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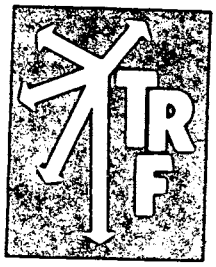

TRANSPORTATION RESEARCH FORUM
In conjunction with

Current Trends in Defining Oil Pipeline Markets for the Purpose of Measuring Competitiveness

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ABSTRACT

A current legislative issue of considerable importance centers on whether or not the interstate common carrier oil pipeline industry should be deregulated for rate-making purposes. Passage of legislation enacting economic (rate) deregulation of oil pipelines may well hinge on empirical determination of whether or not individual interstate common carrier oil pipelines have significant (monopoly) market power. While there is no consensus, there seems to be some support for using the Herfindahl-Hirschman Index as a measure for determining the market power of individual interstate common carrier oil pipelines. What is lacking in the equation for measuring significant market power is an empirical means of defining what constitutes the "markets" for crude oil and refined petroleum products pipelines. Elzinga-Hogarty methodology appears to hold promise for empirically defining interstate common carrier oil pipeline markets, permitting a scientific determination of whether or not individual oil pipelines have significant market power which would preclude their rate deregulation.

I. INTRODUCTION

In 1983, the latest year for which comprehensive aggregate statistics are available, the U.S. oil pipeline industry accounted for the movement of 24.0% (556 billion ton-miles) of the approximately 2.311 trillion ton-miles of intercity freight transported in the United States. In the same year, U.S. oil pipelines accounted for only 3.3% ($8.3 billion) of the nation's $249.7 billion intercity freight bill.[1]

It may be inferred from the statistics that oil pipelines are low-cost transporters of large volumes of intercity freight.

While the statistics suggest that oil pipelines are cost-effective transporters of large volumes of freight, thereby serving the public interest, the oil pipeline industry for the most part remains subject to rate regulation by the Federal Energy Regulatory Commission (FERC). Oil pipelines which operate on a purely *intra*state basis are generally exempt from federal regulation. The regulation of these systems in the public interest is usually a state government responsibility. Also exempt from federal regulation are privately owned interstate oil pipelines which do not transport crude oil and refined petroleum products on a common carrier basis because their owners have elected to keep them exempt from federal regulation. Non-regulated oil pipelines in 1983 accounted for only about 10.0% of total oil pipeline revenues.[2] Thus, the vast majority of the U.S. interstate oil pipeline industry—more than 100 separate interstate common carrier oil pipeline companies competing with one another and with other modes of transport and supply of petroleum for market share—remain subject to rate setting and suspension by FERC.

It is important to note that interstate oil pipelines are separate entities from interstate natural gas transmission systems. Interstate natural gas transmission companies are recognized to be franchised monopolies. They must obtain federal certificates of convenience and necessity to enter or abandon service areas. Such is not the case with oil pipelines. Oil pipelines enter or abandon service areas based on their own economics, emphasizing the fact that they are competitive ventures.

Interstate common carrier oil pipelines were first made subject to federal rate and anti-discrimination regulation in 1906, when John D. Rockefeller's Standard Oil Co. controlled the majority of the interstate oil pipeline mileage in the nation. Much has changed since 1906. As already noted, more than 100 separate interstate common carrier oil pipeline companies now compete with one another and with other modes of transport and supply in the national petroleum transport market.

In recognition of this fact, the Halbouty Commission in 1981 recommended to President Ronald Reagan that interstate common carrier oil pipelines be deregulated. Subsequently, FERC in Opinion No. 154 (Williams) issued in 1982 indicated that the impact of interstate common carrier oil pipeline rates on petroleum prices to consumers was "submicroscopic" and that continued rate regulation was contrary to the public interest. Despite all this, oil pipelines remain the only segment of the competitive U.S. oil industry (excluding natural gas transmission lines) still federally regulated.

II. THE HERFINDAHL-HIRSCHMAN INDEX OF MARKET CONCENTRATION

One means, although not necessarily the best, of measuring significant market power in the current interstate common carrier oil pipeline market is the Herfindahl-Hirschman Index of market concentration.

From 1968 to 1982, the Antitrust Division of the

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U.S. Dept. of Justice made decisions on whether or not to challenge corporate mergers based on market shares of the largest competitors in individual markets. Justice used one sliding scale in deciding whether or not to challenge proposed mergers in "highly concentrated industries," and a second sliding scale in making decisions on mergers in "less highly concentrated industries." Necessary to utilization of this methodology was knowledge of the market shares of the four largest competitors in an industry (the CR4 Index) and of the eight largest competitors in an industry (the CR8 Index).[3]

In 1982, Justice issued new standards for "What Mergers Will Be Challenged" based on Herfindahl Indices of market concentration.

The Herfindahl Index originated essentially in a 1950 Columbia University Ph.D. dissertation by Orris Herfindahl entitled *Concentration in the Steel Industry*.[4] Herfindahl (now deceased) measured the market shares of various steel companies in markets which he defined, and then squared the sum of the market shares of individual competitors to derive an overall market concentration index.

In Herfindahl's schema, if company A had 100% of the market in market X, its Herfindahl Index would be 100 × 100 = 10000, the "worst case" of pure monopoly.

More realistically, if company A had a 42% market share in market X, company B had a 29% share and company C had a 21% share, the Herfindahl Index (H-Index) for company A would be 42 × 42 = 1764; for company B would be 29 × 29 = 841; and for company C would be 21 × 21 = 441. The three competitors combined have a 42% + 29% + 21% = 92% market share. The H-Index of concentration in market X is thus 92 × 92 = 8464, a considerably higher number than would be obtained by simply adding the individual company H-Indices (1764 + 841 + 441 = 3046). It must be assumed in this example that unidentified competitors have the remaining 8% of market, but that the three identified competitors account for a high degree of market concentration.

Today, the Herfindahl or H-Index of market concentration is generally called the Herfindahl-Hirschman or H-H Index of market concentration in recognition of work by Prof. Albert O. Hirschman of Princeton University, who in 1945 published a book entitled *National Power and the Structure of Foreign Trade*[5] which preceded Herfindahl's dissertation. Hirschman used a market shares squared set of equations in his book to measure market concentration in international trade, but ultimately returned to square roots when discussing percent age market shares.

Hirschman in 1964 wrote to the *American Economics Review* to protest that his 1945 invention was being variously referred to by scholars as the "Gini Index" after an Italian who had nothing to do with it or as the "Herfindahl Index" after Orris Herfindahl who did.[6] From this point forward, scholars gradually began referring to the measure as the Herfindahl-Hirschman Index, or "HHI" for short, in recognition of Hirschman's pioneering work.

In 1969, M.A. Adelman in the *Review of Economics and Statistics* evaluated the usefulness of the HHI measure and suggested that it might be preferable in some instances to the more conventional indices of market concentration.[7]

In 1973, Dr. Betty Bock of the Conference Board and Dr. J. Fred Weston of the Graduate School of Management at U.C.L.A. used the HHI in expert witness testimony in a case before the Federal Trade Commission regarding the Litton Industries acquisition of two German typewriter manufacturers. They argued that the sum of the market shares squared HHIs for Litton's Royal-McBee typewriter division combined with the two German firms still indicated Litton had only a trivial degree of market concentration in a typewriter market dominated by IBM. The hearing examiner was impressed with the testimony, in which the HHI appears to have first found its way into the annals of antitrust literature, and ruled in favor of Litton retaining the acquisitions. The FTC commissioners, however, reversed the examiner, saying the traditional CR4 Index was an adequate measure of market concentration and required Litton to divest the German firms.[8]

From 1973 forward, a gradual preference for the HHI over the CR4 and CR8 Indices began to emerge among antitrust scholars. In 1977, Richard Schmalensee in an article in the *Review of Economics and Statistics* compared the merits and weaknesses of HHIs vs. CR4-CR8 Indices and concluded that the HHI might be a preferred measure in certain cases.[9] By 1980, Professors Phillips Areeda and Donald L. Turner in Vol. IV of their influential *Antitrust Law* text indicated a preference for the HHI over conventional market concentration measures.[10] In a *New York Times* interview published in February 1981, Prof. William F. Baxter, immediately prior to his appointment as Assistant Attorney General in charge of the Antitrust Division of the Justice Dept., indicated that he would take a dim view of any merger which produced an increase of more than 100 points in the Herfindahl Index of market concentration of an industry.[11]

In 1982, with Baxter appointed Assistant Attorney General, the Justice Dept. issued its new HHI-based standards for determining in what instances it would likely challenge proposed corporate mergers. In simplified terms, Justice said that where the H-Index of market concentration did not exceed 1000 following a merger, the merger would probably not be challenged on antitrust grounds. Where the post-merger market had an H-Index of 1000 to 1800, a challenge of the merger would not be likely unless the merger produced a post-market H-Index increase of more than 100. In highly concentrated industries where the H-Index before a merger was higher than 1800, any merger that would increase the Index by more than 50 points might be challenged.[12]

Aside from some minor modifications issued in 1984, this basic schema has been the merger challenge standard for Justice since 1982.

The next important step in emergence of the HHI as an oil industry regulatory measure occurred in May 1984, when the Antitrust Division of the Justice Dept. issued *Competition in the Oil Pipeline Industry: A Preliminary Report*.[13] In this report, Justice computed HHIs for crude oil and refined petroleum products pipelines by origin points and destination points. Justice defined the "market" for oil pipeline origin and destination points as the Business Economic Areas (BEAs) in which oil pipelines operated injection facilities or served delivery terminals. There are 183 BEAs covering the 50 states of the United States. Justice computed origin and destination HHIs for crude oil and refined products

pipelines in the 181 BEAs of the lower-48 states, excluding the BEAs of Alaska and Hawaii from the study.

In the report, which extended the HHI from the merger to the regulatory arena, Justice indicated it was considering a standard whereby oil pipelines with HHIs in excess of 2500 in one or more BEAs might be recommended for continued regulation, while those below this threshold would be recommended for deregulation. While the *Preliminary Report* did not specify by names which of the more than 100 interstate common carrier U.S. oil pipelines would be recommended for deregulation and which for continued regulation, Assistant Attorney General Douglas Ginsburg (who replaced Baxter) said at a press conference at which the report was released that perhaps 10 to 17 high-volume oil pipelines in the lower-48 states had HHIs sufficiently large to warrant a recommendation from Justice for continued regulation.

III. RECENT STUDIES OF U.S. OIL PIPELINE CONCENTRATION

Four recent studies of U.S. oil pipeline concentration bear directly on the issue of legislative rate deregulation of oil pipelines.

The first is a Ph.D. dissertation by John Hansen later published in book form which studies oil pipeline market concentration.[14] The second is a study by Dr. Edward J. Mitchell into "worst case" market niches.[15] The third is a study by National/Economic/Research/Associates, a private consulting firm. 16 The fourth is the Justice Dept. *Preliminary Report* already cited. (Excluded from the list is a fifth study by Leonard Coburn dealing primarily with oil pipeline sizing that has been a source of data for several major concentration studies.)[17]

The following table at bottom of page summarizes the definitions of oil pipeline "markets" used in the four major studies.

Needless to say, the authors of the above studies come up with considerably different conclusions from one another in regard to the existence of significant oil pipeline market power because they have arbitrarily defined what constitutes origin and destination markets for crude oil and refined products pipelines. Such contradictory findings will likely continue to prevail until researchers agree upon a method for empirically defining these markets.

IV. FALLACIES ARISING FROM LACK OF EMPIRICAL DEFINITION OF OIL PIPELINE MARKETS IN CURRENT STUDIES OF MARKET POWER

For scholars to reach consensus in estimating oil pipeline market power, it is necessary that researchers agree on a definition of oil pipeline markets. The failure of researchers to date to empirically define such markets has led to what appear to be false conclusions about oil pipeline market power.

Colonial Pipeline Co., by way of demonstrating weaknesses arising from current lack of agreement on market definition, is the nation's largest volume refined petroleum products transporter based on annual ton-miles moved. While Colonial now transports less than 7% of total annual petroleum ton-miles in the nation, it might still be assumed that it is among the U.S. oil pipelines which could exhibit market power if such a thing exists at all in the oil pipeline industry.

Colonial analysis of current oil pipeline market power studies indicates that researchers have considerably overestimated Colonial's market power by failing to recognize the true market in which Colonial competes. That market is much larger than the BEAs, SMSAs, refining centers, market niches or even states which have been used as geographic definitions of markets in current studies.

Colonial directly serves delivery terminals in only 24 BEAs in a 13-state delivery area extending from Louisiana in the Gulf Coast through Georgia-Tennessee and on up the Eastern Seaboard to New York City.

But if the modal market radius of a typical refined petroleum marketing terminal served by Colonial is considered, it quickly becomes obvious that Colonial's true delivery market is much larger than 24 BEAs in 13 states. The typical refined petroleum products terminal in Colonial's Eastern Seaboard market in 1984 served a modal radius of 100 miles by truck.[18] Thus, pro ducts delivered by Colonial to terminals in south Georgia are trucked to cities in Florida such as Tallahassee, giving Colonial market share in Florida even though Colonial does not directly serve any terminals in Florida. Similarly, products are trucked from Colonial-served terminals in Tennessee to Kentucky and Arkansas, from Virginia to West Virginia and so on. Using the modal radius test, Colonial has determined that it provides direct service to 55 BEAs rather than the 24 BEAs

Definitions of Oil Pipeline Markets in Four Recent Studies

Market	Hansen	Mitchell	N/E/R/A	DOJ
Crude Origin	17 states	28-59 "niches"	182 largest oilfields	181 BEAs
Crude Destination	39 refinery markets	59 "niches"	42 refining centers	181 BEAs
Product Origin	27 states	48-59 "niches"	44 refining centers	181 BEAs
Product Destination	61 SMSAs	59 "niches"	183 BEAs	181 BEAs

evaluated by the Justice Dept. As is explained below, these 55 BEAs do not represent the full extent of Colonial's market. In this 55-BEA market area, Colonial must compete with coastal tankers and barges plying the route from the Gulf Coast to the Eastern Seaboard, with Plantation Pipe Line which also originates in the Gulf Coast and approximates Colonial's route to Virginia, and especially, with the vast refining complex of the Eastern Seaboard which directly supplies much of the refined products needs in Colonial's northern delivery zone.

At the next level of competition, Colonial interconnects at a number of points with carriers other than trucks. Products delivered to the New York harbor area by Colonial are barged and tankered to New England, giving Colonial market share in this six-state market. Products are also transferred from the Colonial system to other pipelines such as Plantation and Harbor, but especially, to Laurel, ARCO and Buckeye. These latter connections extend Colonial's market throughout the Upper Great Lakes area from Upstate New York to Northern Illinois. At this level, it begins to appear that Colonial competes in a delivery market that consists of all states east of the Mississippi River plus Louisiana. At one level of competition higher, Colonial's primary origin points are in the vast refining complex of the Texas-Louisiana-Mississippi Gulf Coast (with very small volumes also originating with an Alabama refinery). At the origin point level, Colonial competes for market share with other pipelines originating in the Gulf Coast but serving U.S. markets not served by Colonial. Colonial, in other words, must compete in the Gulf Coast origin market with other pipelines serving the Midwestern market, the market between the Rocky Mountains and Mississippi River and the West Coast market. At this level, the market in which Colonial competes appears to be the entire lower-48 states, rather than 24 Gulf Coast and Eastern Seaboard BEAs.

Finally, at the macroscopic level, Colonial must compete in its Eastern Seaboard market with refined petroleum products imported from foreign nations. Refined products landing at ports from Georgia through New York City increased from 54.1 million barrels in 1982 to 140.6 million barrels in 1984. This 160% increase in imports of pipelineable refined products has had significant negative impact on Colonial throughput from the Gulf Coast to the Eastern Seaboard. Such macroscopic data suggest that Colonial competes in a worldwide rather than a national market.

Now, what is the *true* market in which Colonial competes, the market in which it would be most appropriate for Justice and academic researchers to measure its degree of market power? Is the true market the microscopic seven origin and 24 destination BEAs, the macroscopic worldwide market, or some market that lies between the two extremes?

For reasons more fully discussed below, Colonial considers itself to be competitive in a *national* market with more than 100 other interstate common carrier oil pipelines, with intrastate and non-regulated interstate oil pipelines, with alternate modes of transport such as tankers and barges, and with alternate modes of supply such as the refineries in its northernmost delivery area and with refined petroleum products imports which land directly in its Eastern Seaboard market. But, as discussed at pages 9-11 and 13, it also recognizes that it may be competitive in a smaller market.

By treating the rapidly growing foreign imports as competitive entrants into the U.S. Eastern Seaboard market—rather than as a form of competition requiring Colonial to consider itself to be a small component in a global pertroleum distribution system—Colonial finds itself with the following market shares and HHIs in the national petroleum transport market in the most recent years for which comprehensive statistics are available:

Colonial Pipeline Market Concentration in U.S. Market

Year	Ton-Miles of Petroleum Transported (billions)	Ton-Miles Transported by Colonial (billions)	Colonial Market Share (%)	Colonial Herfindahl-Hirschman Index
1981	1,218.4	93.7	7.69%	59
1982	1,218.2	93.0	7.63%	58
1983	1,222.6	85.5	6.99%	49

The Herfindahl-Hirschman Index is of course designed not to measure the concentration of a single competitor in a market, but rather, the concentration of all competitors. The table below provides ton-mile market shares and HHIs for the major competitors in the U.S. petroleum transportation market:

Market Shares of Major Competitors in U.S. Petroleum Transport Market (in billions of ton-miles transported annually)

	Oil Pipelines		Water Carriers		Rail		Truck	
Year	Share	HHI	Share	HHI	Share	HHI	Share	HHI
1981	46.27%	2141	50.66%	2566	1.03%	1	2.04%	4
1982	46.44%	2157	50.64%	2564	1.06%	1	1.86%	3
1983	45.49%	2069	51.57%	2659	0.96%	1	1.98%	4

It could be argued that the true market in which oil pipelines compete is the market for intercity freight, which is much larger than the market for transport of ton-miles of petroleum. Such a schema would produce much lower overall pipeline industry market shares and HHIs than reported above.
While the CR4 and CR8 market concentration indices are seldom still used, these indices for the oil pipeline industry help to show how fragmented it indeed is. In terms of barrel-miles moved, the four largest oil pipelines in 1981-1983 were Colonial, Lakehead, Sohio (including TAPS throughput) and ARCO (including TAPS throughput). The eight largest, in addition to those just named, included Exxon (including TAPS throughput), Amoco, Shell, Plantation (1981 and 1983 only) and Mid-Valley (1982 only). The following table reports market shares and HHIs for these firms in 1981-1983:

Market Shares of CR4 and CR8 Pipelines in U.S. Petroleum Transport Market

Year	Total Market (Billions of Barrel-Miles)	4 Largest Pipelines Market Share	4 Largest Pipelines HHI	8 Largest Pipelines Market Share	8 Largest Pipelines HHI
1981	8,672.5	15.62%	244	21.37%	457
1982	8,641.8	15.56%	242	21.41%	458
1983	8,640.3	15.36%	236	20.99%	441

As noted above, it could be argued based on actual Colonial deliveries and the final destinations of these deliveries that Colonial's true market consists of the states east of the Mississippi River plus Louisiana. The table below provides data on Colonial deliveries to this market vs. actual supplies to the market.

Market Share of Colonial in States East of Mississippi Plus Louisiana (000 Bbls.)

Year	Total Market	Colonial Deliveries	Colonial Market Share	Colonial HHI
1981	2,200,591	625,405	28.42%	808
1982	2,122,046	625,922	29.50%	870
1983	2,143,194	586,174	27.35%	748

It should be noted that this market configuration considers refined products only and makes no provision for market supply of crude oil. It uses barrels supplied to the market as the measure of market share rather than the more meaningful measures of barrel-miles or ton-miles transported to the market. Finally, it makes no allowance for market shares of competitive pipeline, rail and truck transport of petroleum to the market. It is simply a presentation of an alternative methodology that might be used in measuring market shares of pipelines and other petroleum transporters.

Colonial found seven major classes of errors and misconceptions in the 1984 Justice *Preliminary Report* designed to develop means of measuring oil pipeline market power. Copies of Colonial's detailing of these specific methodological weaknesses in the Justice study are available from Colonial on request. This paper addresses only one of the seven classes of error in the Justice study—Justice's use of oil pipeline capacities as they pass through BEAs rather than the more accurate measures of oil pipeline injections and deliveries.

The Justice Dept. in its *Preliminary Report* found origin and destination HHIs for Colonial considerably higher than those reported in the table at page 11. For seven Colonial origin locations, Justice found BEA-based HHIs ranging from 2006 to 9476, with a mean average origin BEA HHI of 5662. For the 24 BEAs in which Colonial directly serves delivery terminals, Justice found destination HHIs ranging from 2927 to 10000 with a mean average HHI of 6373.

Colonial has determined that a substantial amount of error in the Justice study is due to Justice using maximum pipeline capacities rather than actual pipeline originations and deliveries because capacity data was the best available to Justice. If pipeline capacities correlate highly with actual pipeline originations and deliveries, it would be empirically acceptable to use these capacities as surrogate or proxy measures for the real world. To determine the relationship between the Justice (capacity) measures and the real world, Colonial correlated its actual originations and deliveries with the Justice capacity measures. The resulting Pearson product moment coefficients of correlation—run in several different configurations—were in every case statistically non-significant, indicating the Justice HHI computations are probably erroneous artifacts resulting from use of an invalid surrogate measure of market power.

For the seven Colonial origin BEAs, the correlations between the Colonial origin capacities used by Justice and actual Colonial injections ranged from $r = -.614$ to $r = -.529$. Note the negative correlations, indicating the Justice surrogates are inverse measures of the real world. It is illogical to presume that as pipeline capacities go up injections go down or that as injections go down pipelines will add more capacity. The probability values of the correlations

ranged from $p > .14$ to $p > .18$, indicating that the inverse Justice surrogates are also statistically non-significant.

The correlations between the Justice-used delivery capacity measures for 24 BEAs in which Colonial serves delivery facilities with actual Colonial deliveries to these 24 BEAs ranged from $r = -.107$ to $r = .076$. Probability values ranged from $p > .30$ to $p > .36$. Thus, the Justice-used measure of Colonial destination market power explains from 0.6% to 1.1% maximum of the variance in actual Colonial deliveries.

Clearly, it is empirically inappropriate to use pipeline capacities as surrogate predictors for actual pipeline originations and deliveries when attempting to measure oil pipeline market power.

While much of the error in the Justice study computation of oil pipeline HHIs may be attributed to use of an inappropriate capacity measure, a considerable additional amount of error is the result of Justice misdefining oil pipeline markets as BEAs when available evidence would seem to indicate that oil pipelines actually compete in much larger geographic areas. The other major studies may have similarly erred by arbitrarily defining oil pipeline markets as geographic areas smaller than the actual markets in which oil pipelines compete with a variety of modes of transport and supply.

Any market may be arbitrarily defined to such small limits that one or more competitors *appear* to have significant market power. By analogy, a grain elevator in a small Minnesota town served by no railroads and only one trucking company may be defined as a market in which the trucking company has an absolute monopoly. Similarly, defining a BEA in America's wheat belt served by one railroad and two marginal-carrier trucking companies as a market may result in the railroad appearing to have overwhelming market power. But in reality, is not wheat a nationally and even internationally traded commodity over which a number of modes of transportation including rail and truck compete with one another for transportation market share? Colonial would contend that much the same is true when it comes to transportation of petroleum, a universally consumed commodity comparable to wheat.

What then should be the correct definition of the market(s) in which oil pipelines compete with one another and other modes for market share? How might the market(s) be empirically defined so that researchers will arrive at comparable conclusions when attempting to measure oil pipeline market power?

Colonial suggests that one solution may lie in empirically defining markets by use of Elzinga-Hogarty methodology.

V. THE ELZINGA-HOGARTY TEST FOR DEFINING COMMODITY MARKETS

Elzinga-Hogarty market definition is based on the concept that a geographic area is a market only if it is reasonbly self-sufficient—*i.e.*, that the area produces approximately as much of a commodity as is consumed in the area.

To use the Elzinga-Hogarty Test (hereafter called the E-H Test) to define commodity markets, it is necessary to know how much of the commodity is produced in a given area, how much of the commodity is imported into the area, how much is consumed in the area, and how much is exported from the area to specific other areas. Thus, the E-H Test is based on *actual* market production and consumption rather than on *theoretical capacities*. To apply the E-H Test to U.S. petroleum markets, it is necessary to know the amounts of crude oil and refined petroleum products that are produced, imported into, consumed in and exported from whatever geographic unit is selected for analysis. Researchers might select as the geographic unit of analysis just about anything—counties, BEAs, SMSAs, states or Petroleum Administration for Defense Districts. But a word of caution. The sort of data required for E-H Test analysis is most readily available at the state and PADD level. Getting data by counties, BEAs, SMSAs or other grographic units for petroleum supply can be difficult if not downright impossible.

Elzinga-Hogarty originally considered 75% self-sufficiency/self-supply to be adequate to define a market. That is, they early on defined a market as an area where imports into the area and exports out of the area did not exceed local consumption by 25%. This early criterion, they concluded based on experience by 1978, was not rigid enough, and suggested amending the cutoff to a maximum of 10% imports/exports.[19] Most researchers now use the 90% self-sufficiency criterion, which means that a geographic area becomes a self-sufficient market at the point where it does not import into an area nor export out of it more than 10% of the local consumption of the commodity, producing and consuming the 90% remainder within the geographic boundaries of the market.

To apply the E-H Test, a researcher starts with a small geographic area known to contain major producers of a commodity which is exported to other comparable areas. The researcher wishing to empirically define markets using the county as the geographic unit of measure might thus decide to start with Jefferson County, Texas, site of the still producing Spindletop field, knowing it to be a crude exporter. The researcher using the state as unit of measurement might start with Alaska, knowing it to be a large exporter of crude oil to other states.

The researcher must of course know how much of the commodity is consumed locally, how much is imported into the area, how much is exported, and the destination of the exports. In the case of Alaska, for example, data is available for the amount of crude that is produced, the amount that is consumed within the state (primarily by the MAPCO North Pole refinery), the amount of crude that is imported (zero), the amount that is exported, and the destinations of the exports.

If the greatest amount of crude exported from Alaska is imported by California, Alaska and California are "joined" as a market by the E-H Test. If the new two-state market still exports more than 10% of local consumption, the model then joins the biggest importer from the two-state market—which in this case might be either Texas or Louisiana, both of which import large volumes of Alaskan and to a lesser extent Californian crude. Once a market of several states emerges where supply and consumption are in balance—in this case at the 90% E-H Test criterion—the researcher starts with another state that is a large exporter of the commodity until a second market has been empirically defined. And so the process goes until the entire area of study—in

this case, the United States—has been empirically defined into specific markets.

The E-H Test has already been used to empirically define the U.S. coal transportation market in which railroads compete with one another and other modes of transport and supply for transportation market share. The E-H Test has made its way into the annals of federal antitrust literature and has been accepted as valid methodology for empirically defining commodity markets.

Application of the Little (exported) Out From Inside (LOFI) and Little (imported) In From Outside (LIFO) criteria of the E-H Test to the U.S. coal transport market suggests that railroads and other coal transporters and suppliers compete in a national market for share of the coal transportation business. Since oil is a commodity used even more universally than coal in the United States, it is logical to assume that application of E-H Test methodology to crude oil and refined products transport markets will validate Colonial's contention that U.S. oil pipelines compete in markets much larger than BEAs, counties or SMSAs, and that products pipelines in particular compete in a national market. (The refined products market must be national in scope because refined products are universally available to consumers based on population and industrial density.)

It remains, of course, for the E-H Test to be applied to crude oil and products transport markets to prove Colonial's contention. Until such time as these markets are empirically defined, Colonial concludes it is correct in considering its true market to be the nation, and not the arbitrary geographic units defined as oil pipeline "markets" in the four major recent studies already cited.

VI. CONCLUSIONS

Major studies to date have arbitrarily and probably inaccurately defined U.S. oil pipeline markets as geographic entities much smaller than the true markets in which oil pipelines compete with one another and other modes of transport and supply for transportation market share. Evidence indicates that such questionable definition of markets has led to oil pipelines being assigned market power which they probably do not in fact possess. There is a clear need for empirical definition of the true markets in which oil pipelines compete so that an accurate estimate of their true market power may be computed. Applica tion of the Elzinga-Hogarty Test appears to hold promise as an empirical means of defining these markets.

ENDNOTE

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2. Ibid., p. 4.
3. *Commerce Clearing House Trade Regulation Reporter*. 1968. 1:Para. 4510.
4. See Herfindahl op. cit.
5. See Hirschman op. cit.
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19. Elzinga and Hogarty op. cit.

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