The formulation restrictions did not stop with those imposed by the EPA. State and local governments also imposed restrictions on gasolines sold in their jurisdictions through various State Implementation Plans (SIPs).[547] Although there is no comprehensive list of formulations mandated by all levels of government, there appear to be at least seventeen different formulations—a major increase from

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543 For example, the EPA was concerned with

> potential abuse of the process of adding oxygenate to gasoline downstream of a refinery. This practice, called "splash blending," involves mechanical mixing of finished gasoline or gasoline blending stock having front-end volatility set at a typical warm-season value (RVP of 7 to 8 psi) with a liquid oxygenate (such as ethanol). Splash blending, unlike refinery-performed match blending that renormalizes product output to the required properties of an RFG, can change the proportional constituents of a gasoline by diluting (replacing) their mass and volumetric share in each gallon. It also has the potential to increase the quantity of the total fuel that evaporates from vehicles if the fuel's resulting RVP is significantly higher. EPA sought to obviate this possibility by requiring the type of oxygenate that can be added be stipulated at the refinery and thus maintain RVP integrity.

NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 126-27. The problem was ultimately solved by the EPA's "in situ" sample audits, which led most refiners to blend at the refinery. *Id.* at 127.

544 *But see* McGarity, *MTBE*, *supra* note 496 (arguing that refiners bear a portion of the responsibility for stranded investment because of lack of investigation into environmental impact).

545 *See* STILLWATER ASSOC., INC., MTBE PHASE OUT IN CALIFORNIA 57 (2002), *available at* http://www.energy.ca.gov/reports/2002-03-14_600-02-008CR.pdf (discussing problem of phaseout and recognizing stranded investment issue).

546 James R. Healey, *Ethanol Shortage Could Up Gas Prices*, USA TODAY, Mar. 30, 2006, *available at* http://www.usatoday.com/money/industries/energy/2006-03-30-ethanol-gas-prices_x.htm?csp=1.

547 *See* EPA, Reformulated Gasoline Frequent Questions, http://www.epa.gov/oms/rfg/faq.htm (last visited Apr. 12, 2007) (discussing SIP revisions for state-mandated gasoline formulations).

the single standard (the lead standard) in place in the mid-1980s.[548] In addition, some state and local governments have imposed "biofuel" requirements.[549]

These requirements have three primary effects on gasoline markets. First, the fuel requirements may isolate particular geographic markets from the overall gasoline market, making it harder to bring new supplies to a region or uneconomical to shift supplies out of a region.[550] Second, as noted earlier, additional capital investment may be needed to produce the boutique fuels. This limits the number of current plants able to produce a particular fuel, which creates both an incentive to exit the market and a barrier to enter the market. Econometric investigations into these requirements, comparing prices and price volatility between matched pairs of boutique and non-boutique cities, found that not only is there evidence that boutique fuel requirements raise the cost of gasoline, but that the price impact varies with the geographic isolation and degree of competition in the relevant market.[551] Third, these requirements alter the path of technological change, diverting investment away from improving production processes to meet regulatory requirements.[552]

Additional strong evidence indicates that the boutique fuel requirements, occurring together with limited refinery capacity and pipeline connections to other regions, affect prices.

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[548] MAJORITY STAFF OF THE PERMANENT SUBCOMM. ON INVESTIGATIONS, GAS PRICES: HOW ARE THEY REALLY SET? 94 (2002), *available at* http://www.senate.gov/~gov_affairs/042902gasreport.htm.

[549] *See, e.g.*, HAW. REV. STAT. § 486J-10 (2005) (requiring 10% ethanol content for all unleaded gasoline sold after April 2, 2006).

[550] For example, if a boutique fuel is more costly to create than conventional gasoline, refiners may be unwilling to divert supplies of it to meet a shortage in an area that does not require the boutique fuel. There is evidence that boutique fuels are more costly to produce than standard gasolines. *See* Jennifer Brown, Justine Hastings, Erin T. Mansur & Sofia B. Villas-Boas, *Reformulating Competition? Gasoline Content Regulation and Wholesale Gasoline Prices* 4-5 (Dep't of Agric. & Res. Econ., U. Cal. Berkeley, Working Paper, No. 1010, 2007), *available at* http://repositories.cdlib.org/are_ucb/1010.

[551] *Id.* at 4-5. A forthcoming EPA analysis reportedly finds that boutique requirements are not a factor in increasing gasoline prices, claiming that the refining and distribution network is "able to provide adequate quantities of boutique fuels, as long as there are no disruptions in the supply chain." H. Josef Hebert, *EPA: Special Fuel Not to Blame for Costs*, ABC NEWS, June 22, 2006, *available at* http://abcnews.go.com/Politics/wireStory?id=2108257 (quoting the EPA report). We have not yet seen the EPA report, but the quote suggests the agency focused on the wrong question. It is precisely when there are disruptions in the supply chain that a broad, deep market makes a difference.

[552] One summary of industry trends concluded that air pollution "has driven the direction of our technological development." Jones, *supra* note 116, at xxiii.

After examining regional prices, the FTC found that differences in price variability across regions began appearing in 1992 and have increased since 1995.[553] The agency concluded that "[t]he timing of price changes . . . suggests that they may bear some relationship to the introduction of Phases I (1992) and II (1996) of the stringent and specialized CARB [California Air Resources Board] requirements for gasoline sold in California."[554] While the FTC study found evidence of a boutique fuel price effect in California, it did not find such evidence in the Gulf Coast, where the agency concluded that the larger amount of refinery capacity and greater interconnection of that region with other areas reduced the impact of disruptions at any particular facility.[555] The FTC found similar results in the East Coast, Rocky Mountain, and midwestern states.[556]

The increasing difference between U.S. market and non-U.S. market gasolines represents another effect of boutique fuel requirements.[557] Low sulfur requirements for both gasoline and diesel in the United States limit the types of oil that many refineries can process to make products for the U.S. market.[558] This limits the possibility of importing gasoline from some foreign refineries, reducing those refineries' ability to supply gasoline when there are spot shortages.[559]

As discussed earlier, running a modern refinery is essentially an issue of complex optimization in which refiners must solve the problem of creating the highest-value mix of end products by managing the streams of intermediate products

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[553] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 88-89.

[554] *Id.* at 90.

[555] *Id.* at 94.

[556] *Id.*

[557] NPC, ADEQUACY, *supra* note 59, at 37 ("European conventional gasoline does not meet U.S. specifications for either conventional or reformulated gasoline. Adjusting European gasoline to U.S. quality would require some upgrading with an associated cost increase.").

[558] Mortished, *supra* note 63 ("Few refineries are able to convert more of the heavy sulphurous 'sour' crudes into petrol and most of those are in the United States."). Although Canadian and European sulfur requirements are moving in similar directions, making gasoline from those sources potentially available for the U.S. market, Caribbean and South American refiners are less likely to be able to meet the U.S. sulfur requirements without large capital investments. NPC, ADEQUACY, *supra* note 59, at 41.

[559] BEHRENS & GLOVER, *supra* note 10, at 3 ("Foreign refiners typically manufacture products designed to sell in the international market, not the special product 'boutique fuels' demanded by a significant share of the U.S. market.").

manufactured at different stages.[560] The boutique fuel requirements thus increase the number of constraints in the optimization problem. If the constraints are binding (and they are meaningless if they are not), then the constraints have costs.[561]

The market-fragmenting nature of the various boutique fuel requirements is easy to grasp: by making gasoline sold in Phoenix different from gasoline sold in Tucson, boutique fuel requirements prevent owners of Phoenix-formulated gasoline from selling their gasoline in Tucson and vice versa, limiting the depth of the markets. Indeed, boutique fuel requirements are government-mandated versions of what sellers of branded gasoline spend considerable resources unsuccessfully attempting to persuade gasoline consumers to believe: that a gallon of one gasoline differs significantly from a gallon of another gasoline.[562] What is less obvious is the impact of the broader fuel formulation requirements. The ultra-low sulfur and other wider restrictions all reduced refinery capacity by helping push marginal refiners out of the marketplace and raising the barriers to entry by increasing the capital requirements for entry.[563]

There are two main consequences of fragmenting the gasoline market. First, markets function best when they are deep rather than shallow.[564] That is, when a market has many participants and the materials traded in the market are relatively standardized, there are many potential providers of the goods to each potential buyer. Antitrust law recognizes the

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560 *See* A. Ogden-Swift, *Control and Optimization*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at 181, 181 ("Refinery planning and scheduling, optimization, process control and monitoring are essential to achieving [maximum profits]. Typically savings from improvements in these areas exceed $20 million per year for a world-scale refinery by choosing the best feedstocks, the best way to operate the refinery, effective control at the best point, and efficient detection and management of abnormalities.").

561 *See* Jones, *supra* note 116, at xxi ("The development of products that meet the required quality standards has not generally been unduly difficult; where problems have arisen they have frequently arisen from the need to 'trade off' one characteristic against another.").

562 This seemed to have worked well early on: a 1947 government study noted a "strong consumer tendency to deal regularly at particular stations where the desired brand is sold" and that "the general preference of consumers [is] for branded gasoline." USDOC, WAR AND POSTWAR, *supra* note 39, at 28.

563 NPC, ADEQUACY, *supra* note 59, at 99.

564 Some analyses have found this to be key in gasoline markets. *See, e.g.*, Marshall C. Howard, *Interfirm Relations in Oil Products Markets*, 20 J. MKTG. 356, 361 (1956) ("The greatest source of interfirm friction and competition is price policy of both suppliers and their market outlets when product is in ample supply.").

inherent advantages of markets with many buyers and sellers. This basic premise undergirds virtually all economic discussions of the efficiency of competitive markets. The classic example of deep market efficiency is the market for widely traded public company stocks (e.g., Microsoft) or commodities like gold, silver, and pork bellies. Attempts to exercise market power in such deep markets fail because opponents can easily profit by applying price pressure against the would-be monopolist.[565] Extending a market makes it deeper by bringing in additional participants. There is evidence of such an impact in the case of boutique fuel regulations. A study from the U.S. Government Accountability Office (GAO) concluded that

> [f]or the boutique fuels—which are sold only in certain cities in the East Coast and Gulf Coast regions, or in California—increased market concentration led to higher wholesale prices than for conventional gasoline. This difference likely stems from the limited availability of the boutique fuels, which can only be produced by a few refiners.[566]

Second, boutique fuel requirements defeat the market forces promoting standardization in gasoline. Standardization is an important means of deepening a market. Standardizing a good allows buyers to make low-cost comparisons between goods offered by different sellers, facilitating price competition. In gasoline markets, for example, government regulations require that fuel sellers post octane numbers for fuel and the method used to calculate the octane number[567] in order to facilitate consumer comparison of different sellers' products.[568] The EPA has (commendably) taken a number of steps to reduce the impact of boutique fuel requirements, but these merely mitigate the extent of the problem caused by multiplying fuel formulation requirements,[569] they do not address the

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565 *See* EDWARD CHANCELLOR, DEVIL TAKE THE HINDMOST, A HISTORY OF FINANCIAL SPECULATION 252 (1999) (discussing Hunt brothers' attempt to corner the silver market).

566 GAO, MERGERS, *supra* note 69, at 79.

567 Octane numbers can be determined by various methods. *See* GARY & HANDWERK, *supra* note 61, at 15.

568 *See* Posting of Minimum Octane Numbers on Gasoline Dispensing Pumps, 36 Fed. Reg. 23,871 (Dec. 16, 1971) (FTC rule requiring posting).

569 *See* EPA, TASK FORCE, *supra* note 491, at 11-12 (listing efforts to mitigate problems). Congress has also expanded the EPA's authority to grant waivers when necessary to reduce disruptions. *See* Energy Policy Act of 2005 § 1541 (codified at 42 U.S.C. § 7545). While waivers are useful in an emergency, they do not address the underlying structural problems and do not relieve price impacts from non-emergencies.

underlying issue. Most importantly, the EPA's mitigation efforts actually undercut the regulatory certainty necessary to induce investment in expanding refinery capacity significantly because they signal that investors cannot rely on a stable regulatory environment.

Firms that are able to convince consumers that their products differ significantly from competitors' products are able to charge a price premium because consumers' differentiation between the products reduces competition. For example, Coca-Cola is able to sell its soda for a higher price than store brands because consumers distinguish Coke from store-brand colas. To protect this product differentiation, Coca-Cola spends a considerable amount on advertising aimed at maintaining a brand image.[570] Similarly, "green" energy providers are able to charge above market rates for energy produced by "sustainable" methods to consumers who prefer to consume power that is not produced with non-renewable energy, even though the electricity itself is indistinguishable from power produced by plants using non-renewable energy.[571]

Boutique fuels are a special case of interference with standards. Consumers are not allowed to choose the fuel they will use, except in border regions between areas with different fuel requirements. These fuels prevent arbitrage across geographic markets, preventing market forces from reducing price differentials.[572] Arbitrage produces price convergence with startling effectiveness.[573]

When an imbalance between supply and demand across different geographic markets causes price differentials, for example, opportunities for arbitrage exist and attract the

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[570] *See* Coca-Cola Co., Annual Report (Form 10-K) 70 (2005), *available at* http://www2.coca-cola.com/investors/pdfs/form_10K_2005.pdf (reporting advertising expenditures of $2.5 billion for 2005).

[571] Michael Evan Stern & Margaret M. Mlynczak Stern, *A Critical Overview of the Economic and Environmental Consequences of the Deregulation of the U.S. Electric Power Industry*, 4 ENVTL. LAW. 79, 148 (1997) (noting that green and "dirty" energy cannot be distinguished).

[572] Arbitrage is an attempt to profit by exploiting price differences in different markets.

[573] Indeed, one rationale for the adoption of the euro was that it would facilitate price comparisons and produce arbitrage opportunities across the countries adopting it. *The Euro Will Be One of the Worlds Most Stable Currencies: José Maria Gil-Robles, President of the European Parliament Answers Questions*, CONTEXT EUROPEAN EDUC. MAG., Mar. 2, 1997, *available at* http://www.context-europe.org/ca181.html ("[F]or the first time, it will be possible to easily compare the prices of goods and services in different countries. The Euro will therefore stimulate competition, which will be beneficial for both consumers and enterprises.").

attention of entrepreneurs. If a good costs more in Phoenix than in Tucson, entrepreneurs will buy the good in Tucson and bring it to Phoenix. This will increase demand in Tucson, creating market pressure for higher prices there. It will increase supply in Phoenix, creating market pressures for lower prices there. Ordinarily, the price between Tucson and Phoenix will converge. In general, price differentials will likely persist only where transactions costs limit opportunities for arbitrage.[574] Even where such transactions costs exist, however, there are market pressures to reduce the cost of delivering gasoline from Tucson to Phoenix and allow the Tucson gasoline source to undercut the Phoenix price.[575] Where boutique fuel requirements fragment markets sufficiently to cause price differentials, such individual efforts at arbitrage are also likely to occur—and this reduces the effectiveness of the boutique fuel requirement.

2. Obstacles to Refinery Capacity Growth

In the 1950s, "entry into gasoline retailing [was] 'relatively easy.'"[576] As we have seen, there have been periods of rapid (sometimes too rapid, from the industry's point of view) expansion of refinery numbers and capacity in response to demand and regulatory stimuli. The post-war refinery crunch quickly yielded to considerable expansion in the 1950s and the perverse incentives of the 1970s brought numerous plants online (including some of dubious efficiency) with little lead time. But remarkably, no new refinery has been built in the United States since 1976.[577] Rather than build new refineries,

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[574] A gasoline price differential between Phoenix and Tucson will not be competed away by Tucson gasoline owners trucking their gasoline to Phoenix unless the price in Phoenix is more than the cost of transporting the gasoline from Tucson to Phoenix, plus the cost of gasoline in Tucson. Because an arbitrageur seeking to exploit the price differential will have to bring the gasoline to Phoenix to sell, transportation costs will matter.

[575] Indeed, we observe individuals engaged in arbitrage on small scales where there are artificial barriers to price competition. Thus, for example, on the Arizona-California border, Arizona gas stations advertise the lower price of gasoline in Arizona because Arizona has a lower gasoline tax than California, so individuals fill up their tanks in Arizona to avoid paying the higher tax in California (this information comes from the personal observation of one of the authors). Tax boundaries create such behavior in many instances.

[576] Dirlam & Kahn, *supra* note 33, at 838.

[577] Jad Mouawad, *No New Refineries in 29 Years, But Project Tries to Find a Way*, N.Y. TIMES, May 9, 2005, at A1, *available at* http://www.corpwatch.org/article.php?id=12227; FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 50 ("Since

refiners have expanded existing facilities, meeting the increase in U.S. demand for transportation fuels without domestic greenfield projects.[578]

What accounts for the difference between "easy" entry in the 1970s and a completely stalled new construction program since 1976? For starters, the refining business has not drawn investment because its economics are unattractive. For example, after the oil price shocks in 1973 and 1979, demand for refined petroleum products fell and "[r]efinery expansion plans were consequently curtailed and plans for 'green field' refineries abandoned, particularly in Europe and North America."[579] Similarly, in the 1990s, "some firms divested refineries because of high operating costs and low returns. For companies acquiring these refineries, it was more cost effective to acquire an existing refinery than to build one, especially given the high cost and stringent environmental requirements for refinery construction in the United States."[580] Low interest from investors offers a partial explanation, but the industry's massive investments in compliance with new environmental regulations and expansion of existing refineries demonstrate that considerable capital has flowed into the industry despite the unfavorable economics. Thus, low investor interest cannot entirely explain the absence of new refineries. Put simply, firms had a choice between expanding existing facilities and building new ones and, since 1976, they have chosen the former.

Refiners also contend that they have not been able to build new refineries because of the combination of high capital costs, regulatory costs, and low returns.[581] Emissions controls

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1976, no new refinery has been built in the U.S. with the primary purpose of producing gasoline.").

[578] FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 49 ("Between 1985 and 2005, U.S. refineries increased their total capacity to refine crude oil into various refined petroleum products by 10.3 percent, moving from 15.7 million barrels per day in 1985 to 17.3 million barrels per day in 2005. Most of this new capacity came into operation after 1998. This increase—approximately one million barrels per day—is roughly equivalent to adding approximately 10 average-sized refineries to industry supply." (citation omitted)).

[579] Jones, *supra* note 116, at xviii.

[580] GAO, MERGERS, *supra* note 69, at 42.

[581] One reason is the protectionist impact of air pollution regulations that require new plants to secure off-setting emissions reductions, but grandfather existing facilities. 2 BRADLEY, *supra* note 74, at 1266; GAO, MERGERS, *supra* note 69, at 66. A 1974 report by the National Petroleum Council reached similar conclusions. It found, based on a survey of refiners, that refiners expected to spend on environmental regulatory compliance an amount ($3.3 billion in 1970 dollars) that could have paid for

on refineries have led to massive capital and operating cost expenditures.[582] Of course, many of these same problems would also afflict expansions of existing facilities, but they do not seem to have stopped that process, and critics of the industry remain skeptical.[583]

Land use restrictions provide a more likely explanation for the thirty-year lull in refinery construction. Throughout the industry's history, neighbors of potential refinery sites have objected to their construction. For example, Standard Oil's attempts to build a refinery in Chicago to process the sulfur-laden Lima oil field's production caused opposition from neighbors of the proposed plant "on account of the odor from Lima crude and the fire hazard." The refinery was ultimately built in Whiting, Indiana, "a desolate spot on the sand dunes along the southern shore of Lake Michigan."[584] Today, of course, "desolate spots" close to oil supplies are harder to find than they were in the early twentieth century and even the most desolate spot may have environmental restrictions that impede construction of a refinery. An attempt to build a refinery in a relatively isolated rural area in Yuma County, Arizona, for instance, has drawn some local opposition.[585]

1.3 to 2.2 MMB/CD refinery capacity. NPC, FACTORS AFFECTING, *supra* note 61, at 35-36.

582 2 BRADLEY, *supra* note 74, at 1250-51.

583 Environmental pressure groups, for example, argue that refiners are deliberately restricting the expansion of capacity through mergers and closure of refineries. *See* Public Citizen, *Myths and Facts About Oil Refineries in the United States*, http://www.citizen.org/cmep/energy_enviro_nuclear/electricity/Oil_and_Gas/articles.cfm ?ID=11829 (last visited Apr. 12, 2007) (arguing that "[o]il companies have exploited their strong market position to intentionally restrict refining capacity by driving smaller, independent refiners out of business"). After reviewing data on mergers, the GAO concluded that "anecdotal data" exists to support the idea that mergers "have had some impact on barriers to entry in the U.S. petroleum industry." GAO, MERGERS, *supra* note 69, at 64. There is little question that many refinery owners have reduced capacity by closing plants. The dispute is over their motivation in doing so—refiners contend that the closed plants had been uneconomical to operate, in part because of the costs of capital requirements. An alternative explanation for some of the closures is the impact of antitrust regulators' insistence on divesture of particular refineries as a condition of approval of mergers. For example, vertically integrated oil companies reduced refining capacity by closing or selling unprofitable refineries (sometimes as a result of FTC pressure in mergers), which reduces their capacity and reduces their ability to supply unbranded gasoline.

584 GIDDENS, *supra* note 37, at 10.

585 *See, e.g.*, Jonathan Athens, *Opposition to Refinery Grows*, YUMA SUN, Nov. 21, 2004, *available at* http://sun.yumasun.com/google/ysarchive10913.html. *But see* Tammy Krikorian, *Petitions in Wellton Back Refinery*, YUMA SUN, Dec. 10, 2004, *available at* http://sun.yumasun.com/google/ysarchive111913.html (detailing support in neighboring community). *See also infra* notes 593-99.

The rise of land use regulation, other environmental restrictions, and popular resistance to the "local refinery" limited expanding capacity as early as the 1970s.[586] For example, by 1974, state-level restrictions in California and Delaware posed significant barriers to refinery construction.[587] At the federal level, environmental legislation protecting coastal areas restricted the availability of considerable land with access to tankers for crude supply.[588]

The FTC analysis of the industry concluded that "[i]n general, the FTC has not found entry to be likely in petroleum refining; the sheer complexity of entry (both inherent and due to environmental restrictions) is a significant barrier to timely entry."[589] Furthermore, the agency found that both high-sunk costs and environmental regulations present significant deterrents to entering the refining business. "These entry-deterring factors have become more formidable since the 1980s, as refineries have become more capital-intensive and environmental regulations have become more restrictive."[590] Indeed, the 2005 FTC review of gasoline pricing concluded that "costly and extensive permitting and licensing requirements mandated by various federal, state, and local environmental and other laws, as well as community opposition" "likely" induced U.S. refiners to expand by increasing capacity at existing refineries rather than by constructing new ones.[591] The GAO also recognized these barriers to entry. It concluded that the refining sector "is characterized by pervasive barriers to entry, including large capital investment requirements at the refining level, and regulatory and permitting impediments at the refining and wholesale/retail levels."[592]

The ongoing effort to build a refinery near Yuma, Arizona illustrates the obstacles and difficulties facing refinery

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586 NPC, FACTORS AFFECTING, *supra* note 61, at 5 ("Despite the rigorous standards for both water and air quality that refineries must meet now and in the future, resistance still exists in many areas of the country to constructing plants, even with appropriate environmental equipment.").

587 *Id.* at 42.

588 *See* Breck C. Tostevin, Note, *'Not On My Beach': Local California Initiatives to Prevent Onshore Support Facilities for Offshore Oil Development*, 38 HASTINGS L.J. 957 (1987) (discussing obstacles to development of oil facilities in coastal areas).

589 FTC, MERGERS, *supra* note 5, at 33.

590 *Id.* at 197.

591 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 50.

592 GAO, MERGERS, *supra* note 69, at 66.

construction. In 1999, Arizona Clean Fuels initially sought[593] to build a $2-3 billion refinery[594] in Maricopa County, but Maricopa's emissions restrictions and ozone noncompliance led Arizona Clean Fuels to shift its focus to Yuma County.[595] In addition to the company obtaining state and federal approval for its emissions permit, the refinery would need local zoning changes. All of these requirements involved multiple public hearings and lengthy review by various bodies.[596] Arizona Clean Fuels estimated that it needed "two dozen" permits to build and operate the refinery.[597] Opponents also unsuccessfully sought a referendum on the zoning changes.[598] Arizona Clean Fuels' efforts to secure the required permits persisted for six years, costing the company $30 million without producing a single physical act toward construction.[599]

The capital investment needed to produce boutique fuels provides yet another entry barrier. Meeting these new fuel

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593 *Oil Refinery Permit Takes Next Step for Approval*, YUMA SUN, Feb. 5, 2005, *available at* http://sun.yumasun.com/google/ysarchive12080.html.

594 Initial estimates put the refinery cost at $2 billion. *See* T.M. Schultz, *Surprise! Refinery Eyeing Yuma County*, YUMA SUN, Oct. 31, 2003, *available at* http://refinery.org/news/2003/news_10310305.htm. By 2005, however, news stories estimated the cost at over $3 billion. Jonathan Athens, *Refinery Awaits Green Light from Mexico*, YUMA SUN, Oct. 14, 2005, *available at* http://sun.yumasun.com/google/ysarchive16704.html (noting estimate of $3.2 billion); Blake Schmidt, *Refinery Price Tag at $3 Billion*, YUMA SUN, Sept. 15, 2005, *available at* http://sun.yumasun.com/google/ysarchive16151.html. A new refinery on the Gulf Coast is also estimated to cost a similar amount. *See* NPC, OBSERVATIONS, *supra* note 13, at I-20. Purchases of refineries value them at approximately 25%-33% of new construction cost, according to an industry study. *Id.* at I-21.

595 James Gilbert, *Gas Plant Proposal Still Needs Refining*, YUMA SUN, Jan. 29, 2004, *available at* http://sun.yumasun.com/google/ysarchive13659.html; Schultz, *supra* note 594. The refinery would get its crude from a pipeline from Mexico. *Id.*

596 *See, e.g.*, Jonathan Athens, *Oil Refinery a Slippery Issue*, YUMA SUN, Aug. 20, 2004; Jonathan Athens, *Refinery Permit Subject of Public Hearings*, YUMA SUN, Nov. 8, 2004, *available at* http://sun.yumasun.com/google/ysarchive10707.html. The proposed site included "cultural resource sites" of two Native American tribes, about which the refinery owner had held two years of meetings. Jonathan Athens, *Wellton District Closer to Land Transfer*, YUMA SUN, Mar. 10, 2005, *available at* http://sun.yumasun.com/google/ysarchive12622.html.

597 Tammy Krikorian, *EPA: No Objection to Refinery Permit*, YUMA SUN, Mar. 22, 2005, *available at* http://sun.yumasun.com/google/ysarchive12823.html.

598 Jonathan Athens, *Refinery Foes Form Battle Plan*, YUMA SUN, Dec. 3, 2004, *available at* http://sun.yumasun.com/google/ysarchive11094.html; Jonathan Athens, *Board of Supervisors Unanimously Approves Land Use Change for Proposed Oil Refinery in East Yuma County*, YUMA SUN, Dec. 14, 2004, *available at* http://sun.yumasun.com/google/ysarchive11268.html (noting that, "[i]n a surprise move," opponents abandoned their plan to seek a referendum).

599 David Sharp, *Farm Leader: U.S. Needs More Refining Capacity*, YUMA SUN, Sept. 11, 2005, *available at* http://sun.yumasun.com/google/ysarchive16041.html. This lengthy process is not unique in refinery permitting. *See* 2 BRADLEY, *supra* note 74, at 1263-64 (discussing delays for projects in the 1970s).

formula specifications "required substantial investments." Environmental regulation-related investments in domestic refineries reached at least 25% of total refinery investment during the 1990s, with industry groups estimating it accounted for $102 billion in 2004 dollars, up to half of the oil industry's total environmental expenditures.[600] Many smaller refineries closed in the 1990s, in part because they lacked the capacity to meet the new fuel requirements and their owners declined investing in the upgrades needed to provide that capacity.[601] Significant investments were required in the 1990s, particularly to enable production of the 1992 RFG gasoline.[602] The FTC *Mergers* report noted that "[s]ome recent [refinery] closures have been related to the large investments required to meet new fuel specifications."[603] For example, in 2001, an Illinois refinery closed rather than make a $70 million investment to meet new product specifications.[604] "Refinery environmental investments, which peaked near $3.3 billion in 1992 ($3.9 billion in 2002 dollars) . . . accounted for about 25% of total domestic refinery capital investment during the 1990s."[605] Environmental expenditures hit a new peak in the 1990s, around the introduction of the 1992 gasoline formulation requirements.[606]

Thus, it seems likely that the combination of refinery economics' unattractiveness, capital-intensity, economies of scale, and fuel specification and locational regulatory requirements provides significant barriers to entry for the refining industry. Together, these factors may well form a greater barrier to entry than the sum of their parts. For example, the relatively low refinery profitability not only deters investment in this capital-intensive business, but magnifies the hurdle posed by the required regulatory investments. Moreover, some of these barriers apply to expanding refineries into new boutique fuel product lines. Although the FTC noted

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600 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 57.

601 *Id.* at 52; *see also* FTC, MERGERS, *supra* note 5, at 184 (stating that "the large capital investments required under recent environmental regulations may disadvantage small refineries, which lack economies of scale relative to larger ones").

602 FTC, MERGERS, *supra* note 5, at 69 ("Total environmental capital investments peaked at $4.8 billion in current dollars ($5.7 billion in 2002 dollars) in 1993 with the implementation of new product standards for gasoline, improvements to retail station tankage, and other pollution control measures.").

603 *Id.* at 186.

604 *Id.*

605 *Id.* at 69.

606 *Id.* at 82 fig.3-9.

that even if entry into refining by building entirely new refineries is not likely, entry by existing refiners into new product lines remains possible.[607] Such entry can often require significant capital investment even at an existing refinery, however. Unfortunately, the low margins are insufficient to justify the investment necessary to overcome these hurdles.[608]

The undeniable reality remains that the number of domestic refineries has steadily fallen, even as capacity has grown, leaving relatively little slack in the system if a refinery shuts down for unplanned maintenance or to weather a hurricane.[609] Planned maintenance can also be a problem, since major maintenance is typically planned up to a year in advance[610] and so may coincide with unplanned events (weather, etc.) that cause supply disruptions. Even the impressive capacity growth of the past thirty years, partially caused by the rise in utilization rates, has reduced system flexibility by leaving little unused capacity available to make up for unplanned closures.[611]

3. Crowding Out Investment

Refineries pollute the air, emitting a variety of impurities through their operations, including "fugitive emissions of the volatile constituents in crude oil and its fractions, emissions from the burning of fuels in process heaters, and emissions from the various refinery processes themselves."[612] "Evaporative losses from refinery tankage also represent a significant proportion of the total loss," particularly

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607 *Id.* at 197.

608 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 50.

609 This is what happened with the Katrina-related reduction in capacity in the Gulf Coast region refineries.

610 NPC, OBSERVATIONS, *supra* note 13, at II-4.

611 FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 76 ("High utilization rates also can contribute to price volatility and periodic supply problems. When unexpected gasoline supply disruptions occur or gasoline demand increases unexpectedly, then high refining utilization rates can mean that no or little extra refining capacity is available to remedy a supply shortage or satisfy an increase in demand.").

612 EPA, PROFILE, *supra* note 68, at 39 ("Fugitive emissions occur throughout refineries and arise from the thousands of potential fugitive emission sources such as valves, pumps, tanks, pressure relief valves, flanges, etc. While individual leaks are typically small, the sum of all fugitive leaks at a refinery can be one of its largest emission sources. Fugitive emissions can be reduced through a number of techniques, including improved leak resistant equipment, reducing the number of tanks and other potential sources, and, perhaps the most effective method, an ongoing Leak Detection and Repair (LDAR) program.").

from floating roof storage tanks.[613] As one would expect, refineries are heavily regulated under the Clean Air Act.

Controlling some of these emissions is relatively straightforward, yet sometimes costly. Simply replacing floating roof tanks with less leaky alternative storage containers and fixing leaky pipes and valves reduces pollution and can improve a refinery's bottom line. "Studies have shown that 70% of all emissions from a process unit originated from about 1% of the leaks' sources."[614] Although "[s]imply tightening of valve seals can often eliminate leakage once detected" and only a few valves are the source of most leaks,[615] identifying which of the thousands of valves in a refinery are the 1% causing the problem is time-consuming and costly.

In addition to investments in pollution control, refineries face market and regulatory pressures to invest in expanding capacity, adding the capability of processing cheaper heavy-sour crudes,[616] and upgrading equipment to meet the new fuel specifications.[617] In particular, meeting fuel standards requires expensive investments in refining equipment upgrades,[618] and refineries undoubtedly will continue to have to

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[613] Martin, *supra* note 37, at 201.

[614] *Id.*

[615] *Id.*

[616] Stock analysts favor companies with the ability to refine cheaper heavy-sour crudes. *See, e.g.*, Stock Report, ConocoPhillips, STANDARD & POOR'S (Apr. 8, 2006), at 2 (citing "considerable ability to refine heavy-sour crude feedstocks" as a positive attribute); Stock Report, ConocoPhillips, MORNINGSTAR (Mar. 29, 2006), at 2 (ConocoPhillips "is well positioned to benefit from a trend toward wider spreads between the cost of lighter, high-quality oil and heavier, low-quality feedstock."). *Compare* Stock Report, Sunoco, MORNINGSTAR (Mar. 2, 2006), at 1 (noting Sunoco is relatively less attractive because it "is unable to add a significant amount of heavy sour crude conversion capacity like many of its peers"). *But see* Stock Report, Valero Energy, MORNINGSTAR (Mar. 15, 2006), at 1 ("We think Valero's heavy sour crude refining capacity provides a nice short-term competitive advantage, but not a sustainable one.").

[617] Standard & Poor's stock analyses of refining companies see increasing restrictions on fuel composition as improving returns in refining. *See, e.g.*, Stock Report, Frontier Oil, STANDARD & POOR'S (Apr. 8, 2006), at 3 ("[W]e expect increased fuel demand amid tightened sulfur regulations for gasoline and diesel fuel, the phase-in of ethanol and the elimination of MTBE as a gasoline blending component to support above mid-cycle refining margins in 2006 and 2007."). *But see* Stock Report, Marathon Oil, MORNINGSTAR (Feb. 28, 2006), at 1 (noting refining and marketing "are brutally competitive areas where companies have to resort to being price-takers").

[618] FTC, MERGERS, *supra* note 5, at 182 ("Downstream processing units also have been important in allowing refineries to meet new environmental regulations for fuel products."). In one case, the FTC even found that synergies from a merger "were likely to contribute significantly to the continued viability of the acquired refinery in light of the upcoming investments needed to satisfy regulatory requirements for cleaner-burning fuels." *Id.* at 35; *see also id.* at 184-85 (describing synergies).

make those investments to meet the new fuel specifications and reduce pollution from operations.[619] Moreover, there are important scale economies to operating groups of refineries as a unit,[620] creating an incentive to combine refineries through acquisitions, and Wall Street, if not the FTC, views regional capacity concentration positively.

There are thus pressures on refiners to invest significant capital in multiple areas: mergers and acquisitions, reducing refinery emissions, new processing equipment for heavy crudes, new processing equipment for the new fuel formulations, and expanding capacity. These pressures mount in the context of a highly cyclical business,[621] with low returns in some years, albeit at least partially offset by high returns in others.[622] For example, returns were below zero in 1992 and near zero in 1995,[623] but reached record levels in 2005.[624] The cyclical nature of the business raises the cost of capital by making investors more reluctant to purchase equity. For example, Morningstar's spring 2006 reports on the major U.S. refiners argue that their stocks are heavily overpriced, a whopping 36% for Marathon Oil, the second largest independent refiner, and 69% for Valero Energy, the largest independent refiner.[625]

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[619] *See, e.g.*, Stock Report, Valero Energy, MORNINGSTAR, *supra* note 616, at 1 ("We expect capital spending to remain high over the next couple of years as the firm finishes making capital improvements to comply with the new Environmental Protection Agency clean-air regulations and adds capacity.").

[620] FTC, MERGERS, *supra* note 5, at 185 ("[I]t may be possible to increase the total amount of gasoline produced, or to produce it at lower cost, by blending higher octane, higher sulphur gasoline from one refinery with lower octane, lower sulphur gasoline from another refinery. The advantages of multi-refinery operation in allowing a firm to exchange intermediates probably have become more important since the mid-1980s because of the larger number of environmental mandates for gasoline specifications.").

[621] *See* Stock Report, Sunoco, MORNINGSTAR, *supra* note 616, at 1 (refining is "an economically unattractive and cyclical industry").

[622] *See, e.g.*, Stock Report, BP PLC ADR, MORNINGSTAR (Mar. 29, 2006), at 1 ("Refining and marketing activities . . . have less attractive economics [than exploration]. The industry has historically been plagued by periods of excess capacity that lead to weak—or even negative—gross profits.").

[623] FTC, MERGERS, *supra* note 5, at 72.

[624] *See, e.g.*, Stock Report, Tesoro, MORNINGSTAR (Mar. 2, 2006), at 1 (noting "refiners have been riding a cyclical high and raking in the profits" and that Tesoro's "gross refining margins increased more than 75% from 2003 to 2005"); Stock Report, ConocoPhillips, MORNINGSTAR, *supra* note 616, at 2 ("ConocoPhillips is reaping the benefits of refining margins that are well above historical averages.").

[625] This was calculated by comparing the "fair price" with the "current price" (price as of the report date).

Investing in emissions control and boutique fuel processing restricts refiners' ability to invest in increasing capacity. That is, the opportunity cost of the environmental spending likely reduces capacity expansion. Investment in upgrading refineries to meet environmental requirements and add the capacity to produce boutique fuels, which the American Petroleum Institute (API) estimates at $47 billion in the last decade, may be crowding out investment in upgrading capacity. As API's Edward Murphy noted, such investment "is going to cost you money and the only thing you will get is cleaner air and less emissions—which are good—but no new capacity."[626] For the past thirty years, U.S. refining capacity has grown exclusively through increasing capacity in domestic refineries (rather than from new refineries), a trend likely to continue,[627] which suggests that the industry's ability to keep pace with demand will be reduced by the capital needed to meet regulatory requirements. Furthermore, these regulatory-related investments impede the industry's ability to make domestic refineries more flexible in their inputs, such as adding more heavy-crude processing capacity. The ability and incentive to invest in innovation are also crowded out: "Almost all that is changing today is driven by environmental regulation, causing refiners to tweak the existing processes. The technology introduced in the last 15 years has been centered on catalyst improvement, not new processes."[628]

If refineries in the United States cannot meet domestic demand, of course, the United States might be able to import gasoline from foreign refineries.[629] European refineries often produce a surplus of gasoline, primarily because of Europe's greater demand for diesel fuel for passenger vehicles and, to be sure, the United States has imported significant amounts of gasoline from Europe in the past decades.[630] Some refineries outside the United States have significant cost advantages

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[626] Mouawad, *supra* note 577.

[627] FTC, MERGERS, *supra* note 5, at 197 ("Future supply increments are expected to come from expansion of existing refineries and increased reliance on imported refined products rather than the opening of new refineries.").

[628] LEFFLER, *supra* note 40, at 5; Jones, *supra* note 116, at xxi (noting that regulatory product specifications are one of the factors which "has a significant influence on the prioritization of technological development within the industry").

[629] Gasoline imports rose during the 1990s, from 4.7% of supply in 1992 to 9.7% in 2004. FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 59. The FTC expects imports to grow further in the future. FTC, MERGERS, *supra* note 5, at 61.

[630] *See* Alexei Barrionuevo, *Europe Drives Up Gas Exports, Keeping U.S. Pump Prices Low*, WALL ST. J., Oct. 28, 2002, at A1.

because of lower labor and regulatory costs. For example, in the early 1970s—before much of the Clean Air Act's impact—refineries in the Caribbean had a forty to sixty cent per barrel cost advantage over U.S. Gulf Coast refineries.[631] In some cases, these cost advantages can make imports of gasoline competitive despite the increased transportation costs. Boutique fuel specifications, however, reduce the ability of foreign refineries to export gasoline or blendstocks to the U.S. market. There is, thus, some question about whether imports of gasoline and blendstocks will be able to expand significantly if the growth of U.S. refinery capacity begins to lag behind the growth of demand.

4. Cumulative Market Impacts

These negative regulatory market externalities have weakened the gasoline market's competitive forces. Consequently, the market is slower to adjust to supply disruptions, less likely to produce arbitrage opportunities, and more insulated from market pressures for innovation. While the refining industry is competitive when market concentration is measured against a national market, with relatively low standard measures of concentration,[632] the same is not true of specific markets. For example, the California market, separated from the rest of the country by both geographic isolation and the CARB boutique fuel specifications, is quite concentrated. Indeed, before the CARB specifications, the standard measure of market concentration (HHI)[633] fell from 1,434 in 1985 to 1,184 in 1990, but rose again to 1,475 in 2003 after the CARB specifications were introduced. It would have been significantly higher had the FTC not forced divestitures of several refineries during mergers in that period.[634] For example, the FTC calculated that the Exxon/Mobil and Chevron/Texaco mergers would have produced an HHI of 2,377

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[631] NPC, FACTORS AFFECTING, *supra* note 61, at 6-7.

[632] FTC, MERGERS, *supra* note 5, at 191.

[633] Herfindahl-Hirschman Index is a "commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. The HHI number can range from close to zero to 10,000." Investopedia.com, Herfindahl-Hirschman Index, http://www.investopedia.com/terms/h/hhi.asp (last visited Apr. 12, 2007).

[634] FTC, MERGERS, *supra* note 5, at 196.

for the CARB market in the absence of the divestitures.[635] Moreover, the boutique fuel specifications limit competition from foreign refineries.[636]

While there are reasons to be skeptical of the FTC's analyses of market competitiveness, the point is not whether any particular energy company merger should proceed. Rather, the point is that more sophisticated analyses of the gasoline market, analyses which pay attention to fuel specifications and pipeline connections, suggest that the market is less competitive than the national statistics indicate. Because much of the data necessary to evaluate the competitiveness of submarkets is proprietary and unavailable to the public, we cannot directly test this hypothesis. The available evidence, however, comports with our analysis.

Why does this matter? The total impact of the various environmental regulations described above is more than the mere sum of its parts. These combined trends, together with the other industry and general economic trends noted earlier, suggest that the United States depends on a smaller number of larger refineries clustered in fewer geographic locations and connected by fewer pipelines than it would without these policies. Of course, environmental regulations are hardly the only cause of this situation. Indeed, we contend that the current situation stems from bad policies and industry trends spanning the entire twentieth century. However, on the margin, environmental regulations have exacerbated these other trends, leaving the United States dependent on a refinery infrastructure more vulnerable to natural disasters, terrorist attacks, and industrial accidents than it would be if different environmental policies had been pursued.

C. Incentives for Fragmentation: Gasoline and the Structure of the Clean Air Act

Two structural features of the Clean Air Act frame the context in which regulators design the programs they implement. First, the Act establishes national ambient

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635 *Id.* at 197; *see also* KEITH LEFFLER & BARRY PULLIAM, PRELIMINARY REPORT TO THE ATTORNEY GENERAL REGARDING CALIFORNIA GASOLINE PRICES, at chart 7 (1999) (noting that the seven largest refiners of California gasoline had a total market share of 95% in the late 1990s).

636 *See, e.g.*, Stock Report, Valero Energy, MORNINGSTAR, *supra* note 616, at 2 (stating that "the limitation of refined product imports because of new EPA regulations" makes domestic refiners' stocks more attractive).

standards.[637] These standards are generally to be achieved through SIPs, largely drafted by state environmental agencies.[638] The state agencies must demonstrate through EPA-approved emissions models that their SIPs' combined restrictions will yield compliance with the national ambient standards and other requirements of the Clean Air Act.[639] Thus, states must achieve the relevant ambient standard by effectively allocating the emissions among the sources (including new sources) within the state's jurisdiction.[640] The ability to allocate additional emissions is valuable, because a state that cannot provide for emissions from new or expanding sources will be shut off from economic growth.[641]

Second, the Clean Air Act treats mobile and stationary sources differently.[642] Stationary sources are subjected to national technological requirements as well as highly specific operating restrictions included in the SIPs.[643] As significant stationary emissions sources, refineries are heavily regulated under the Clean Air Act and emissions controls erect more barriers to entry, blocking new refineries.[644]

Until the 1990 Clean Air Act Amendments, mobile-source pollution control primarily involved the EPA regulating tailpipe emissions when new cars left the factory.[645] States enjoy very limited authority over vehicle emissions systems, primarily to prevent fragmentation of the automobile market.[646]

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637 This paragraph draws on Andrew P. Morriss, Bruce Yandle & Andrew Dorchak, *Regulation by Litigation: The EPA's Regulating of Heavy-Duty Diesel Engines*, 56 ADMIN. L. REV. 403, 408-09 (2004) (describing basic framework of Clean Air Act regulation).

638 Andrew P. Morriss, *The Politics of the Clean Air Act*, *in* POLITICAL ENVIRONMENTALISM, GOING BEHIND THE GREEN CURTAIN 263 (Terry L. Anderson ed., 2000) (overview of SIP process).

639 *See* Morriss, Yandle & Dorchak, *supra* note 637, at 415-21 (overview of EPA modeling).

640 States cannot allow deterioration of better-than-standard ambient conditions to the ambient standard and there are qualifications necessary with respect to toxics pollutants as well. These are beyond the scope of this article.

641 Morriss, Yandle & Dorchak, *supra* note 637, at 408-09.

642 *Id.* at 412-15.

643 *Id.* at 412.

644 *See* NPC, ADEQUACY, *supra* note 59, at 41 ("The ongoing requirement for environmental expenditures coupled with the need to make significant investments for product quality changes will result in capital expenditures by the industry approaching the maximum historical levels.").

645 Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 37-42 (noting that most of the improvement in mobile source emissions from 1970 to 1990 came from measures in the design of engines and exhaust systems).

646 Morriss, Yandle & Dorchak, *supra* note 637, at 412-13.

Consequently, the improvements in mobile-source emissions were largely driven by EPA action, with California contributing through its unique authority to impose additional exhaust-system controls.[647]

Although states may also impose transportation controls, these are politically unpopular and rarely used.[648] Instead, states more commonly adopt inspection and maintenance (I&M) programs, which are also unpopular and rarely effective.[649] As a result, a state's primary politically feasible means of reducing mobile-source emissions today is regulation of gasoline blends sold within the state.[650]

In the late 1980s and early 1990s, the EPA faced an increasingly serious regulatory problem with respect to ozone. "Of the 29 urban areas required by the Clean Air Act Amendments of 1990 to submit State Implementation Plans, 27 were unable to submit plans that showed attainment by the mandated date of 1998."[651] This sparked interest in new methods of regulation, including a focus on fuel composition.[652] The ozone problem proved technologically difficult to solve, because ozone production by its precursors depends on a variety of conditions.[653] Moreover, the scant knowledge about actual fleet emissions "leads to substantial uncertainties in the calculations of emissions."[654] Nevertheless, the 1990

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[647] *See* Morriss, *supra* note 638.

[648] Morriss, Yandle & Dorchak, *supra* note 637, at 412-13.

[649] *See* Todd A. Stewart, *E-Check: A Dirty Word in Ohio's Clean Air Debate—Ohio's Battle over Automobile Emissions Testing*, 29 CAP. U. L. REV. 265, 285-96 (2001) (describing battles over I&M program in Ohio). Nonetheless, even ineffective I&M programs generate credits in the EPA's mobile source models. On the ineffectiveness of I&M programs, see NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 96 ("I&M can, in principle, detect a malfunctioning control system. In practice, however, the test has been too simplified in most locations to detect more than a few possible malfunctions.").

[650] Little attention was paid to this until the 1990 Clean Air Act Amendments authorized fuel regulation.

[651] NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 17.

[652] *Id.* at 18 ("With the persistence of the ozone-pollution problem comes the need to develop new and innovative approaches to lowering ozone-precursor emissions. The federal RFG program is but one example of a new approach that is being promulgated to address this need.").

[653] *See id.* at 23 ("[T]he rate of ozone formation is a complex and variable function of the concentrations of VOC and NO_X as well as meteorological conditions. As a result, establishing the relative benefits of VOC and NO_X emission controls can be a difficult and challenging task."); *id.* at 23-29 (explanation of NO_X/VOC interaction); *id.* at 69 ("[N]ot only does ozone formation respond differently to different VOC species, but it will often respond differently to the same compound in different locations or during different episodes at the same location.").

[654] *Id.* at 66.

Amendments required states to revise their SIPs to bring ozone nonattainment areas into attainment by statutory deadlines and set interim targets.[655] In addition, states could "opt in" to the mandatory RFG program as one means of reducing ozone precursor emissions.[656] The EPA could still require delays in such opt-ins, however, if delays would help maintain sufficient supplies of RFG gasoline for the mandatory markets.[657] Because of the political unpalatability of serious I&M programs and driving restrictions, states had few options beyond boutique fuel requirements.

Regrettably, some of these mandates were imposed without supporting data. For example, "[w]hen the 1990 Clean Air Act Amendments were passed, there was little quantitative information on the relation between fuel composition and emissions, especially regarding oxygenates, on which to base prescriptions for changes in fuel properties that would reduce the ozone-forming potential of emissions."[658] But once these programs are entrenched, they are difficult to dislodge,[659] even when environmental benefits prove elusive.[660] For example, the requirement that ethanol be blended into gasoline nets no

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[655] NPC, 1990S, *supra* note 63, at 9 ("States are to use the existing State Implementation Plan (SIP) process to impose the necessary measures to bring their nonattainment areas into compliance by [the 1990 Act deadlines]. States with moderate, serious, severe, and extreme ozone nonattainment areas must achieve interim reductions in VOC emissions of 15 percent by 1996 and 3 percent per year thereafter until attainment is reached.").

[656] *Id.* at 12 (Los Angeles, San Diego, Houston, Chicago, Milwaukee, Baltimore, Philadelphia, New York, and Hartford).

[657] *Id.* (On application of a governor, another area can opt in to the RFG program effective January 1, 1995, but the EPA can delay it for up to three years if there is insufficient domestic capacity for RFG production.). Refiners were concerned about opt-ins, telling the NPC's consultant that there was "a need for cautious management of opt-ins" and that they saw "the potential for uncontrolled actions by state and local governments seriously crippling the industry's ability to meet compliance requirements." *Id.* at 7.

[658] Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 43. "[I]n retrospect we see that oxygenates represent a reasonable approach to limit CO emissions and maintain octane ratings in the face of other composition changes but appear to offer negligible benefits in terms of decreasing atmospheric ozone formation." *Id.*

[659] *See, e.g.*, Stewart, *supra* note 649 (discussing difficulties in ending an I&M program in Ohio once established).

[660] PEARSON, *supra* note 132, at 88-89 ("Adding oxygenates to gasoline reduced hydrocarbons and carbon monoxide in both current and older vehicles, but had no significant effect in more modern vehicles. One reason could be that modern vehicles have much lower hydrocarbon and carbon monoxide emissions because of their efficient exhaust catalyst systems. There was no significant effect of adding oxygenates on emissions of nitrogen oxides except for low-aromatic fuels, where the addition of MTBE increased NO_X.").

environmental benefits,[661] but provides important economic benefits for politically powerful interests.[662] Moreover, mandating specific fuel ingredients has stunted technological development. Ethanol and MTBE, for example, both boost octane and compete with refining processes like catalytic cracking that can raise octane more economically.[663] In addition, gasoline characteristics may increase pollution in one vehicle while reducing it in another.[664]

Moreover, both federal and state environmental regulators must balance allocating emissions among stationary and mobile sources. Permission to emit is valuable, and emissions allocated to one source are unavailable for use by another. A state seeking new industry must allocate the new polluters sufficient permits to emit. But if the state's emissions are fully allocated, it must reduce existing emissions in order to permit a new source. In the absence of markets, this can occur in only two ways: (1) the state must reduce an existing stationary source's emissions, taking a valuable right away from an existing source, or (2) the state must acquire emissions credits by altering the EPA's calculation of mobile-source emissions by adopting more stringent emissions controls, imposing gasoline formulation requirements, transportation controls, or an I&M program. Transportation controls and I&M programs impose direct, politically unpopular costs on automobile owners. Emissions controls, on the other hand, raise the cost of new cars in a way that is hidden from car buyers, and formulation requirements raise the price of gasoline (as we discuss below), while hiding the cost of this measure from consumers. Predictably, regulators find the

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661 Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 43 ("The addition of ethanol to gasoline is generally counterproductive with respect to ozone formation."); David Pimental & Tad W. Patzek, *Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybeans and Sunflower*, 14 NAT. RESOURCES RES. 65 (2005) (calculating ethanol's net energy benefits as negative). The theory behind the oxygenate requirement was that introducing oxygen into the fuel would ensure more complete burning of the hydrocarbons, leading to less CO and more CO_2 and H_2O, while reducing HC emissions. LEFFLER, *supra* note 40, at 145.

662 *See* Adler, *supra* note 158.

663 NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 105-06 ("In general, those processes [e.g., cracking] can be more economical than those that produce oxygenates; and thus, oxygenates were not initially the additive of choice for enhancing the octane number in fuels . . . .").

664 TAMINIAU, *supra* note 38, at 218 ("[C]hanges in a given property may lower the emissions of one pollutant but may increase those of another . . . [and in] some cases, results also depended on vehicle category," with changes in fuel improving emissions from some types of vehicles but not from others.).

latter two methods more politically acceptable than the former two.

The structure of the Clean Air Act's regulatory apparatus made gasoline regulation almost politically irresistible by 1990. Prior regulatory efforts had focused elsewhere, making additional regulation of tailpipe emissions, for example, even more costly as regulations moved up the marginal cost curve. The need to allow for new emissions from stationary sources created pressure to gain emissions reductions from mobile sources, and fuel regulation was the most politically attractive of the available options. Fuel regulation avoided imposing costs on the auto manufacturers, imposed primarily hidden costs on consumers, and offered refiners the prospect of a level playing field surrounded by a regulatory fence that could deter would-be competitors through higher capital costs.

The fuel requirements also give regulators something to "sell" in the political marketplace. As the fuel mandates become increasingly complex, and are largely buried in the details of poorly indexed and massive SIPs,[665] it seems likely that they will evolve toward specifications designed to take account of the capacities of incumbent refineries in particular markets purely through technical dialogues between regulators and refineries. Political pressures can accelerate this trend; recall how quickly the energy regulations on price mutated in the 1970s.[666] As gasoline formulation requirements proliferate and become more complex, they can hardly avoid the political imperatives to evolve in a similar way.

Refiners and automobile manufacturers share some, but not all, interests. Both have an enormous investment in the future of internal combustion engine-powered automobiles. Auto makers and gasoline refiners have long recognized this interdependency and have, on a number of occasions,

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[665] *See* Morriss, *supra* note 638 (discussing SIP's massive size and complexity).

[666] LANE, *supra* note 299, at 55-56 ("The FEA and DOE amended the regulations through formal rulemaking over 200 times in the seven years following their formal promulgation in January 1974, and many of these changes were complex, multi-part amendments. . . . In addition to the regulations themselves, the various administrators of the regulations issued dozens of formal rulings on such complex matters as the definition of 'property' and the 'refiner price formula.' Furthermore, the Office of General Counsel provided over 2,800 formal interpretations of the rules to various individual firms. Finally, some 1,600 final decisions regarding exceptions, appeals, and other petitions for special relief or redress were issued by DOE's Office of Hearings and Appeals (OHA) and its predecessor offices.").

attempted cooperative efforts to address emissions.[667] Yet each prefers that the other incur the costs of environmental regulations on auto emissions.[668] For example, an analysis of a joint oil/auto company emissions control project in Europe noted disagreements over the proper allocation of pollution control responsibilities, with the oil industry arguing "that if they have to make the precise fuels the car industry wants the fuel will be so expensive that 'you will have to buy it in little bottles in the pharmacy.'"[669]

Of course, government policies have rarely been explicitly aimed at causing market fragmentation. Yet the market appears fragmented, with the federal government rejecting the conclusion that gasoline markets are national, and the FTC looking at transportation costs and refinery

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[667] Ford and Mobil formed the Inter-Industry Emission Control Program (IIEC) in 1967 in response to pressures to improve air quality. "The objective of the IIEC was to develop a powerplant and emission-control system that not only lowered emissions, but also improved fuel economy, vehicle driveability, and vehicle durability." J. ROBERT MONDT, CLEANER CARS: THE HISTORY AND TECHNOLOGY OF EMISSION CONTROL SINCE THE 1960S, at 5 (2000). The project had an initial budget of $7 million and a three-year plan. By 1971, it included thirteen companies, including six oil companies and seven car companies (only Ford of the Big Three). *Id.* at 45. A second stage began in 1974 and was completed in 1977, spending a total of $32 million during the two stages. *Id.* at 46.

> [GM] elected not to be a partner in IIEC, preferring to develop emission control technologies using its own internal resources, including personnel and facilities. Chrysler also did not join the IIEC program, electing to rely on internal resources and considerable support from its supplier base. Concerns relating to antitrust laws perhaps were an additional factor in these decisions.

Id. at 47.

In 1989, "the auto and oil industries initiated the Auto/Oil Air Quality Improvement Research Program (AQIRP) . . . The purpose of AQIRP was to develop data on potential improvements in vehicular emissions and air quality that could be realized through the use of RFG, various alternative fuels, and the development of automotive technology." NAS, OZONE-FORMING POTENTIAL, *supra* note 142, at 110. AQIRP involved 3,000+ emissions tests, twenty-six reformulated fuels, two reference gasolines, twenty 1989 cars and light-duty trucks, and fourteen older vehicles from 1983-1985. *Id.* at 133.

[668] A report on negotiations over the final report of the joint oil-auto program to develop technological data to inform regulators in the EU illustrates the tradeoffs between emissions controls based on fuel changes and those based on engine changes:

> [T]ensions arose between the two industries who were fighting hard to get the most results favorable for their industry. It often was a win-lose situation where improvements for the auto industry meant a loss for the oil industry and vice-versa. . . . [The discussions] was also described as "physically, mentally and morally very hard" and the competition between the two industries was compared to European warfare.

TAMINIAU, *supra* note 38, at 217.

[669] *Id.* at 202 (footnotes omitted).

capacity for specific blends as factors in defining regional markets.[670] A partial explanation may lie in the opportunity for a "bootleggers and Baptists" coalition inherent in the environmental regulatory scheme. As economist Bruce Yandle explained in formulating the theory, a "bootleggers and Baptists" coalition is analogous to the combination of interests supporting laws barring alcohol sales on Sunday.[671] Bootleggers support such laws because they restrict competition from legal sellers of alcohol. Baptists support the laws because of their general opposition to alcohol sales. While the bootleggers and Baptists disagree over the appropriate policy concerning many aspects of alcohol—Baptists would be more likely to support harsh penalties for bootlegging, for example, while bootleggers would not—their interests overlap with respect to Sunday liquor laws. Not only is their coalition larger than either group individually, but the Baptists provide a crucial legitimate rationale for the laws benefiting the bootleggers.

In the case of gasoline markets, the "bootleggers" are the stationary sources and automobile manufacturers, while the "Baptists" are the environmentalists, whose faith[672] includes a creed that largely rejects the power of market incentives to improve environmental quality without detailed government regulations. Both auto makers and stationary sources have a strong interest in seeing air quality improvements "purchased" through regulations on someone else.[673] Thus, shifting the cost of controlling emissions to drivers and refiners appeals to both groups. Doing so directly, however, has the potential to provoke a political response, while regulating fuel content in a manner that conceals the cost to the public through "clean fuel" mandates is less likely to draw opposition.[674] Although refiners currently bear the brunt

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670 FTC, MERGERS, *supra* note 5, at 23-24.

671 *See* Bruce Yandle, *Bootleggers and Baptists: The Education of a Regulatory Economist*, REGULATION, May/June 1983, at 12, 13.

672 *See* Robert Nelson, *Environmental Religion: A Theological Critique*, 55 CASE W. RES. L. REV. 51 (2004) (describing environmentalism's similarities to more traditional religions).

673 One example is the automobile industry's effort to reduce fuel volatility. *See* NPC, ADEQUACY, *supra* note 59, at 93 ("There is disagreement between the automobile and oil companies about the vehicle performance benefits of lower DI gasoline.").

674 *See, e.g.*, *id.* at 37 ("[S]ome costs [of fuel regulations] may not be apparent to consumers. Examples include the fuel economy loss from oxygenate addition to gasoline and the shareholder value lost from low capital returns to the industry.").

of the costs imposed through fuel regulations, their reward is a regulatory "fence" around the industry that prevents new entry, allowing them to pass along the costs of the massive investments necessary to meet the new fuel specifications.[675]

III. CONCLUSION AND RECOMMENDATIONS

While the specifics of the fragmented gasoline markets described above rest on a regulatory history unique to the United States, other countries are following the U.S. lead in modifying fuel composition for environmental reasons.[676] And to be sure, most industrialized nations have had distorted energy markets since World War II, with each choosing to warp its markets in its own fashion, making the problem of negative regulatory externalities a general one. Indeed, the tempest currently brewing in gasoline markets threatens to worsen as five related regulatory and market conditions loom along the horizon:

> (1) Refineries are becoming more complex and costly as refining technology evolves to meet the combined demands of regulators and modern engines.
>
> (2) The number of refineries is declining, even as their individual capacity increases, due, in part, to the increasing complexity and cost of refining technology. As a result, gasoline supplies are vulnerable to unplanned outages at refineries.
>
> (3) The pipeline interconnections between refineries and markets are insufficient to support a national market.
>
> (4) Boutique fuel requirements prevent gasoline blended for one location from being sold in other locations.
>
> (5) Reduced inventories leave little slack in the system for unplanned refining shutdowns.

The confluence of these conditions leaves the gasoline market vulnerable to hurricanes, accidents, crude supply interruptions, terrorists, and dictators.[677] These vulnerabilities, in turn, jeopardize market stability, threatening consumers with price

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[675] This seems particularly likely in light of the EPA's unsuccessful attempt to build a fence around the U.S. market through its foreign refiners' rule.

[676] A. Cluer, *Gasoline Processes*, *in* 2 MODERN PETROLEUM TECHNOLOGY, *supra* note 37, at 83, 85.

[677] Andy Webb-Vidal, *US Is 'Not Ready' for Chávez Oil Ban Threat*, FIN. TIMES (London), June 14, 2006 (reporting unreleased Government Accountability Office report highlighting U.S. vulnerability to oil pressure from Venezuela).

hikes and fuel shortages. Lest we overstate our case, this is not a doomsday scenario, but merely recognition of the compounded problems confronting the nation's gasoline markets.

As we have discussed, these problems have long, complicated histories. Recall that much of America's energy policy flows from its own blend of political, industrial, and regulatory interests. The Arab oil embargo in the early 1970s combined with the advance of environmentalism and helped undermine industry efforts to develop new technologies or build new refineries. As regulators convinced the industry and environmental advocates that market barriers best served the country's economic and ecological interests, the economic regulatory schemes became politically entrenched, despite their subsequent failure. These then exacerbated the burden of increasingly stringent environmental regulations adopted through the 1980s and 1990s.

Gasoline formula regulation is, we have argued, an artifact of both the structure of the Clean Air Act and the long history of gasoline regulation. The regulations fragmented the market and effectively de-commodified gasoline. Fuel composition regulations can also reduce gasoline supply by making it uneconomical to convert portions of a barrel of crude into gasoline.[678] Mandating fuel blends ignores the fact that most mobile-source emissions come from a fraction of the total vehicle pool.[679] But altering fuels affects all vehicles, and it remains an open question whether doing so is a cost-effective way to address a problem primarily caused by a small minority of vehicles. Consider as well that customizing petroleum blends is also a way for refiners to distinguish their products. Some refiners are already trying to distinguish their gasolines on the basis of environmental quality.[680] To the extent that

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[678] *See* NPC, ADEQUACY, *supra* note 59, at 99 ("For a 50ºF DI reduction, 10 to 15% of the heavier gasoline molecules must be removed and either cracked to lighter molecules or replaced. . . . [T]he NPC believes that, in general, refiners would tend to remove the heavy molecules from the gasoline pool and seek other outlets for these molecules, such as to distillate or export . . . [and cause] a gasoline volume loss of as much as 10-15%.").

[679] Calvert, Heywood, Sawyer & Seinfeld, *supra* note 133, at 40.

[680] Jones, *supra* note 116, at xxi ("Where companies have sought to distinguish the quality of their fuels in recent years it has . . . [been] more usually on the basis of environmental quality.").

market fragmentation restricts such competition, it potentially forestalls market forces that promote environmental quality.[681]

Having acknowledged such problems and traced their heritage, policy makers should begin to consider ways to mitigate future disruption and damage. One lesson from the tortured history of gasoline regulation is that sending regulators home might be the simplest way to avoid further problems. But there are lessons as well for those unwilling to rely on markets alone. In the most general terms, of course, the gasoline market must slowly be defragmented as consumers, producers, and policy makers treat gasoline as a true commodity in need of a deep and broad market. To accomplish this, we do not advocate installing another layer of top-down federal agency micromanagement. Although we recognize the entrenched political interests involved, the problem need not have only a governmental solution; the government's abysmal record in anticipating fuel trends counsels against relying on central planning solutions.[682] Furthermore, the dangers of federally mandated technical specifications are apparent from the record. By creating incentives to shift pollution reductions to fuel specifications at the time when the refining industry became most susceptible to market fragmentation, Congress and the EPA have vastly complicated the gasoline market. If Congress had instead focused on creating incentives for emissions reductions, rather than specifying technologies, gasoline refiners and auto manufacturers would have been drawn to work together to develop methods of capturing those incentives.

Rather than focus on new federal solutions, the gasoline market's regulatory schemes should be streamlined to minimize their arcane complexity, and harmonized with consistent, long-term policy agendas to limit regulators and market forces working at cross-purposes. In light of the five regulatory and market conditions listed above, we recommend removing barriers to expanding and diversifying refinery capacity and making clean fuels more desirable to producers

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[681] *See* 2 BRADLEY, *supra* note 74, at 1264-68 (discussing anti-environmental impacts of environmental regulation).

[682] Petroleum demand forecasting in particular is remarkably imperfect. Both OPEC and the International Energy Agency failed to foresee the rate at which world demand for oil grew in 2004, for example, estimating a 1.5% increase in demand when actual demand grew by 3.3%, more than twice forecasts. FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 26.

and consumers alike.[683] For example, there are moves to standardize elements of refinery design by reducing costs through the use of off-the-shelf components rather than custom ones.[684] Fragmenting the market for gasoline reduces the opportunities for such standardization. Regulators could "fast track" approval of designs based on such components, encouraging the trend.[685]

Encouraging investment that deepens the market can also help. Valero, a major U.S. refiner, made significant investments in the ability to process lower-quality "sour" crudes in recent years, investments that paid off by allowing Valero to buy cheaper crude.[686] More refiners might be following Valero's path but for the expense of regulatory compliance. Unfortunately, fuel regulation and political interests have diverted investment away from technology that could improve environmental quality and funneled it into technology like ethanol and MTBE, whose environmental virtues are dubious at best.[687] Not only is such investment a waste, but continuing such regulatory diversions threatens the overall market. An important step would be to eliminate the ethanol mandate and replace it with a performance standard. Similarly, adopting a strategy similar to that used in the lead phaseout for sulfur reductions, rather than imposing a uniform sulfur standard in a short period as the EPA has done, could spur both technological developments to reduce sulfur and increase refining capacity by allowing refineries to adapt more economically to the requirements.[688]

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683 The best incentive is to remove the disincentives and to allow market processes to work. Politically, of course, a laissez faire approach to energy issues seems unlikely. The most we can realistically hope for is a set of policies that do relatively little harm.

684 Jones, *supra* note 116, at xx.

685 The permitting process takes significant time. *See, e.g.*, NPC, ADEQUACY, *supra* note 59, at 134 (noting six to eighteen months necessary for permit applications and state agency review); *id.* at 136-40 (describing overall process times).

686 Valero Energy Corp., Annual Report (Form 10-K), at 6-15 (Mar. 14, 2005), *available at* http://eol.edgar-online.com/edgar_conv_html/2005/03/14/0000950134-05-004779.html.

687 Agencies tend not to recognize the opportunity cost of compliance. For example, one FTC report concluded that the additional costs of producing boutique fuels "made the countervailing cost savings that refineries found through technological and other advances even more important in keeping the price of gasoline relatively low during the 1990s." FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 58. This ignores the fact that these savings are not the result of the regulation and thus would have been implemented regardless of the increased costs. Such savings thus are not "countervailing," but merely fortuitous.

688 *See* NPC, ADEQUACY, *supra* note 59, at 27.

Finally, deregulatory and market-based steps should be taken to allow investors to build and expand refineries and pipelines. Recent damage from Gulf Coast hurricanes should prompt the industry and regulators to consider the strengths and weaknesses of the fuel-transportation infrastructure, with an emphasis on new and secure methods of transport designed to withstand multiple emergency refinery closings. The EPA's shift away from allowing refineries to trade off pollution increases from expansions against offsetting reductions from the same plant and the New Source Review litigation[689] against refiners slow increases in capacity through expansion of existing refineries' capacity.[690] Refiners have identified interest groups' court challenges to permits as a significant barrier to expansion of refinery capacity[691] and such challenges could certainly be resolved more quickly. Likewise, more attention needs to be paid to the rigidity of boutique fuel requirements that prevent blends in one city from being moved to another during a crisis. Doubt remains as to whether all of the touted gains from boutique fuels are even realized. Removing pollutants like lead and sulfur from the fuel supply provides net environmental benefits, assuming the octane enhancers that replaced lead are not later found to cause even worse problems. But with respect to the volatility and other more recent specifications met by altering the blendstocks used to formulate particular gasoline blends, the gains are offset by emissions from the substitute uses of the displaced blendstocks. Although the EPA attempted to prevent "dumping" of high-volatility blendstocks and refiners can alter the mix of hydrocarbons produced in refineries to some degree, there remains an empirical question about whether these changes improved environmental quality.

Empirical questions can often be answered, if anyone cares to spend the time and money on research to do so. There have been some efforts at such research. Concerns over regulation prompted many firms in the auto and refining industries to join together to examine the technical details of the fuel-engine interaction and its impact on emissions. Fourteen oil companies, together with the "Big Three" U.S. auto makers, formed the Auto/Oil Air Quality Improvement

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689 *See, e.g.*, *id.* at 140-41 (discussing NSR issues).

690 *Id.* at 27.

691 *Id.* at 118 (discussing impact of environmental justice litigation).

Research Program (AQIRP) in 1989 "to develop data on fuel/vehicle systems" to study emissions, with modeling focused on ozone and economic analysis of alternatives.[692] The participants ultimately spent $40 million on the program.[693] The AQIRP research produced data suggesting that the impact of gasolines' composition varied considerably across vehicle types and ages.[694] It also showed that at least some changes traded decreases in one pollutant for increases in another,[695] while others had unambiguously positive impacts on emissions.[696] Encouraging such research through clear restrictions on antitrust actions could vastly expand our knowledge of how fuel composition affects the environment.

More speculatively, one wonders what might happen if U.S. gasoline markets were not fragmented. There are clear relationships between fuel properties and engine emissions (as well as between fuel properties and other aspects of engine performance). In the absence of gasoline composition regulation, how might these be addressed? A hint of this alternative future lies in the ASTM fuel specification (D4814) created in 1988 and modified in 1994 by the private standards organization. This specification includes multiple classes of fuels.[697] The trend in the United States is away from using it

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692 MONDT, *supra* note 667, at 199; Blackmore, *supra* note 92, at 247 ("The project aimed to develop data to help regulators meet the US goals for cleaner air, and was the largest and most comprehensive of the type ever undertaken. . . . [T]he project . . . embraced not only vehicle fuel-emission measurements but also air-quality modeling and economic analysis."). The program involved Chrysler, Ford, and GM plus Amoco, Arco, Ashland, BP, Chevron, Conoco, Exxon, Marathon, Mobil, Phillips, Shell, Sun, Texaco, and Unocal. PEARSON, *supra* note 132, at 83. This cooperation was motivated in part by fear that alternative fuels (e.g., methanol) would be mandated based on their perception as "clean" fuels. "Automobile and oil companies, traditionally uncomfortable partners, joined forces in order to quantify the possible improvements in emissions due to changes in conventional fuel composition." *Id.* at 82.

693 PEARSON, *supra* note 132, at 85.

694 *Id.* at 87 ("Reduction of gasoline aromatics content from 45% to 20% produced the interesting result of hydrocarbon emissions being reduced by some 6% for current vehicles and increased by 14% for older vehicles. . . . Nitrogen oxides were reduced by 11% in older vehicles, yet there was no significant effect in current vehicles.").

695 *Id.* at 88 ("Reducing gasoline olefin content from 20% to 6% increased hydrocarbons by 6% and decreased nitrogen oxides by 6% for both current and older fleets.").

696 *Id.* ("Reducing sulfur . . . from 450 ppm to 50 ppm reduced all pollutants in current fleets substantially by improving the efficiency of the catalytic converters. Hydrocarbon emissions were reduced by 18%, carbon monoxide by 19%, and nitrogen oxides by 8%. Air toxics were reduced by 10%.").

697 Blackmore, *supra* note 92, at 246 (six vapor-pressure classes and five vapor-lock classes).

due to Clean Air Act fuel requirements, but the reliance on a private standards organization is an alternative path for resolving the conflict between the gasoline refiners and auto manufacturers over responsibility for emissions reductions.[698] Market-based measures also have the potential to produce innovative contractual measures that improve air quality. Creative contracting is important, both for consumers of fuels such as trucking companies and airlines, and for refiners seeking stable, long-term supplies of crude.[699] Thus, given the dangers of a highly fragmented boutique gasoline market with depleted refinery capacity and low inventories, market-driven incentives should be developed to ameliorate future risks and economic disasters. In the meantime, burdensome economic and environmental regulatory entanglements should be loosened to spark innovation. To borrow a line from country singer Terri Clark, "Let 'em go 'cause I don't need no strings; just give me a road and a little gasoline."[700]

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[698] *See* Morriss & Dudley, *supra* note 314, at 355-56 (discussing potential roles of private standards-setting organizations).

[699] *See, e.g.*, FTC, GASOLINE PRICE CHANGES, *supra* note 9, at 30 (describing importance of futures contracts as hedges against price increases and for refiners' planning).

[700] TERRI CLARK, *A Little Gasoline*, *on* FEARLESS (Mercury Nashville 2000).