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THE ECONOMIC INCIDENCE OF THE INTERSTATE COMMERCE ACT OF 1887: A THEORETICAL AND EMPIRICAL ANALYSIS OF THE SHORTHAUL PRICING CONSTRAINT

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ABSTRACT

The *public* and *private* interest hypotheses permeate contemporary regulatory analyses. Both theories are used to explain the inception of the first major federal regulatory agency, the Interstate Commerce Commission (ICC). According to the public and private interest hypotheses, the regulations promulgated by the ICC benefited *either* railroads or shippers. This paper presents an alternative view consistent with the *multiple* interest theory of regulation. It is demonstrated that the major regulatory instrument of the ICC, the shorthaul pricing constraint (SHPC), altered the equilibria of railroad markets in a way which benefitted the class of shippers (shorthaul shippers) facing monopolistic railroad markets. The SHPC also benefitted some railroads by increasing the correspondence between unregulated, cooperative and regulated, noncooperative levels of longhaul shipments. The proposition that the ICC benefited shorthaul shippers and railroads is supported by an empirical analysis of the effects of the inception of federal regulation and implementation of the SHPC on stock prices. The results of the paper indicate that the public and private interest interpretations of the ICC are neither contradictory or complete, but instead are complementary. A theoretical and empirical analysis of the chief regulatory mechanism of the ICC provides this synthesis.

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Thomas W. Gilligan, William J. Marshall, Barry R. Weingast*

I. INTRODUCTION

Many positive theories of regulation posit a solitary motivation for public intervention in microeconomic markets. The *public interest* theory maintains that regulation occurs when markets fail (Bator, 1958; Baumol, 1965; and Head, 1962). Political governance of a market enhances economic efficiency by increasing consumer welfare. In contrast, the *private interest* theory holds that regulation is a mechanism of monopoly (Stigler, 1971; and Posner, 1974). Political governance of a market diminishes economic efficiency by retarding competitive processes and fostering producer profits.

These theories of regulation are deficient on many grounds. Theoretically, a *multiple interest* perspective often seems more appropriate in assessing the positive determinants of regulation, particularly when either producer or consumer groups are composed of heterogeneous classes of individuals (Peltzman, 1974; and Becker, 1984). This approach is particularly fruitful when analyzing modern environmental regulation (Ackerman and Hassler, 1981; Crandall, 1984; Elliott, Ackerman, and Millian, 1986; and Pashigian, 1985). Empirically, the evidence seldom supports either the pure public or private interest theories but, rather, seems consistent with aspects of both (Joskow and Noll, 1981). The positive power of these theories is slight, especially when used to try to explain modern economic deregulation (Keller, 1984). And only infrequently are the implications of single interest theories consistent with the explicit mechanisms of regulatory control (Hilton, 1966).

Studies of the Interstate Commerce Commission (ICC), the first major federal regulatory agency, exemplify the inadequacies of single interest theories of regulation. The *traditional hypothesis* holds that the ICC protected shippers from railroad monopolies (Buck, 1920; Benson, 1955; Bernstein, 1955; Nash, 1957; Miller, 1971; and Hoogenboom and Hoogenboom, 1974). The ICC arose to thwart the exercise of market power and, thus, was beneficial to consumers and injurious to the commercial interests of railroads. The *revisionist hypothesis* maintains that the ICC sustained railroad monopolies (MacAvoy, 1965; Kolko, 1965; Spann and Erickson, 1970; and Alexis, 1982). The ICC promoted the exercise of market power and, thus, was beneficial to railroads and detrimental to shipping interests. The chief supporting evidence for the traditional interpretation is lower prices in some (shorthaul) markets while the evidence most frequently sighted by revisionist proponents is higher prices in other (longhaul) markets. Taken together, this evidence is potentially inconsistent with either of the single interest theories. Moreover, analyzes of the political struggles surrounding the inception of the ICC indicate that both railroad and shipping interests were important considerations in the development of the final legislation (Fiorina, 1984; Gilligan, Marshall and Weingast, 1986). The regulations that emerged represented a compromise among

distinct groups. Neither of the single interest theories is entirely consistent with the explicit regulatory mechanisms contained in the Interstate Commerce Act (ICA) (Hilton, 1966).

In a companion paper, the political foundations of a multiple interest group perspective on the ICC is developed (Gilligan, Marshall and Weingast, 1986). It is shown that the ICA resulted from a coalition of shorthaul shipping *and* railroad interests. The purpose of this paper is to provide the economic foundations for this approach by examining the economic effects of the chief regulatory mechanism of the ICC. This mechanism, the shorthaul pricing constraint (SHPC), explicitly related the prices that railroads charged in shorthaul and longhaul markets. The effect of the SHPC was to decrease shorthaul prices and, provided railroads behaved as other than Bertrand competitors in longhaul markets, increase longhaul prices. The SHPC also increased the correspondence between unregulated, collusive levels of shipments and regulated, noncooperative levels of shipments in longhaul markets. Theoretically, the SHPC unambiguously increased the indirect utility of shorthaul shippers and may have increased the profits of railroads operating in both longhaul and shorthaul markets. This latter effect holds even if the competitive conjectures held by railroads in longhaul markets remain unaltered by the ICA. Thus, the ICA benefitted shorthaul shippers and could have been beneficial to railroads, even if no provisions of the ICA facilitated cooperation among railroads in otherwise competitive markets.

The conclusion that shorthaul prices declined as a result of the ICA is widely accepted, even among proponents of the revisionist hypothesis. The proposition that the ICA benefitted shorthaul shippers is further supported by an empirical analysis, conducted in this paper, of the effects of the inception of the ICC on shorthaul shipper security prices. The relationship between the ICA and longhaul prices and its interpretation is more controversial (Zerbe, 1980; and Ulen, 1983). A fundamental question in assessing theories of early railroad regulation is, however, whether the ICA enhanced railroad profitability. The theoretical proposition that railroads benefitted from the imposition of the SHPC is supported by an empirical analysis of the effects of the regulation on the prices of railroad securities. Indeed, it appears as if the primary beneficiaries were railroads insulated from pervasive state regulation influenced by agrarian interests and with extensive shorthaul markets who could, thus, rely on the SHPC to increase longhaul prices and profits. The empirical evidence is consistent with interpretations drawn from the theoretical section of the paper. The empirical analysis does not support the proposition that the ICA enhanced cooperative behavior among railroads in competitive markets.

One implication of this paper is that the single interest theories of regulation, at least as applied to the study of early railroad regulation, are incomplete but complementary. The ICA, through the SHPC, benefitted some railroads and some shippers. The fundamental deficiency in the single interest theories regarding the analysis of early railroad regulation is the assumption of homogeneity among producer and consumer groups. Shorthaul and longhaul consumers had very little in common. Each faced different railroad market structures. The problems and goals of railroads differed greatly depending on their geographical location and the nature and extent of railroad markets. A more natural coalition arose between railroads with both long and shorthaul markets and shorthaul shippers. The SHPC was a regulatory mechanism which, given the economics of the railroad industry at the time, benefitted both shorthaul shippers and railroads.

Another, more methodological, implication of this paper is that the mechanisms of regulatory control reflect the goals of and compromises among members of the coalition supporting the legislation. A major weakness of the multiple interest theory is that it lacks the clear, if erroneous, predictions of the single interest theories. By analyzing the explicit mechanisms of regulatory control, information can be gained regarding not only the incidence of the regulation, but also the economic interests reflected in the ultimate legislation.

Section II of this paper presents existing theories of early railroad regulation and a summary of the important remaining empirical issues. Section III presents a model and analysis of the effects of the SHPC on railroad rates, railroad profits and shipper welfare. Section IV contains an empirical analysis of the effects of the imposition of federal regulation on the security prices of railroads and shorthaul shippers. And finally, Section V is a summary of the conclusions of the paper.

II. INTERPRETATIONS OF THE INTERSTATE COMMERCE ACT

The market structure of the railroad industry in the middle and latter parts of the 19th century is essential to interpretations of the origins of the first major federal regulatory agency, the Interstate Commerce Commission (ICC). Many markets were served by only a few or, in many instances, one railroad. These so-called shorthaul markets were city-pairs in which at least one end point was not a major shipping terminal (e.g., the shipment of freight between isolated communities in the upper midwest and the eastern seaboard). Shippers in shorthaul markets faced pervasive monopolistic and discriminatory pricing (Friedlaender, p. 11-12). Thus, the ICC may have protected shorthaul shippers from railroad monopolies. This interpretation is known as the *traditional hypothesis* (Buck, 1920; Benson, 1955; Bernstein, 1955; Nash, 1957; Miller, 1971; and Hoogenboom and Hoogenboom, 1974). The reduction in shorthaul shipping rates following the passage of the ICA is frequently held to support the traditional hypothesis.

Other markets were served by many railroads or alternative modes of transportation. These so-called longhaul markets were city-pairs in which both end points were major shipping terminals (e.g., the shipment of freight between Chicago and major cities on the eastern seaboard). While these longhaul markets contained several potentially competing railroads, nearly all were characterized by explicit yet only partially successful cartels (Kolko, 1965; and Ulen, 1980). The rates charged in longhaul markets were subject to frequent and wide fluctuations (Ulen, 1983; and Porter, 1983). Thus, the ICC could have facilitated longhaul cartels. This interpretation is often referred to as the *revisionist hypothesis* (MacAvoy, 1965; Kolko, 1965; Spann and Erikson, 1970; and Alexis, 1982). Increases in the level and stability of longhaul rates subsequent to the passage of the ICA are said to support the revisionist hypothesis.

The revisionist interpretations of the ICA have not gone unchallenged. This so-called *post-revisionist* literature has questioned either the statistical validity of the empirical evidence (Zerbe, 1980) or the theoretical basis underlying the tests (Ulen, 1983). This later category of papers primarily argues that the increases in longhaul prices subsequent to the ICA were a by-product of general market activity or other provisions of the ICA and unrelated to the effectiveness of the ICA in promoting longhaul cartels. The post-revisionist literature, for the most part, provides explanations for the empirical regularities of the post-ICA period that are unrelated to the revisionist

view of railroad regulation. The factual political and legislative basis of both the traditional and revisionist interpretations have also been challenged (Fiorina, 1984; and Skowronek, 1982).

The post-revisionist literature notwithstanding, several facts about the circumstances surrounding the passage of the ICA are known. First, shorthaul shippers, longhaul shippers, and railroads were the primary interest groups involved in the construction of the ICA and affected by its provisions. Second, prior to the passage of the ICA, shorthaul shipping rates were at or near monopoly levels and longhaul shipping rates approximated competitive levels. And third, shorthaul shipping rates declined while longhaul shipping rates increased subsequent to the passage of the ICA. Figure 1 illustrates these facts. The vertical and horizontal axes represent longhaul and shorthaul prices, respectively. The range for both prices is competitive (p_{lc}, p_{sc}) to monopolistic (p_{lm}, p_{sm}). The preferences of shippers are monotonically declining and lexicographic in their respective prices. The upper contour sets of the railroad's profit function are convex in prices.[1] U_s^*, U_l^*, and π^* represent shorthaul shipper indirect utility, longhaul shipper indirect utility, and railroad profits at the railroad equilibrium prior to the imposition of the SHPC, p^*. The points p' and p'' represent two possible outcomes under the ICA consistent with the empirical findings in the literature.

Figure 1 also illustrates the primary unresolved issue concerning the economic incidence of the ICA. Point p'' represents a regulatory equilibrium consistent with the empirical findings in the literature which *reduces* railroad profits, while p' reflects a regulatory change that *raises* railroad profits. Can a theoretical analysis of the mechanisms of regulatory control contained in the ICA help identify which of these two points were more likely, given the parameters of railroad economics at the time? The next section of the paper addresses this question with a theoretical analysis of the pricing and profit consequences of the SHPC. And empirically, is there a way to estimate if, in fact, the implementation of the regulations contained in the ICA had a positive or negative impact on railroad profits? Section IV addresses this question by examining the capital market response to the passage and implementation of the ICA.

III. REGULATORY IMPACT OF THE SHORTHAUL PRICING CONSTRAINT

The ICA contained several substantive sections addressing different aspects of the regulation of the railroad industry of this period. Sections 1-3 of the ICA prescribed that rates be "reasonable and just, non-discriminatory and non-preferential." Section 5 prohibited the pooling of traffic or revenues by railroads. Section 6 required railroads to publish and reasonably maintain their tariffs while sections 7 and 8 provided enforcement regime for the ICA. Each of these provisions either alone or in conjunction with the others may have affected the equilibria of railroad markets of this period.

Arguably, the most important aspect of the ICA was section 4, the shorthaul pricing constraint (SHPC).[2] The SHPC made it "unlawful for any common carrier subject to the provisions of the act . . . to charge or receive any greater compensation . . . for a shorter than for a longer distance over the same line, in the same direction, the shorter being included within the long distance." Broadly interpreted, the SHPC required that a given railroad charge no more for shorthaul than for longhaul shipments when certain conditions were met.

Two important comparative statics questions arise concerning the SHPC. First, what are the effects of the SHPC on prices in the longhaul and shorthaul markets? Is it possible that the theoretically predicted consequences of the SHPC regarding railroad rates are consistent with those observed subsequent to the adoption of the ICA? While it is obvious that the SHPC required the equalization of short and longhaul rates for many railroads, it is not clear whether this requirement was met by simply reducing shorthaul prices, raising longhaul prices, or some combination of the two. What are the conditions which determined how a given railroad complied with the SHPC? Second, what are the effects of the SHPC on railroad profits? Could a regulatory provision so explicitly aimed at mitigating local rate discrimination also positively effect railroad profits? And how is the impact of the SHPC on railroad profits affected by the exogenous variables of the model? This section of the paper conducts an analysis of the effects of the SHPC on railroad rates and profits.

Assumptions and the Model: Several assumptions and simplifications are employed in the subsequent analysis. It is assumed that there is one longhaul market containing N, $i = 1, \ldots, N$, railroads producing a homogeneous service. Each railroad operates in one and only one shorthaul market, and no shorthaul market is served by more than one railroad. Thus, each railroad is a monopolist in its shorthaul market and, at least potentially, a competitor in the longhaul market. The variables q_{li} and q_{si} represent the quantity of freight hauled by the ith railroad in the longhaul and its shorthaul market, respectively. The existing transport technology is represented by $f_i + c_i(q_{li}, q_{si})$, where f_i is a fixed cost incurred by the ith railroad if either q_{li} or q_{si} is nonzero and $c_i(\cdot)$ is the continuous, twice- differentiable and strictly convex variable cost function of the ith railroad.[3] Inverse demand in the longhaul market is given by $p_l(Q_l)$, where $Q_l = \Sigma_{i \in N} q_{li}$, and in the shorthaul markets by $p_{si}(q_{si})$, and are continuous, twice-differentiable and strictly decreasing in the total quantity of shipments hauled.

Define the variable $\mu_i = p_{si}(q_{si}) - p_l(Q_l)$, which reflects the relationship between longhaul and shorthaul prices. In the absence of the SHPC, equilibrium shorthaul prices exceed longhaul prices. That is, $\mu_i > 0$. The effect of a binding SHPC is to constrain μ_i to zero. The comparative statics of the SHPC are thus given by assessing the effects of deviations of μ_i away from its unconstrained levels.

Unconstrained Equilibria: In the absence of regulatory constraints, the ith railroad maximizes

$$(3.1) \qquad \pi_i = p_l(Q_l)q_{li} + p_{si}(q_{si})q_{si} - f_i - c_i(q_{li}, q_{si})$$

with respect to q_{li}, q_{si} and μ_i subject to the condition that $\mu_i - p_{si}(q_{si}) + p_l(Q_l) = 0$. Thus, the shadow value of the constraint μ_i equals zero and equilibria in the long and shorthaul markets have familiar representations. Indeed, these equilibria are characterized by the following $n + 1$ equations

$$(3.2) \qquad p_l(Q_l^*)\,[1 + \theta/\varepsilon_l(Q_l^*)] = \Sigma_{i \in N} s_i MC_i(*)$$

$$(3.3) \qquad p_{si}(q_{si}^*)\,[1 + 1/\varepsilon_s(q_{si}^*)] = MC_i(*), \quad i = 1, \ldots N,$$

where $\varepsilon_l(Q_l^*)$ and $\varepsilon_s(q_{si}^*)$ are price elasticities of demand in the longhaul and shorthaul markets,

respectively, $s_i = q_{li}^*/Q_l^*$, the longhaul market share of the *ith* railroad, and $MC_i(*)$ is marginal cost. $\theta = \Sigma_{i \in N} s_i \theta_i$ where θ_i is the *ith* railroad's conjecture about the reaction of other railroads in the longhaul market. θ_i is equal to zero, s_i or one as the *ith* railroad holds Bertrand, Cournot or collusive conjectures about its competitors behavior. θ equals zero, the Herfindahl index or unity as the longhaul market is competitive, Cournot or collusive. Notice that equilibria of the longhaul and shorthaul markets are related only through the variable cost function. Indeed, if variable costs are separable in short and longhaul shipments, equilibria of the two markets are totally unrelated.

Panels A and B in Figure 2 illustrate the unconstrained equilibria of the long and shorthaul markets, respectively. The curves MMR_{li} and MMR_{si} are the marginal revenue schedules for the ith railroad in the long and shorthaul markets given monopoly behavior. The curve PMR_{li} is the perceived marginal revenue schedule for the *ith* railroad in the long haul market for $0 < \theta_i < 1$. Equilibria occur, of course, where the relevant marginal revenue curves intersect the marginal cost curves. The prices p_l^*, p_{si}^* in the figure represent equilibrium prices. Notice that, consistent with the circumstances prior to regulation, $\mu_i^* = p_{si}^* - p_l^* > 0$.

Constrained Equilibria and the Comparative Statics of the SHPC: Under the SHPC, μ_i is no longer a choice variable but instead an exogenous variable constrained to zero. Thus, given the SHPC, the ith railroad maximizes (1) with respect to q_{li} and q_{si} for a fixed μ_i. For any fixed μ_i, the necessary conditions for profit maximization for the *ith* railroad are given by

$$(3.4) \quad p_l(Q_l^c)[1 + (\theta_i/\varepsilon_l(Q_l^c))(1 + \lambda_i^c/q_{li}^c)] = MC_i(*)$$

$$(3.5) \quad p_{si}(q_{si}^c)[1 + (1/\varepsilon_s(q_{si}^c))(1 - \lambda_i^c/q_{si}^c)] = MC_i(*)$$

$$(3.6) \quad \mu_i = p_{si}(q_{si}^c) - p_l(Q_l^c)$$

where λ_i^c is the shadow value of the constraint μ_i. From (3.4) - (3.6) it is apparent that λ_i^c, and thus the level of μ_i itself, affects the optimal choice of q_{li} and q_{si}, given by q_{li}^c and q_{si}^c. The contrast between the unconstrained and constrained cases is represented by continuous changes in μ_i, the fixed positive difference between short and longhaul prices. The comparative statics of interest are $dq_{si}^c/d\mu_i$ and $dq_{li}^c/d\mu_i$. In the appendix it is shown that $dq_{si}^c/d\mu_i < 0$. $dq_{li}^c/d\mu_i > 0$ if and only if $\theta_i > 0$. Thus the SHPC has the effect of reducing shorthaul prices for all values of the exogenous variables of the model. The SHPC also raises long haul prices whenever railroads are other than perfect competitors.

The intuition behind these comparative statics results is straightforward. In the absence of constraints, $p_{si}(q_{si}^*) > p_l(Q_l^*)$ for all $i \in N$, as is the case in Figure 2. The SHPC necessitates the equalization of short and longhaul prices. The SHPC explicitly links the equilibria of the long and shorthaul markets by reducing the marginal revenues of longhaul shipments and increasing the marginal revenues of shorthaul shipments. Under the SHPC, the marginal revenues of longhaul shipments has the extra term $\lambda_i^c \partial p_l(Q_l^c)/\partial q_{li}^c < 0$. Increases in q_{li} reduce $p_l(Q_l)$ which, under the SHPC, necessitate decreases in $p_{si}(q_{si})$ which are achieved by increases in q_{si}. That is, increases in q_{li} require increases in q_{si} farther from its monopoly optimum. The curve CMR_{li} in panel A of Figure 2 represents the marginal revenue schedule for longhaul freight under the SHPC. Similarly, under the SHPC, the marginal revenues of shorthaul shipments has the additional term

$-\lambda_i^c \partial p_{si}(q_{si}^c)/\partial q_{si}^c > 0$. Increases in q_{si} reduce $p_{si}(q_{si})$ which permits reductions in $p_l(Q_l)$ and, therefore, increases in q_{li}. Thus, increases in q_{si} allow increases in q_{li} closer to the unconstrained, noncooperative optimum for any θ_i. The curve CMR_{si} in panel B of Figure 2 represents the marginal revenue schedule for shorthaul freight under the SHPC. Notice that CMR_{li} and CMR_{si} intersect their respective marginal cost curves at points where $\mu_i = p_{si}(q_{si}^c) - p_l(Q_l^c) = 0$.

The price effects of the SHPC are highlighted by the fact that the longhaul price remains unchanged when $\theta_i = 0$; when railroads in the longhaul market are Bertrand competitors. When $\theta_i = 0$ for all $i \in N$, no railroad expects to affect longhaul price by altering its level of shipments. That is, $\partial p_l(Q_l^c)/\partial q_{li}^c = 0$ and the marginal revenue schedule in the longhaul market is not altered by the SHPC. All of the adjustment to the SHPC must, therefore, take place in the shorthaul market.

Railroad Profits and the SHPC: It is also apparent from (3.4) - (3.6) and the comparative statics results that the SHPC affects the profits of railroads. To examine this question, let $\pi_i^c(q_{li}^c(\mu_i), q_{si}^c(\mu_i), \mu_i)$ represent the maximum profits of the *ith* railroad for every value of μ_i. Applying the envelope theorem,

$$(3.7) \qquad d\pi_i^c/d\mu_i = [(dQ_{-i}^c/d\mu_i)s_i^c p_l(Q_l^c)]/\varepsilon_l(Q_l^c) + \lambda_i^c(\mu_i)$$

where $dQ_{-i}^c/d\mu_i = \Sigma_{i \in N} dq_{li}^c/d\mu_i$ for all but the *ith* railroad and represents the change in the total shipment of longhaul freight resulting from an increase in μ_i. The second term in (3.7), λ_i^c, is the direct effect of the SHPC on railroad profits. Since the SHPC constrains railroads from their optimal choice of q_{li}, q_{si}, this term is positive whenever the SHPC is binding and zero otherwise. A reduction in μ_i away from the unconstrained optimum marginally reduces railroad profits. The first term in (3.7) is the indirect effect of the SHPC. Since the SHPC causes all railroads to reduce longhaul shipments when $\theta_i > 0$, this term is negative. For $\theta > 0$, the SHPC moves the longhaul level of freight shipments closer to the unconstrained, monopoly optimum therefore contributing to railroad profits.

Whether the direct or indirect effects of the SHPC dominate depend on the exogenous variables of the model. For instance, the marginal increase in railroad profits resulting from the imposition of the SHPC is larger the more elastic is longhaul demand and the more inelastic is shorthaul demand.[4] Elastic longhaul demand increases the magnitude of the indirect effect by reducing the absolute value of the denominator and increasing the size of the numerator. The later effect results since elastic longhaul demand necessitates larger reductions in q_{li} to meet the SHPC and, thus, more of a correspondence between the constrained optimal level of longhaul freight and the unconstrained monopoly level of longhaul shipments. On the other hand, inelastic shorthaul demand increases the costs of adjusting to the SHPC in shorthaul markets. Inelastic shorthaul demand increases the longhaul adjustments necessary to comply with the SHPC and, again, creates more of a correspondence between the constrained optimal level of longhaul freight and the unconstrained monopoly level of longhaul shipments. The net effect of the SHPC on railroad profits remains, however, a matter for empirical investigation.

IV. SOME EVIDENCE ON THE ANTICIPATED EFFECTS OF THE ICA

The empirical debate over the validity of the traditional and revisionist interpretations of the ICA have focused almost exclusively on post-ICA longhaul and shorthaul prices. There is little doubt that shorthaul prices in the period immediately following the passage and implementation of the ICA were lower. Similarly, longhaul prices appeared to rise, albeit moderately, in the post-ICA environment. This evidence is necessary but not sufficient for the interpretation of the SHPC presented above. There are alternative explanations for the rise in longhaul prices subsequent to the passage of the ICA. Long haul prices could have risen due to the level and stability of the demand for railroad services in the post-ICA period. Such circumstances may have increased the effectiveness of the private mechanisms of railroad cartel enforcement (Ulen, 1983). These critiques indicate that movements in longhaul prices subsequent to the ICA may have little bearing on the beneficial aspects of the ICA for railroads or the interpretations derived above. Moreover, shorthaul and longhaul price data, in general, are insufficient to determine the profits consequences of the ICA for railroads. An alternative empirical technique is required.

Regulation and Asset Prices: Consider an asset that represents a claim on a percentage of the future profits of a firm. Let P_{it} be the discounted value of all future cash flows to the asset at time t. Then

$$(4.1) \qquad P_{it} = \Sigma_{i \in \Omega} s_i \pi_{it+k}/(1 + r_i)$$

where $\Omega = [1,\infty)$, π_{it+k} is the cash flow to the asset in period $t + k$, s_i is the percentage claim to the cash flow of the *ith* asset, and r_i is the discount rate representing the opportunity costs of the cash flow given its riskiness (assumed constant over time).

Suppose that the time series of expected cash flows is changed by regulation. The contemporaneous price of the asset changes by the capitalized value of the changes in the expected future cash flows according to

$$(4.2) \qquad P^*_{it} - P_{it} = \Sigma_{i \in \Omega} s_i (\pi^*_{it+k} - \pi_{it+k})/(1 + r_i)$$

where P^*_{it} and π^*_{it+k} are the equilibrium price and expected cash flows in the new regulatory environment. The effects of regulation on the future profitability of a firm are magnified and captured in the contemporaneous change in asset prices. Regulations that cause large (small) and immediate (distant) changes in the expected profits of a firm result in large (small) changes in the current price of the asset. These effects are also reflected in any time series based on the asset's price, such as the percentage return to the asset.

A Model of Railroad Stock Returns: Abnormal changes in the returns to certain assets can be used to assess the expected effects of the ICA and the SHPC. Assumptions about the workings of capital markets and the formation of equilibrium asset prices must be specified to determine precisely what is meant by "abnormal" and thus to conduct such tests. The first assumption is that the *efficient markets/rational expectations* hypothesis holds. This hypothesis states that asset prices reflect all available relevant information. An implication of the hypothesis is that it is impossible to make profits by trading stocks on the basis of available information. That is, if R_{it} is the return on the *ith*

asset or portfolio of assets in period t, Φ_{t-1} is the information available in period t - 1, and E(*) is the expectation operator, then $E(e_{it}) = 0$ where $e_{it} = R_{it} - E(R_{it} \mid \Phi_{t-i})$. Essentially, this hypothesis implies that the effects of new information are reflected fully and quickly in asset prices. The empirical evidence supporting this hypothesis is substantial (Schwert, 1981).

A second assumption concerns the process by which equilibrium asset returns are generated. A *multiple factor model* is used to represent the process generating asset return risk premia.[5] Accordingly,

$$(4.3) \quad R_{it} - R_{ft} = E_i = \Sigma_{j \in j} \beta_{ij} X_{jt} + e_{it}$$

where R_{it} is the return to the *ith* asset in period t, R_{ft} is the return to a risk-free asset in period t, X_{jt} is the value of the jth systematic factor commonly influencing all asset's returns in period t, E_i is the expected return premium for the *ith* asset, β_{ij} are parameters, and e_{it} is the idiosyncratic noise term associated with asset i in period t. The idiosyncratic term is assumed independent across assets, independent of the factors and has a mean of zero.

(4.3) provides a basis for measuring "abnormal" returns to assets. Abnormal returns are the measured parts of $R_{it} - R_{ft}$ unaccounted for by relation (4.3). Given the efficient markets/rational expectations hypothesis, abnormal returns result from changes in information relevant for determining the expected future profits or cash flows underlying $R_{it} - R_{ft}$.

Regulatory Events: Two events are taken to reflect the regulatory impact on the stock returns of relevant assets analyzed below. The first event is the Supreme Court's decision in *Wabash, St. Louis & Pacific v. Illinois* in late October of 1886. This decision struck down existing state regulation affecting interstate commerce thus changing the opportunities for federal regulation. Indeed, *Wabash* ended the decade long legislative stalemate between the House of Representatives (dominated by shorthaul shipping interests) and the Senate (dominated by railroads). A compromise bill was fashioned in Congress within six weeks of the *Wabash* decision. The Supreme Court's decision in *Wabash* changed the prevailing expectations regarding the likelihood of federal regulation of railroads.[6]

The second event encompasses the establishment of the ICC and its preliminary interpretations of the SHPC. As many scholars of the early years of ICC regulation point out, the statutory language creating the SHPC was somewhat ambiguous and subject to interpretation.[7] Indeed, there is little doubt that the eventual interpretation given Section 4 by the Supreme Court was at variance with that intended by it Congressional sponsors.[8] However, the degradation of the SHPC by the courts did not occur until the midpoint of the last decade of the nineteenth century.[9] Early interpretations and enforcement attempts by the ICC indicated an intention to construe this section strictly and apply it rigidly.[10] These events should move the expected outcome under federal regulation towards that of the theoretical model presented above.

Data and Specification: Equation (4.4) is estimated for the six portfolios identified in Table 1 using monthly data for the five year period 1884-1888. One of these portfolios contains the assets of one of the major shorthaul shippers of the period, coal mining companies, while the remaining five portfolios contain the securities of railroads from different geographical regions of the country. This

geographical diversity is exploited further below.

$$(4.4)\ PORT_{it} - MONEY_t = \alpha_i + \beta_{1i}\, MARKET_t + \beta_{2i}\, FINANCE_t + \beta_{3i}\, OUTPUT_t + \beta_{4i}\, PRICES + \gamma_{1i}\, WABASH + \gamma_{2i}\, SHPC + e_{it}$$

where $PORT_{it}$ = the return to the *ith* index or portfolio of assets in month t;
$MONEY_t$ = the commercial paper rate in New York City on choice 60-90 day two name paper for month t;
$MARKET_t$ = the return risk premium on an index of common industrial stocks in month t;
$FINANCE_t$ = the percentage change in total monthly bank clearings outside of New York in month t, in thousands of dollars;
$OUTPUT_t$ = the percentage change in an index of U.S. pig iron production for month t;
$PRICES_t$ = the percentage change in a price index for the U.S. in month t;
$WABASH_t$ = an indicator variable equally 1 for the months of October and November, 1886 and 0 otherwise;
$SHPC_t$ = an indicator variable equally 1 for the months of April and May, 1887 and 0 otherwise;[11]
$\alpha_i, \beta_{ji}, \tau_{ki}$ = estimated parameters of the model; and
e_{it} = a serially uncorrelated random error term.

The β_{ji} of the model represent the factor loadings of the systematic variables on the *ith* portfolio. Since $MARKET_t$ is an approximation to the return risk premium on the market portfolio, $\beta_{1i} > 0$. The remaining systematic variables are theoretically correlated with the general level of economic and financial activity. The variables $FINANCE_t$, $OUTPUT_t$ and $PRICES_t$ are measures of real and nominal economic activity. Thus, β_{2i}, β_{3i} and β_{4i} should all correlate with the portfolio returns. Table 2 describes the variables used in the estimation of (4.4) and identifies their sources. Table 3 presents some summary statistics of these variables.

Estimation Results: Equation (4.4) is estimated for each of the six monthly return series described above. These equations are estimated jointly using Zellner's Seemingly Unrelated Regression Technique to allow for contemporaneously correlated error terms across equations.[12] Table 4 presents the estimation results.

To begin, most of the systematic variables help explain the variation in the returns to the individual portfolios. The variable MARKET is significant in each equation at greater than the .01 percent level and the coefficients are, as expected, all positive. The hypothesis that the coefficients on MARKET across all six equations jointly equal zero can also be rejected with a high degree of confidence, as reflected by the likelihood ratio test statistic reported in the last column of Table 4. Several of the other systematic variables are also significant in the individual equations. The variable OUTPUT, when significant, is positively correlated with the portfolio returns. The portfolio returns are also sensitive to changes in the price level, as reflected by the variable PRICES. The

hypothesis that all six coefficients jointly equal zero (H1)[13] can be rejected at at least the .10 percent level for PRICES and OUTPUT.

The variables WABASH and SHPC also help explain the variation in the returns to the individual portfolios. Many of the coefficients on WABASH and SHPC individually are significantly different from zero. For instance, WABASH increased values by 9.1% (standard error, 4.7) on the COAL, by 10.0% (3.1) on the SOUTH, and 3.3% (3.1) on the JEC portfolios. SHPC increased values by 7.7% (3.1) on the JEC and by 3.4% (2.6) on the WEST portfolios. All of the coefficients on the regulatory response variables are positive. Moreover, the the hypothesis that the sum of the coefficients on the WABASH and SHPC variables equals zero (H2)[14] can rejected at at least the .10 percent level for the COAL, JEC, and SOUTH portfolios. Jointly, WABASH and SHPC increased values by 15.8% on the COAL, 11.0% on the JEC, 2.3% on the IOWA, 13.1% on the SOUTH, 4.6% on the WEST, and 4.1% on the SHORT portfolios. The hypothesis that all of the coefficients on the regulatory event variables equal zero is rejectable at the .01% level for WABASH and at the .15% level for SHPC.[15]

The results of the analysis confirm that the imposition of federal regulation of railroads through the ICA benefitted shorthaul shippers. Shorthaul price declines were anticipated and reflected in the expected return of a portfolio of shorthaul shippers' assets. The empirical results further indicate that despite the reduction in shorthaul prices and the beneficial effect of the ICA on shorthaul shippers, federal regulation also benefitted railroads. The abnormal returns for all of the railroad portfolios is positive and, in the majority of cases, significantly different from zero. These results augment the debate about the behavior of longhaul prices subsequent to the ICA. These results also support the chief hypothesis of this paper that shipping and railroad interests were not necessarily contradictory under federal regulation. The ICA benefitted both (shorthaul) shippers and railroads.

Heterogeniety in Return Responses: Further support for the hypothesis of this paper along with identification of the characteristics of railroads benefitted by the ICA are gained by modelling the estimated return responses of railroads to WABASH and SHPC. According to the theoretical model presented above, the ability of the SHPC to enhance railroad profits depended on the existence of monopolistic shorthaul markets. The equalization of prices under the SHPC caused longhaul price increases and movements towards the longhaul monopoly optimum. The rate of return on physical railroad capital, ROI, is used to measure the existence and extent of monopolistic shorthaul markets contained in the territory served by the railroads in a given portfolio.[16] The higher the rate of return of railroads in a given portfolio, the larger the expected abnormal return.

The relationship between the estimated regulatory response and ROI given by the model developed above is in stark contrast to the revisionist interpretation. According to the revisionist hypothesis, the ICA benefitted railroads by facilitating collusion in otherwise competitive markets. Railroads in competitive markets and earning a lower return on capital than those railroads in monopolistic markets should, therefore, have experienced a larger regulatory response. Examining the relationship between the observed regulatory responses and ROI provides a direct test of the revisionist interpretation versus the interpretation given above.

An additional test of the revisionist hypothesis is possible given the recognition that the success of private cartels prior to the ICA varied across railroads in our various portfolios. For instance, railroads in the SOUTH portfolio were reported to have the most successful cartel of the period,[17] while those in the JEC, IOWA and WEST suffered frequent bouts of competitive behavior.[18] Railroads in the SHORT portfolio served mostly shorthaul markets and were less dependent on successful private cartels for their profitability. The dummy varible NET, equal to unity for JEC, IOWA and WEST and zero otherwise, identifies those railroad portfolios likely to differentially benefit from the ICA *if* its purpose was to foster and stabilize private cartels. If the revisionist hypothesis holds, NET should be positively correlated with the estimated share price responses of the railroad portfolios.

The regulatory response may vary for reasons other than those posited by the models presented above. For instance, the intrusiveness of state regulation on railroad behavior varied greatly across the six portfolios. While all states had state railroad commissions, the goals and resources of these commissions were not homogeneous. The actual consequences of these commissions often depended on the salient political interests in the state. Elsewhere we show that the value of farmland is a good proxy for farming (shorthaul shipping) influence in the state regulatory processes.[19] It is expected that the beneficial effects of federal regulation for railroads is offset by the influence of shipping interests in state regulatory commissions subsequent to the ICA. The per capita value of farmland in the territory served by the railroads in a given portfolio, LAND, is used to measure farming influence in state regulatory process and, thus, should reduce the observed regulatory response.

Consequently, the response parameters are modelled as

$$(4.5) \qquad \gamma_{ji} = \delta_{0j}+\delta_{1j}LAND_i+\delta_{2j}ROI_i+\delta_{3j}NET_i, \; j = 1, 2$$

where $LAND_i$ = the per capita value of farm land in the territories served by railroads in the *ith* portfolio;

ROI_i = the average return on railroad capital in the territories served by railroads in the *ith* portfolio; and

NET_i = a dummy variable equally 1 for JEC, IOWA and WEST and 0 otherwise.

Equation (4.4) is re-estimated for the five railroad portfolios with (4.5) substituted for γ_{ji}. Moreover, while the parameters on the characteristics can be uniquely estimated for each of the regulatory events, here they are restricted to equality.[20] This restriction cannot be rejected at the .10 percent level. Each event is allowed to have a unique constant, however.

The results of the estimation are present in Table 5. The first two parameters are estimates of the mean regulatory responses to WABASH and SHPC, respectively. The next three parameters illustrate the relationship between the regulatory responses and the heterogeneous characteristics of the portfolios. As predicted by the model presented above, ROI increases the value of the regulatory responses at a statistically significant level. A small increase in ROI at the mean rate of return increases the regulatory response by 14.31%. The impact of per capita land values on the regulatory responses is negative as expected and statistically significant. A small increase in the per capital value of farm land decreases the regulatory response by 6.11%. And finally, the relationship

between the regulatory response and the characteristics of railroad cartels is negative and insignificant. The hypothesis that all of the characteristics are irrelevant for explaining the heterogeneous share price responses (H3) can be rejected with a high level of certainty, as indicated in the table.

The results of the regulatory response estimation support the theoretical model derived above. Railroads participating in monopolistic markets derived substantially higher benefits from the imposition of federal regulation. Railroads in regions of strong farm influence in local regulatory processes gained less from the adoption of federal regulation. The success of private railroad cartels had little bearing on the observed share price response. The evidence contradicts the revisionist hypothesis that the ICA benefitted railroads by facilitating collusion in competitive markets and supports the interpretation derived above.

V. CONCLUSION

This paper provides the economic foundations of a multiple interest perspective for the motivations and effects of the first major federal regulatory agency, the ICC. The theoretical implications of the chief regulatory mechanism of the ICC, the SHPC, were examined. It was shown that the SHPC decreased shorthaul prices and, providing that railroads were other than Bertrand competitors, increased longhaul prices. These results comport with the empirical findings of the effects of the ICA on railroad rates reported elsewhere. It was also shown that the SHPC may have caused an increase in the total profits of railroads operating in both short and longhaul markets. The SHPC creates two effects. First, the SHPC causes increases in the total shipments of shorthaul freight beyond the monopoly optimum. This effect reduces railroad profits. Second, the SHPC causes decreases in the total shipments of longhaul freight toward the monopoly optimum. This effect increases railroad profits. If the longhaul effect dominates the shorthaul effect, railroad profits increase. The longhaul effect is more likely to dominate the more (in)elastic is demand in the (shorthaul) longhaul market. The ability of the SHPC to affect railroad profitability assumes constant competitive conjectures by railroads. The ICA did not have to promote collusion among railroads to enhance railroad profits.

The empirical analyses support the arguments developed in the theoretical section of the paper. The share price data indicate that changing expectations about the possibility of federal regulation and the application of the SHPC increased the future expected profits of a major class of shorthaul shippers (coal mines) and *all* types of railroads. The average regulatory response for all portfolios was 7.97% while the average regulatory response for the railroad portfolios was 6.12%. Based on a *crude* calculation, the implied present value increase in railroad profits totalled $461.3 million nationally.[21] Moreover, the regulatory response was greater for those railroads operating in monopolistic markets, a result implied by the analysis of the SHPC presented above but one inconsistent with the revisionist interpretation. The presence of strong agrarian influence reduced the regulatory response for railroads as well as non-agrarian, shorthaul shippers. The relative success of private railroad cartels had little bearing on the estimated effects of the ICA.

These results are incongruous with the single interest interpretations of the ICC and suggest that a multiple interest perspective is more appropriate. More generally, the analysis conducted in this paper identifies situations where the single and multiple interest approaches are applicable. Where producers and consumers constitute relatively homogeneous groups *and* markets are similarly characterized, the single interest perspective is appropriate. In these situations, the inexorable tension between producers and consumers exists and regulations which alter economic equilibria can benefit one group only at the expense of the other. Where producers or consumers are heterogeneous or the characteristics of markets are disparate, the multiple interest perspective should be utilized. In such situations, regulation can alter equilibria in complicated and subtle ways conferring benefits and harm on limited classes of consumers and/or producers. This conclusion suggests that detailed analysis of the explicit mechanisms of regulatory control and their incidence on different types of producers and consumers can be helpful in understanding the motivations and effects of regulation. This conclusion also suggests that understanding the political institutions that generate regulatory mechanisms and the role that various producer and consumer types play in them can also contribute to our understanding of regulation. This latter conclusion is drawn out in a companion paper.

APPENDIX

This appendix presents the comparative statics exercise summarized above. Let f_1, f_2, and f_3 represent the three first-order necessary conditions presented in (3) above and H the border Hessian of second-order sufficient conditions. Sufficiency requires

$$(A.1) \quad |H| = \begin{vmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{vmatrix} > 0$$

where $f_{11} = \beta_i\{[1+(\theta_i/\varepsilon_l(Q_l^*))(1+\lambda_i^*/q_{li}^*)]-\lambda_i^*/q_{li}^*\}-\partial MC_i/\partial q_{li}$

$f_{12} = 0$

$f_{13} = \beta_i$

$f_{21} = 0$

$f_{22} = \alpha_i[1+(1/\varepsilon_s(q_{si}^*))(1-\lambda_i^*/q_{si}^*)+\alpha_i\lambda_i^*/q_{si}^*]-\partial MC_i/\partial q_{si}$

$f_{23} = -\alpha_i$

$f_{31} = \beta_i$

$f_{32} = -\alpha_i$

$f_{33} = 0$

$\beta_i = p_l(Q_l^*)\theta_i/\varepsilon_l(Q_l^*)q_{li}^*$

$\alpha_i = p_{si}(q_{si}^*)/\varepsilon_s(q_{si}^*)q_{si}^*$

The comparative statics of interest are $dq_{li}^*/d\mu_i$ and $dq_{si}^*/d\mu_i$. That is, how do the optimal quantities of freight shipments by the *ith* railroad in the long and shorthaul markets change as the positive difference between short and longhaul prices increases. Total differentiation of system (3) yields the system of linear equations

$$(A.2) \quad \begin{bmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{bmatrix} \begin{bmatrix} dq_{li}^*/d\mu_i \\ dq_{si}^*/d\mu_i \\ d\tau_i^*/d\mu_i \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$$

Solving for $dq_{li}^*/d\mu_i$ and $dq_{si}^*/d\mu_i$ by Cramer's rule,

$$dq_{li}^*/d\mu_i = -f_{22}f_{13}/|H| > 0$$

(A.3)

$$dq_{si}^*/d\mu_i = -f_{11}f_{23}/|H| < 0$$

Notice that f_{13} and, thus, $dq_{li}^*/d\mu_i$ are equal to zero when θ_i equals zero. The level of freight carried by the *ith* railroad in the longhaul market is unaffected by fixed differences in short and longhaul price if and only if railroads are Bertrand competitors in the longhaul market.

FOOTNOTES

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1. Let (p, y) and (p', y') be two profit-maximizing price-output combinations and let $p'' = \tau p + (1-\tau)p'$ for any $0 \leq \tau \leq 1$. It is clear that $\pi(p'', y'') = p''y'' = \tau py'' + (1-\tau)p'y''$. Since y'' is not necessarily the profit-maximizing level of output for either p or p', $py'' \leq \pi(p, w)$ and $p'y'' \leq \pi(p', w)$. Thus, $\pi(p'', w) \leq \tau\pi(p, w) + (1-\tau)\pi(p', w)$.

2. Hadley (1887) summarizes the ICA as follows.

> The Interstate Commerce Act, as finally passed, contained four sets of provisions: 1. A reaffirmation of the common-law doctrine of equality of treatment, with certain special provisions as to publicity and stability of rates, which should aid in securing such equality; 2. The prohibition of a greater aggregate charge to or from an intermediate point than for the whole through route—the so-called Short Haul Clause; 3. The prohibition of pools; 4. The establishment of a Commission to aid in enforcing the law, but with power to suspend the execution of the Short Haul Clause in certain cases. (p. 162)

He continues by recognizing that the shorthaul clause attracted the most attention of all of the provisions of the Act. Indeed, in the early months of the Commission, temporary suspensions of the shorthaul clause were requested and issued (*First Annual Report of the Interstate Commerce Commission*). However, none of these variances were continued. Moreover, early interpretations of the SHPC by the Commission narrowed the range of possible exceptions to the SHPC (*in re* Louisville and Nashville, 1 *Interstate Commerce Reports*, 31, and Vermont State Grange v. Boston and Lowell, 1 *Interstate Commerce Reports*, 158). The Commission boasted some years later that flagrant instances of local discrimination had been eliminated except in certain parts of the Southeastern part of the country (*Eleventh Annual Report of the Interstate Commerce Commission*, p. 41).

3. This assumption is consistent with the cost analysis conducted in Spann and Erickson (1970).

4. Indeed, the total demand facing railroads in longhaul markets was probably more elastic than shorthaul demand. Railroads often faced competition from alternative modes of transportation,

such as barge or riverboats. The storage facilities available shippers were more prevalent at longhaul origination points, thus giving shippers some flexibility pertaining to the timing of their shipments.

5. The linearity of the portfolio return premia in these systematic factors follows from an Arbitrage Pricing Theory (Ross, 1976; Roll and Ross 1980) or a Multi-Beta Capital Asset Pricing Model (Sharpe, 1977; Rosenberg and Guy, 1976; and Ross, 1976).

6. To quote Fiorina (1984) on the surprise, "During the recess (for the 1886 congressional elections) the Supreme Court dropped a bombshell with its Wabash decision. Furthermore, given the earlier debates and events there is good reason to believe that absent the Wabash stimulus, the House and Senate would have remained at loggerheads, continuing the decade-long debate into future congresses." This judgement is supported by contemporary observers. In the *New York Times*, for example, two day following *Wabash*, an article urged national legislation stating that *Wabash* was the strongest kind of argument in favor of long-delayed national legislation. By December 10th, the *Times* reported that there was little doubt that the bill would become law, and (two days latter) that *Wabash* was believed to have pushed forward the legislation. This surprise view is widely held. See Hilton (1966), Haney (1908), Cushman (1941), and Schwartz (1973).

7. Literal application of the SHPC was impossible absent the interpretations given it by the Commission and, eventually, the courts. Phrases such as "like kind of property," "under substantially similar circumstances and conditions," "same line," "special cases," and "investigation" rendered application of the SHPC, at least conceptually, problematic. See Hilton (1966) for a discussion of these points.

8. The courts eventually "emasculated" the SHPC by its interpretations of what constituted a "same line" (*Osborne v. Chicago & Northwestern R.R. Co.*, 52 Fed. Rep. 912, 1891, and 48 Fed. Rep. 49, 1892) and what constituted "substantially similar circumstances and conditions" (*I.C.C. v. Texas & Pacific R.R. Co.*, 57 Fed. Rep. 187, 1896, and *I.C.C. v. Alabama Midland R.R. Co.*, 168 U.S. 144, 1897). Indeed, the Supreme Court found in the *Alabama Midland* decision that differences in competitive circumstance (the existence of water carriers) created sufficient dissimilarities to suspend applications of the SHPC.

9. Dewey (1935) identifies four distinct periods in the history of the SHPC in federal rate regulation. These periods are (1) the beginning of effective control, 1887-1897, (2) the principle emasculated, 1897-1910, (3) the revival of effective control, 1910-1920, and (4) extensions of effective control, 1920-present (1935). The "emasculation" of the SHPC was conducted by the courts in cases identified above.

10. The earliest interpretation of the SHPC by the Commission established its position on this important regulatory issues for years to come (*In Re Louisville and Nashville R.R. Co.*, 1, I.C.C., 31, 1887). The commission began hearings on the applicability of the SHPC in this cases in April of 1887 and rendered its decision on June 15th, 1887. Generally speaking, the commission's decision established a rigid interpretation of the SHPC and acknowledged few exceptions. The discussion in Dewey (1935, p. 65-74) is an excellent summary of the issues involved with enforcement of the SHPC.

11. The use of these two, two month event windows is motivated by the nature and timing of the regulatory events (see footnotes #6 and #10). The qualitative results of the analysis remain unaltered when additional months are added to either side of these two month windows. The precision of the results, of course, suffer (Brown and Warner, 1980).

12. See Binder (1985) for a discussion of this technique.

13. Under the null hypothesis, the likelihood ratio test statistic is distributed as $\chi^2(6)$. The critical value for $\chi^2(6, .10)$ is 10.62.

14. Under the null hypothesis, the likelihood ratio test statistic is distributed as $\chi^2(6)$. The critical value for $\chi^2(1, .10)$ is 2.72.

15. The likelihood ratio test statistic is 19.53. which is distributed as $\chi^2(12)$ under the null hypothesis.

16. The territorial groups are taken from *The Fifth Annual Report of the Interstate Commerce Commission* and correspond rather well with the actual localities served by railroads in the various portfolios. The ROI variable equals the ratio of gross revenues to capital investment (the sum of the value at costs of railroad property, plant, and equipment). These data are taken from the *Statistical Abstract of the United States* for that year.

17. See D. T. Gilchrist (1960). Indeed, many of the practices and mechanisms used by the Southern Railway and Steamship Association to foster their cartel were used to exemplify the "ideal" railroad position in attempts to gain federal legislation.

18. See Porter (1983) for an empirical investigation of the cartel (in)stability of the JEC. M. Klein (1984, p. 137-175) has a good description of the instability that characterized western railroads.

19. These variables are used in estimations of key votes on the ICA in the House of Representatives. The relationships between these variables and voting behavior is as expected (for instance, representatives from states with higher valued farm land tend to vote for provisions benefitting farming interests) and statistically significant in several alternative specifications (Gilligan, Marshall and Weingast, 1986).

20. The likelihood ratio statistic to test the hypothesis of homogeneous coefficients across regulatory responses is 4.457, which is distributed as $\chi^2(3)$ under the null hypothesis of the unrestricted model. The critical value for $\chi^2(3, .10)$ is 6.25.

21. Recall that ROI = GR/CAP where GR is gross revenues and CAP total railroad capital. Then dROI = (1/CAP)/dGR. The dGR figure implied by dROI is the reported in the text. Notice that since the capital market analysis reflects only adjusts to claims available to equity holders, this figure represents a lower bound.

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TABLE 1
STOCK PORTFOLIOS

Portfolio/Composition	Notation	ICC Territorial Grouping[1]
Coal Mining	COAL	II
Joint Executive Committee	JEC	II & III
Canadian Southern		
Lake Shore		
Michigan Central		
New York Central		
New York Central & Hudson River		
New York, Chicago & St. Louis		
New York, Lake Erie & Western		
Iowa Pool	IOWA	VI
Chicago & Northwestern		
Chicago, Milwaukee & St. Paul		
Chicago, St. Paul, Minneapolis & Omaha		
Wabash, St. Louis & Pacific		
Chicago, Burlington & Quincy		
Chicago, Rock Island & Pacific		
Missouri Pacific		
Southern Railroads	SOUTH	IV & V
Chesapeake & Ohio		
Louisville & Nashville		
East Tennessee, Virginia & Georgia		
Mobile & Ohio		
Memphis & Charleston		
Nashville, Chattanooga & St. Louis		
Norfolk & Western		
Western Railroads	WEST	VII & VIII
Union Pacific		
Atchison, Topeka & Santa Fe		
Central Pacific		
Northern Pacific		
Shorthaul Railroads	SHORT	III
Cleveland, Columbus, Cincinnati & Indiana		
Columbus, Hocking Valley & Toledo		
Evansville & Terre Haute		
Indiana, Bloomington & Western		

[1] *Fifth Annual Report of the Interstate Commerce Commission.*

TABLE 2
DATA DESCRIPTION AND SOURCES

Variable	Description and Source
MONEY	Monthly commercial paper rate in New York City for choice 60-90 day two name paper (Macaulay, 1938).
MARKET	Monthly return premium on industrial common stock index (railroads excluded) (Cowles, 1939).
COAL	Monthly return premium on index of common coal stocks (Cowles, 1939).
JEC	Equally-weighted monthly return premium on stocks contained in JEC portfolio (*Commercial and Financial* Chronicles, 1884-88).
IOWA	Equally-weighted monthly return premium on stocks contained in IOWA portfolio (Commercial and Financial Chronicles, 1884-88).
SOUTH	Equally-weighted monthly return premium on stocks contained in SOUTH portfolio (*Commercial and Financial* Chronicles, 1884-88).
WEST	Equally-weighted monthly return premium on stocks contained in WEST portfolio (Commercial and *Financial Chronicles*, 1884-88).
SHORT	Equally-weighted monthly return premium on stocks contained in SHORT portfolio (*Commercial and Financial Chronicles*, 1884-88).
FINANCE	Percentage change in total monthly bank clearings outside of New York, in thousands of dollars (Macaulay, 1938).
OUTPUT	Percentage change in a monthly index of pig iron production, (Macaulay, 1938).
PRICES	Percentage change in a monthly index of the general price level (Macaulay, 1938).
LAND	The per capita value of farm land in an ICC territorial grouping, in millions of dollars (Fogel, 1964).
ROI	The rate of return on railroad capital in an ICC territorial grouping (*Statistical Abstract of the States*, 1890).

TABLE 3
SUMMARY STATISTICS

Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
MONEY	.00401	.00065	.00287	.00560
MARKET	.00640	.02116	-.08162	.05530
COAL	.01197	.08960	-.18551	.30529
JEC	-.00347	.05980	-.13777	.14401
IOWA	-.00648	.04597	-.15056	.09644
SOUTH	.00156	.06482	-.17294	.16965
WEST	-.00936	.05316	-.16811	.14453
SHORT	.00048	.06552	-.17359	.18032
FINANCE	.00462	.07889	-.14310	.21936
OUTPUT	.01127	.05922	-.18876	.17303
PRICES	-.00041	.00462	-.01274	.01274
LAND	.11828	.07171	.03993	.20686
ROI	9.05667	2.42268	5.35700	11.43700

TABLE 4
SEEMINGLY UNRELATED REGRESSION ESTIMATES:
PORTFOLIO RETURNS

Variables	Portfolios						Likelihood Ratio Test of H1[b]
	COAL	JEC	IOWA	SOUTH	WEST	SHORT	
Constant	-0.006 (0.006)	-0.019 (0.006)	-0.016 (0.005)	-0.014 (0.006)	-0.019 (0.005)	-0.015 (0.006)	---
MARKET	2.637 (0.409)	1.660 (0.269)	1.338 (0.227)	1.782 (0.269)	1.668 (0.219)	2.087 (0.250)	129.69
FINANCE	-0.084 (0.118)	0.066 (0.078)	-0.100 (0.066)	-0.061 (0.077)	0.033 (0.063)	0.030 (0.072)	5.15
OUTPUT	-0.057 (0.146)	0.163 (0.096)	0.056 (0.081)	0.055 (0.096)	-0.067 (0.078)	0.155 (0.090)	14.18
PRICES	2.034 (2.020)	1.583 (1.328)	0.056 (1.122)	2.504 (1.329)	2.729 (1.082)	2.883 (1.237)	11.71
WABASH	0.091 (0.047)	0.033 (0.031)	0.002 (0.026)	0.100 (0.031)	0.012 (0.025)	0.015 (0.029)	19.54
SHPC	0.067 (0.048)	0.077 (0.031)	0.021 (0.026)	0.001 (0.031)	0.034 (0.026)	0.026 (0.029)	9.35
Likelihood Ratio[c] Test of H2	5.041	5.943	0.341	5.108	0.985	0.073	
SSE	0.068	0.045	0.038	0.049	0.037	0.042	

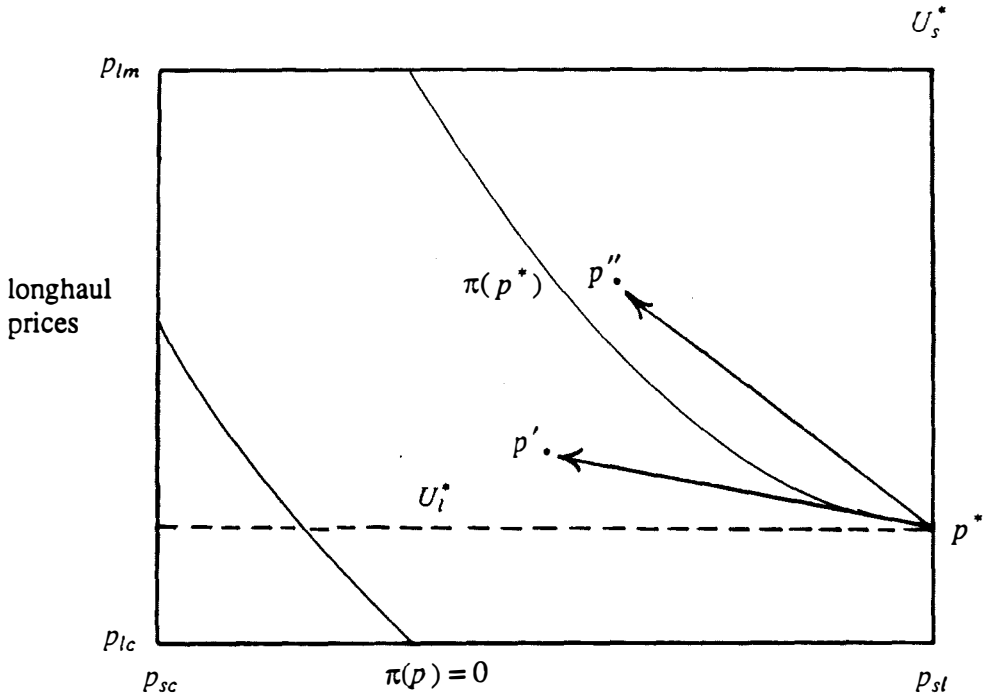
[a] Standard errors in parentheses below estimates.
[b] The likelihood ratio test statistic is distributed $\chi^2(6)$ under the null hypothesis that all of the parameters for the *jth* systematic or indicator variable equals zero. The critical value for $\chi^2(6, .05)$ is 10.64.
[c] The likelihood ratio test statistic is distributed $\chi^2(1)$ under the null hypothesis that the sum of the parameters on the indicator variables equals zero. The critical value for $\chi^2(1, .05)$ is 2.71.

TABLE 5
SEEMINGLY UNRELATED REGRESSION ESTIMATES:
RETURN RESPONSE PARAMETERS[a]

Variable	Parameter
WABASH	-0.046 (0.042)
SHPC	-0.029 (0.042)
ROI	0.018 (0.008)
LAND	-0.583 (0.258)
NET	-0.023 (0.019)
Likelihood Ratio Test of H3[b]	30.02

[a] Standard errors in parentheses below estimates.
[b] The likelihood ratio test statistic is distributed as a $\chi^2(3)$ under the null hypothesis that the sum of the parameters on ROI, LAND and NET equal zero. The critical value for $\chi^2(3, .05)$ is 7.81.

FIGURE 1
RAILROAD EQUILIBRIA PRIOR AND
SUBSEQUENT TO THE ICA



p^* = railroad equilibrium prior to regulation
p' = regulatory equilibrium consistent with the observed effects which *increases* railroad profits
p'' = regulatory equilibrium consistent with the observed effects which *decreases* railroad profits

FIGURE 2
RAILROAD MARKET EQUILIBRIA AND THE
SHORTHAUL PRICING CONSTRAINT