RAMSEY PRICING AND ITS APPLICATIONS*

by Sylvester Damus
Senior Economist
Economic Council of Canada

Mr. Damus opened his presentation on Ramsey pricing by discussing Ex Parte 347 Sub No. 1 and the ICC's Notice of Proposed Guidelines for setting maximum rates on coal nationwide. In the proceeding, the railroads and their witnesses advanced the idea of Ramsey pricing as a regulatory tool which was preferred to any cost allocation formulae. The Commissioners in their decision recognized that a strict costing approach for establishing maximum rate levels was inappropriate, but they did not accept Ramsey pricing. They also failed to settle on a specific approach for setting maximum rates. However, the ICC's interim decision affirmed a commitment to the concept of differential pricing as an important tool in assisting railroads towards revenue adequacy.

Mr. Damus then speculated on why the railroads' arguments for Ramsey pricing achieved so little success. In general, in advancing Ramsey pricing as official policy for the first time, the railroads made a weak case for themselves by narrow application of incomplete theories. The shippers, some of whom agreed with differential pricing, hinted at important issues but failed to develop them sufficiently. Together, in Mr. Damus' view, both railroads and shippers offered too little to guide the ICC towards a decision on pricing guidelines.

Mr. Damus identified several unresolved problems with Ramsey pricing:

- the railroads' reasoning on rate guidelines is circular;
- Frank Ramsey would disown their pricing schemes;
- it is impossible to put a literal interpretation of their ideas into practice;

and

- Ramsey pricing is best understood as a potentially low-cost but troublesome system for decentralized pricing.

Mr. Damus observed that Ramsey pricing is now superannuated and its weakness is correspondingly unsurprising.

Mr. Damus next reviewed recent research on pricing. A Ramsey price is one that maximizes a railroad's public benefits, subject to a breakeven constraint on the road's revenue. This suggests its potential usefulness as a regulatory tool. It is also a monopoly price, but nevertheless, price regulation seemed unnecessary to some authors. However, Mr. Damus observed that rate of return regulation does not prevent the choice of prices in excess of the profit maximizing ones. Research has also indicated the following characteristics of Ramsey pricing:

- Under certain cost conditions, a multiproduct monopoly subject to competition in a regime of free entry and exit will find Ramsey pricing to be its safest pricing strategy; only sunk costs and exit barriers permit deviations from Ramsey pricing.
- A Ramsey pricing railroad operating in captive and competitive markets cannot reduce prices in both markets without losing net revenue. Ramsey's rules preclude malicious pricing such as increasing prices in both markets because the resulting reductions in output will reduce profits more than the increased prices. Thus Ramsey pricing can be said to minimize an index of the prices charged.
- Ramsey prices are not guaranteed to be subsidy free; they can involve cross-subsidization. Furthermore, the prohibition of cross-subsidies, often viewed as a criterion of fair

pricing practices, may in fact reduce total public welfare. In addition, wasteful duplication of an incumbent's plant is not prevented by Ramsey pricing.

- When total revenue is inadequate to return a normal rate of profit on the industry's rate base, the Ramsey price equals the profit maximizing one. Profit maximizing prices can involve cross-subsidization, even when the resulting revenue is inadequate. Cross-subsidies are possible whenever services are complementary.
- The policy of a revenue-pooling cartel would be pursued in keeping with Ramsey's rules in instances where Ramsey prices and Ramsey's revenue constraint are applied to the industry as a whole, not merely to the firm. The industry-wide revenue constraint allows some firms to ring up profits while some firms suffer losses, but because of the constraint, the profits cancel the losses. Losers will accept the constraint if they are compensated by side-payments financed by the winners' profits, thus developing a policy of cross-subsidy and a revenue-pooling cartel.
- Ramsey pricing removes the incentive to set joint rates always lower and more profitable to the participating carriers than the combined rate because the breakeven constraint dissipates the profit from through traffic by reduction of single line rates. This reduction is imposed by the revenue constraint. When two carriers are forced into joint Ramsey pricing, the imposition of a single breakeven constraint on both necessarily involves discussion of single line rates, discussions which are clearly contrary to the Staggers Act. Merger allows more efficient Ramsey pricing without contravening the Staggers Act.
- Ability to substitute joint for combined rates is one incentive to merger. Another advantage is avoiding empty hauls through an enlarged network. Carrier size is optimized by balancing the cost of administering a larger network with the gains from rationalized itineraries and substitution of single line for combined rates.

Mr. Damus then discussed the railroads' confused and circular reasoning regarding maximum rate guidelines. He observed that the railroads' extensive discussion of Ramsey pricing and stand-alone costs failed to answer the ICC's request for maximum rate guidelines. The railroads argued that:

- a railroad which has inadequate revenue should be allowed to minimize losses or to set profit-maximizing prices; and
- profit maximization rules out cross-subsidies.

These arguments are clearly contrary to the recent literature on pricing. During the proceedings, the need for guidelines was recognized in case railroads achieved revenue adequacy. Profit maximization cannot be equated with socially-efficient Ramsey pricing, if it leads to long-run profits. It was suggested that the ICC confine itself to the regulation of profits. However, breakeven revenue does not necessarily imply Ramsey pricing. Instead of prescribing Ramsey pricing in guidelines, the railroads proposed that exploitation of captive shippers be prevented by adding a stand-alone cost test to the breakeven requirement. Mr. Damus observed that the stand-alone cost test prevents cross-subsidies. However, if the ICC wants welfare maximizing Ramsey prices, the Commission then must accept the cross-subsidies involved in them. The railroads, on the other hand, want to avoid cross-subsidies and the invitation to competitive entry which is inherent in them. In a deregulated environment, the railroads cannot ask for entry restrictions and must carry out

stand-alone cost tests for their own protection. Mr. Damus concluded that prevention of cross-subsidies may be inconsistent with maximization of the public utility of the roads and with Ramsey pricing.

Mr. Damus' discussion of the railroads' circular reasoning ended with his observation that in proposing a stand-alone cost test, the railroads come full circle by rejecting arbitrary cost allocations and then returning to a point where they need cost allocations to compute a stand-alone cost test.

Mr. Damus next turned to what turns discriminatory prices into Ramsey prices. During the testimony in Ex Parte 347, little was said about the precise specification of the revenue constraint and objective functions from which the inverse-elasticity and equiproportional reduction rules were derived by Frank Ramsey. The railroads failed to discuss the importance of counting constraints and identifying the objective function that they would like to maximize. Since there are many carriers, there can be as many revenue constraints as there are independently reporting firms, and as many objectives as there are groups of shippers served by each carrier. In pricing his products, a monopolist follows Ramsey's rules when he submits to a revenue constraint and maximizes the public's welfare; he does not follow the rules when he [only] prices with regard to elasticity of demand [without the constraint on profit]. The railroads maintained that if the constraint is non-binding because there are no prices meeting it, profit maximization seems indicated. However, Mr. Damus judged their position to be false because they omitted to show what they claimed to be a non-binding constraint is actually the proper one to apply. They failed to explicitly cite which constraints they applied. The statement that the relevant elasticities are those faced by the carrier, and the proposed stand-alone cost tests imply that the constraint is on the revenue of an individual carrier. However, Brown and Heal had demonstrated that Ramsey's rules are derived from an industry-wide constraint and are commodity-specific; they are not derived from individual constraints and are not firm-specific.

In Mr. Damus's view, the railroads' arguments were too strongly influenced by recent studies of natural monopoly. The railroads erroneously jumped to the conclusion that a natural monopolist does not set Ramsey prices when his strategy is to keep potential entrants at bay with differential pricing for zero profit. In making this argument, the railroads neglected spatial competition; transport markets have room for many monopolies, each occupying a niche in a wide space. Once several firms have settled in a market, the conclusion that they set Ramsey prices while filling their own revenue requirements is no longer warranted.

Mr. Damus next proceeded to argue that "stand-alone Ramsey pricing" does not minimize an index of freight rates. If rates are set subject to an industry-wide constraint, marginal costs of production and transportation are equalized for all movements of identical commodities. However, rates set subject to firm-specific revenue requirements --- rates which pass stand-alone cost tests--- do not equalize marginal costs. They do not cause goods to be carried over the cheapest routes, nor shipped from the most convenient locations, nor sold in the markets where they are most valued.

The testimony of two witnesses, W. J. Baumol and R. D. Willig, correctly stated that the optimality of Ramsey pricing arises from equiproportional reductions in consumption. However, the remainder of their testimony implied non-proportional reductions. Mr. Damus gave a numerical illustration to prove that the optimality of so-called Ramsey pricing claimed by the railroads was nonexistent as was an equiproportional reduction in consumption. Mr. Damus continued with this example of two railroads to demonstrate that with true Ramsey pricing, there would be a side payment from a profitable carrier to a losing carrier, thus completing the task of Ramsey's breakeven constraint. The

side-payment is a subsidy of the loser financed by the gainer's rates in excess of his stand-alone costs. The loser's deficit does not excuse it from submission to a revenue constraint. Profit-maximization is the proper policy only if the industry as a whole has inadequate revenues.

Mr. Damus then turned to through rates. He maintained that Ramsey pricing of interchange traffic is "frustrating," even though any new ratemaking theory must solve the problem of pricing interline services. There are three ways to apply Ramsey's rules to through rates:

1. set a joint rate that maximizes the benefits the public receives from the interlining railroads subject to each road's revenue requirement;
2. set a combined rate that optimizes public benefits subject to the requirement that each carrier stand alone;

and

3. try a second-best rate that maximizes public welfare subject to pooled revenue adequacy.

Mr. Damus argued that the first two methods are inferior ways to establish rates. Based on the mathematical conditions for the first two methods of interline rate setting, he concluded that "seemingly Ramsey-like prices" for through traffic do not exist if railroads have to pass a stand-alone cost test. And since Ramsey prices are solutions to a simultaneous ratemaking problem that involves interline and single line movements, the non-existence of Ramsey prices for interline traffic means also the non-existence of "stand-alone seemingly Ramsey-like prices" for single line traffic. The third alternative, true Ramsey pricing, is workable but often undesirable and always illegal. Since it does not demand that the two carriers meet unreasonable conditions relating to their cost and traffic configuration, revenue pooling is a requirement for Ramsey pricing. Its prohibition means that Ramsey pricing is illegal, and the way around illegal pooling is merger. Mergers will be an appealing alternative since Ramsey pricing remains attractive as a means to increase the services' public benefits and as a necessary line of defence against potential entrants.

Mr. Damus concluded by stating that Ramsey pricing is essentially a pricing technique for a nationalized industry. It is thus unsuitable for a deregulated environment. Mr. Damus noted that the attention given Ramsey pricing by the ICC and the witnesses shows that they do not regard marginal cost pricing as an alternative. Since this is the economists' "first-best" pricing method, and their "second-best" does not work, Mr. Damus concluded that deregulation must be third-best or worse. He warned that if railroads go ahead with their "stand-alone Ramsey pricing," economists may soon return with new estimates of allocative inefficiency which are potentially large. Although stand-alone pricing permits independent operation of privately-owned railroads, it is also discriminatory and sub-optimal. Further, allegations of Ramsey pricing may even encourage those who favor nationalization.

Mr. Damus' final comment was that the most valuable lesson in Ex Parte 347 is that inefficiency is the carriers' worst enemy. Yet, problems with inefficient pricing are far from cut and dried. He contended that effort spent on speculation on pricing would be better spent on detailed costing.

RAMSEY PRICING AND ITS APPLICATIONS**

by Sylvester Damus
Senior Economist
Economic Council of Canada

Transportation Research Forum
Washington Chapter

Seminar on Transport Pricing, Costing, and User Charges.

Washington, D.C., April 7, 1982.
REVISED VERSION, MAY 1, 1982.

On May 17, 1978, the Interstate Commerce Commission ICC issued an Advance Notice of Proposed Guidelines for setting maximum rates on Western Coal. After a lead investigation; the Commission issued on November 18, 1980, in Ex Parte 347 Sub No. 1 a Notice of Proposed Guidelines for setting maximum rates on coal --- nationwide. In this proceeding, the railroads and their witnesses advanced the idea of Ramsey pricing as a superior regulatory tool, one to be preferred to any cost allocation formulae. In their interim decision reached on December 16, 1981, the commissioners "remain committed to the concept of differential pricing[1] as an important tool in assisting railroads toward revenue adequacy."[2] They now recognise that a strict costing approach based on a rigid cost formula is an inappropriate device for establishing maximum rate levels. "[3] But the Commission has not settled on a specific approach to the prescription of maximum rates. Specifically, they have not accepted Ramsey pricing. They appear disturbed by it, by the railroads' proposal to maximise differential pricing, and by unresolved issues relating to the fixed and common costs which differential pricing is supposed to cover.

Ex Parte 347 was perhaps the first occasion on which it was attempted to elevate Ramsey pricing to official policy. The theoretical principles behind this pricing scheme seem sound, and some of the economists who developed them were on hand as witnesses for the railroads. Yet their arguments achieved less than resounding success, which is often the case with first attempts at innovation. However, Ramsey pricing has been known for 55 years.[4] The Commission's vacillation on maximum rate guidelines seems puzzling, since even some witnesses for the shippers agreed with differential pricing. [5] This agreement made a frontal attack on Ramsey pricing very difficult. Instead of attempting any sort of attack, shippers could have questioned details of the railroads' proposal and defended their positions with the Ramsey-pricers' own arguments. This was only half-done, but was perhaps sufficiently well done to explain the Commission's interim decision. It seems to me that this decision was right. The railroads had made a weak case for themselves by narrow application of incomplete theories. The shippers had hinted at important issues but did not develop them sufficiently. Together they offered too little to guide the Commission towards a decision on pricing guidelines. Among the unresolved problems I would like to discuss these:

1. The railroads' reasoning on rate guidelines is circular;
2. Frank Ramsey would disown their pricing schemes;

3. It is impossible to put a literal interpretation of their ideas into practice; and

4. So-called Ramsey pricing is best understood as a Potentially low-cost but trouble some system for decentralized pricing.

Lest the reader think I am unduly harsh, I hasten to point out that apart from Ramsey's ideas being only 10 years under retirement age, some railroad witnesses announced that they had always applied Ramsey pricing rules.[6] Other witnesses said the same, when they made analogies between Ramsey and value-of-service pricing, and equated Ramsey prices with profit-maximizing ones. A superficial equivalence of Ramsey and value-of-service pricing is established and passed statistical tests performed on century-old rates.[7] Ramsey pricing is now superannuated, and its weakness is correspondingly unsurprising. Before we proceed any further, let me state without proof certain unassailable theoretical results. We shall need these to judge the merits of their attempted application.

I. A CONCISE REVIEW OF RECENT RESEARCH ON PRICING.

The Ramsey price is one that maximizes the public utility of a road subject to a break-even constraint on the road's revenue. This immediately suggests its potential usefulness as a regulatory tool . Ramsey's is also a monopoly price but, nevertheless, price regulation seemed unnecessary to some authors. It has been said that a regulator can confine himself to determination of the adequacy of railroad revenue.[8] In fact, rate o f return regulation alone does not necessarily lead to a socially desirable outcome. It does not prevent the choice of prices in excess of the profit-maximizing ones.[9] Under certain cost conditions a multiproduct monopoly subject to competition in a regime of free entry and exit will find Ramsey's to be its safest pricing strategy.[10] The firm's economies of scale and scope are not a cause of objectionable price behavior. Only sunk costs and exit barriers permit deviations from Ramsey pricing.[11] Thus, were it not for sunk costs, a regulator would not need to prescribe Ramsey prices, if indeed he wanted such prices to be charged.

A Ramsey pricing railroad operating in captive and competitive markets cannot reduce prices in both markets without losing net revenue. Ramsey's rules preclude malicious pricing of the type that increases prices in both markets without profiting the seller because of the resulting reductions in output.[12] Thus Ramsey pricing can be said to minimize an index of the prices charged.[13] The behavior of railroads in Ohio around the year 1887 to followed the shape of the price-iso return locus derived by Baumol *et al.*[14]

Ramsey prices are not guaranteed to be subsidy free. They can involve cross-subsidization in the sense that some users will pay less than the marginal costs of services they receive and some class of users pays more than the stand-alone cost of service rendered to them.[15] Furthermore, "the prohibition of cross-subsidies, which is often regarded as a criterion of fair pricing practices, may in fact reduce total welfare."[16] Entry controls are necessary if public welfare is pursued with cross-subsidizing Ramsey prices because cross-subsidies invite entry that can be wasteful if the incumbent has increasing returns to scale and scope.[17] The unsustainability of Ramsey prices is particularly bothersome in the case of transport.[18] Should Baumol's "weak invisible hand" be able to work without cross-subsidies, it would still be incapable of simultaneously guiding a firm's pricing behavior and optimizing its investment decisions unless the firm was protected by entry controls. [19] Wasteful duplication of an incumbent's plant is not prevented by Ramsey pricing.

When total revenue is inadequate to return a normal rate of profit on the industry's rate base the Ramsey price equals the profit maximizing one.[20] Profit maximizing prices can involve

cross-subsidies even when the resulting revenue is inadequate. Cross-subsidies are possible whenever services are complementary.[21.]

Even with increasing returns to scale a number of firms may compete for a market provided they do not have dissimilar technologies with transray convex costs.[22] The spatial character of transportation also permits the coexistence of several firms with increasing returns. When there are several firms, Ramsey's revenue constraint is applied to the industry as a whole. This results in Ramsey prices which are commodity-specific, not firm-specific.[23] The industry-wide revenue constraint allows some firms to ring up profits while other firms suffer losses but, because of the constraint, the profits cancel the losses. The losers' acceptance of the constraint can be obtained by compensating them with side-payments financed by the gainers's profits. This is another instance of cross-subsidy and the policy that would be pursued to secure "inherent advantages."[24.] It mould also be the policy of a revenue-pooling cartel and more thoroughly in keeping with Ramsey's rules than "totally regulated second-best."[25]

One of the functions of cartels is to set through rates for interline traffic. These can be *combined rates* or *joint rates*. The joint rate is always lower and more profitable to the participating carriers than the combined one.[26] There is, however, no scientific rule ---- better than custom ---- for the division of joint profits. Ramsey pricing removes the incentive to set joint rates because the break-even constraint dissipates the profit from through traffic by reduction of single line rates.[27] This reduction is imposed by the revenue constraint. When two carriers are forced into joint Ramsey pricing, the imposition of a single break-even constraint on both must necessarily involve discussion of single line rates. Single-line rates are involved because the joint Ramsey rate is one of a number of simultaneous solutions for all rates that determine the revenue that is constrained within a regulated and adequate level. However, such a simultaneous discussion of joint and single line rates is contrary to the Staggers Act.[28] Single line rates for branch to main-line movements can also be viewed and made as joint rates. If they follow Ramsey's rules under a constraint on branch and main-line revenues they can involve cross-subsidies from main to branch-lines. Branch-line deficits are not irrational. The extent of joint rate-making, and the benefits which may flow from it to the public depend on who happens to own the tracks since merger allows more efficient Ramsey pricing without contravening the Staggers Act.

Ability to substitute joint for combined rates is one incentive to merger. Another is that by enlarging a network it may become easier to avoid empty hauls.[29] Carrier size is optimized by balancing the cost of administering a larger network with the gains from rationalized itineraries and substitution of single line for combined rates.

II. MAXIMUM RATE GUIDELINES; THE RAILROADS' CONFUSED AND CIRCULAR REASONING.

The ICC had asked for maximum rate guidelines but got an extensive discussion of Ramsey pricing and stand-alone costs. These are incompatible and do not answer the Commission's question.

It was said that a railroad which has inadequate revenue should be allowed to minimize losses or to set profit-maximizing prices [30] Although discriminatory prices seem unobjectionable because they are like Ramsey prices.[31] It was also thought that profit maximization rules out cross-subsidies.[32.] Unfortunately, all these statements by railroad witnesses are contrary to the literature cited in the previous section.

The need for guidelines mas recognized in case railroads achieved revenue adequacy. Profit maximization cannot be equated with socially efficient Ramsey pricing if it leads to long run monopoly profits. These could be constrained by freedom of entry and exit, or by Baumol's weak invisible hand. Apparently, this was judged to be too weak. It was suggested that the ICC regulate profits.[33] and confine itself to that task. However, break-even revenue does not imply Ramsey pricing. This would have to be prescribed and is all that is required by way of guidelines. Instead of it, railroad witnesses proposed that exploitation of captive shippers be prevented by adding a stand-alone cost test to the break-even requirement.

The stand-alone cost test prevents cross-subsidies. It is not clear why the ICC should want this. If it wants welfare maximizing Ramsey prices, the Commission has to accept the cross-subsidies involved in them. Of course, the Commission did not ask what prices maximize welfare, should not have been bothered with Ramsey's theories, and can choose to forbid cross-subsidies. However, railroads would avoid them on their own. The carriers are interested in avoidance of cross-subsidies because these invite competitive entry. In a climate of deregulation railroads cannot ask for restrictions on entry and must carry out stand-alone cost tests for their own protection. Prevention of cross-subsidies may be inconsistent with maximization of the public utility of the roads and with Ramsey pricing, but this should concern the regulators more than the carriers.

In proposing a stand-alone cost test, the railroads sought security where they could not find it. Witness Hall thought about the network for which such a cost could be computed and found that "shippers with a multitude of route origins and destinations would soon turn the stand-alone shipper into the owner of the full railroad."[34] The railroads themselves seem confused by this new test:

> The stand-alone cost test ... can be accomplished with existing cost finding tools ...
> But the application of this test, for which it would be impossible to develop a cost system, will result in all the delays and burdens typical of special studies.[35]

Baumol and Willig also found their test impractical [36] and in its stead advocated an indirect ones profits must be zero or negative and no group of commodities should leave a deficit greater than the carrier's.[37] But how can it be said that individual rates within the group are subsidy-free? For that one would have to make arbitrary allocations of the costs common to the group. Thus the argument has gone full circle, back to where the railroads and their witnesses began. They rejected arbitrary cost allocations and returned to a point where they need them as much as ever.

III. WHAT TURNS DISCRIMINATORY PRICES INTO RAMSEY PRICES?

A large part of the testimony in Ex Parte 347 mas devoted to discussion of the inverse-elasticity and equiproportional reduction rules. Little mas said about the precise specification of the revenue constraint and objective functions from which these rules mere derived by Frank Ramsey. In the theoretical literature one usually finds only a single revenue constraint on the entire industry. This industry is assumed -- often explicitly and sometimes implicitly ---- to consist of a single monopoly firm. In that case there clearly is only one revenue constraint and a single public utility objective. Many railroads were represented in Ex Parte 347, but not one of their witnesses touched on the importance of counting constraints and identifying the objective function that they would like to maximize. Whenever there are many carriers there can be as many revenue adequacy constraints there are independently reporting firms and as many objectives as there are groups of shippers served by each carrier.

It is well known that every monopolist prices his products in inverse proportion to their elasticity of demand. However, a monopolist does not follow Ramsey's rules when he prices with regard to elasticity of demand. He follows the rules when he submits to a revenue constraint and maximizes public utility.

If the constraint is not binding because there are no prices meeting it then profit-maximization seems indicated. This is one of the positions taken by those railroads who asked the ICC for leave to maximize differential pricing.[38.] But their position must be presumed to be false because they omitted to show that what they claimed to be a non-binding constraint is actually the proper one to apply.

Which constraints they applied can only be inferred from their testimony. They are not cited explicitly. The statement that the relevant elasticities are those faced by the carrier [39.] and the proposed stand-alone cost tests imply that the constraint is on the revenue of an individual carrier. Professor Wecker's illustration of Ramsey pricing also shows that each railroad is supposed to set prices according to its separate revenue requirements.[40] These firm-specific constraints were inspired by Braeutigam's "partial regulation:" he proposes that the revenue constraint be imposed only on railroads and not on surface transport as a whole.[41]

In his article Braeutigam did not analyze pricing by specific railroads but theorized about the result of imposing a single constraint on the railroad industry as a whole. Further balkanization of the transport industry by addition of firm-specific revenue constraints compounds a misconception of Ramsey-pricing. As Brown and Heal had demonstrated, Ramsey's rules are derived from an industry-wide constraint and are commodity-specific; they are not derived from individual constraints and are not firm-specific. Partial regulation is therefore not comparable with Ramsey's commodity taxation. The contrary impression may have been created by confusion of transport services with final consumption goods and by a tendency to equate the transport firm with the industry. The railroads' arguments were too strongly influenced by recent studies of natural monopoly. The theory of natural monopoly is quite applicable to the case of captive coal traffic, but it can be misleading. Proof that a natural monopolist's strategy is to keep potential entrants at bay with differential pricing for zero profit does not imply that he sets Ramsey prices. The jump to this conclusion was made by neglecting spatial competition. It was forgotten that transport markets have room for many "monopolies," each occupying its little corner in a wide space. Once several firms have settled in a market the conclusion that they set Ramsey prices while filling their own revenue requirements is no longer warranted.

A mathematical analysis of the problem would show the following: If rates are set subject to an industry-wide constraint, marginal costs of production and transportation are equalized for all movements of identical commodities. However, rates set subject to firm-specific revenue requirements ---- rates which pass stand-alone cost tests----do not equalize marginal costs. They do not cause goods to be carried over the cheapest routes, nor shipped from the most convenient locations, nor sold in the markets where they are most valued. Therefore, "Stand-alone Ramsey pricing" does not minimize an index of freight rates.

Baumol and Willig correctly stated that the optimality of Ramsey pricing arises from equiproportionate reductions in consumption.[42] Unfortunately, the remainder of their testimony implies non-proportional reductions. Baumol and Willig let the proportion vary from one railroad to the next depending on the revenue requirements of each and without regard to the commodities carried or their utility to final consumers. A simple numerical illustration will clarify this point and the one made in the previous paragraph.

Suppose there were only two roads. Each carries coal and potatoes, none of which is consumed at their origins. Freight rates are assumed to be initially equal to marginal costs, so traffic is optimal, except for deficit-finance problems. One line carries 80 tons of coal and 20 tons of potatoes. The other transports 20 tons of coal and 80 tons of potatoes. To eliminate deficit finance, the roads are allowed their kind of "Ramsey-pricing," which may be more accurately labelled "stand-alone pricing under seemingly Ramsey-inspired rules." After consulting costs and elasticities of demand, each railroad forces traffic reductions by differential rate increases to a break-even level. The initial deficits, costs, and elasticities are assumed such that the first road cuts its traffic by 10 percent to 72 tons of coal and 18 tons of potatoes, and the other road cuts its traffic by 20 percent to 64 tons of potatoes and 16 tons of coal. Each road is making a proportional reduction but does it according to a proportion it set itself without guarding proportions in consumption by its patrons. Consumption of coal is then reduced by 12 percent, from 100 to 88 tons. Consumption of potatoes is cut 18 percent, from 100 to 82 tons. There is no equiproportional reduction in consumption. Therefore, the optimality of so-called Ramsey pricing claimed by the railroads and their witnesses is nowhere to be seen.

With true Ramsey pricing the traffic of both lines is shrunk equally by---say --15 percent to 85 tons of coal and 85 tons of potatoes. This would raise the rates of the coal carrier by more, and those of the potato line by less than in the previous case. Therefore, the coal carrier would reap a profit, while the potato line is still saddled with a deficit. Since 15 percent shrinkage was chosen to make the pair break even, one line's profit must equal the other line's loss. A side-payment from one to the other completes the task of Ramsey's break-even constraint. The side payment is a subsidy of the potato line financed by the coal carrier's rates in excess of his stand-alone costs. The potato line's deficit does not excuse it from submission to a revenue constraint. Inadequate revenues do not mean that profit-maximization is its proper policy. This is warranted only if the industry as a whole has inadequate revenues. It must be so because Ramsey's commodity taxation satisfies only the industry-wide revenue requirements. If this were neglected and the Baumol-Braeutigam scheme accepted, one would not get a commodity tax, but a transport tax that varies from carrier to carrier. That is not the original meaning of Ramsey-pricing. There may be no harm in using that author's name to denote something he had not recommended, but in this case there is a misrepresentation of public utility effects that cannot be claimed as a result of stand-alone pricing.

IV. THROUGH RATES.

More than half of all shipments pass over the rails of two or more carriers. To be useful for the greater part of traffic, a new rate-making theory must solve the problem of pricing interline services. This is an especially difficult problem, and Ramsey pricing of interchange traffic is frustrating, or flustrated by legislation.

One can attempt to apply Ramsey's rules to through rates in three different ways: first, set a joint rate that maximises the public utility of two roads subject to their separate revenue requirements. Second, set a combined rate that optimises subject to the requirement that each carrier stand alone. And thirdly try a second-best rate that maximises public utility subject to pooled revenue adequacy. The first two explicitly rule out inter-carrier cross-subsidies and thus meet stand-alone cost tests. The third requires only that the industry here supposed to consist of only two carriers stand alone. It does not rule out that one firm contribute profits to a revenue pool and that the other firm draw on this

pool to cover a deficit. I have previously argued that the first two are inferior methods of rate-making. I will now argue that they are impossible.

The mathematical conditions for the first two methods of interline rate setting make interline "Ramsey pricing" very unlikely. The mathematical condition for a solution of the railroads' constrained utility maximisation problem is that the Lagrange multipliers involved in such an exercise be equal for both firms. The economic meaning of this is that a dollar of net revenue must have equal value regardless of which carrier receives it. This cannot be unless both have--- in a sense ---equa1 need for revenue in excess of that which would be raised by marginal cost pricing. From this condition follows this other one: that both carriers can stand alone even if they set all rates with identical price/marginal cost ratios. If that were so, one railroad's costs could be used as exact measures of the other one's and one line could copy the other line's tariff book. This is sufficiently unlikely to conclude that "seemingly Ramsey-like prices" for through traffic do not exist if railroads have to pass a stand-alone cost test. Since Ramsey prices are solutions to a simultaneous rate-making problem that involves interline and single-line movements, the non-existence of Ramsey prices for interline traffic means also the non-existence of "stand-alone seemingly Ramsey-like prices" for single-line transport.

The third alternative ---- true Ramsey pricing ---- is workable but often undesirable and always illegal. It does not demand that the two carriers meet unreasonable conditions relating to their cost and traffic configuration. Therefore, revenue pooling is a requirement for Ramsey pricing. Its prohibition means that Ramsey pricing is illegal. The way around illegal pooling is merger. Carriers will continue to follow this route because Ramsey pricing remains attractive as a means to increase the public utility of services, and as a necessary line of defence against potential entrants.

V. WHERE DO WE GO FROM HERE?

The inconsistencies in Ex Parte 347 and the impossibility of the pricing rules proposed in it are not surprising. Ramsey pricing is essentially a public finance tool or a pricing technique for a nationalised industry. As such it is unsuitable as a response to deregulation and its problems. The attention given to it by the ICC and the witnesses shows that they do not regard marginal cost pricing as an alternative. Since this is the economists' "first-best" pricing method and their "second-best" does not work, deregulation must be third-best or worse. Perhaps third-best is the normal state of the transport industries. Deregulation should then be desired on its own merits and not for efficiency reasons.

Regulation has been sufficiently discredited and proven costly. But if the railroads go ahead with their "stand-alone Ramsey pricing" economists may soon return with new estimates of allocative inefficiency. These are potentially large. Whether they are larger than those caused by regulation is an empirical question that cannot be resolved without extensive investigation of the facts. The merit of stand-alone pricing is that it permits independent operation of privately owned railroads. That will surely be recognised as a better objective than the economists' penchant for public utility or social welfare maximisation. But it must also be recognised that stand-alone pricing is discriminatory and sub-optimal. As such, it presents shippers and carriers with opportunities to negotiate for better rates and even for pooling. Only ideologues would argue that questions of efficiency, regulation, and ownership can be resolved easily. Allegations of Ramsey pricing may tip the balance towards those who still toy with the idea of nationalization. That is not the road carriers want to follow.

The most valuable lesson in Ex Parte 347 and the literature leading to it is that inefficiency is the carriers' worst enemy. The problems with inefficient pricing caused by monopoly, pooling, regulation, and so on are far from being cut and dry. Avoidance of inefficiency requires also more detailed knowledge of costs. The effort put into speculation on pricing is better spent on costing.

FOOTNOTES.

*. Transportation Research Forum, **Proceedings: Seminar on Transport Pricing, Costing, and User Charges, April 5-7, 1982**, pages 36-39.

**. These are the speaking notes read at the Seminar and summarized in the Proceedings above.

1. ICC, Decision on Coal Rate Guidelines----Nationwide, Ex Parte 347 Sub-No. 1 December 16, 1981, page 3.
2. *Ibid.*, p. 8.
3. *Ibid.*, p. 8.
4. Its origin is in Frank Ramsey's "Contribution to the Theory of Taxation," ECONOMIC JOURNAL, 371, March 1927, 47-61.
5. Aaron J. Gellman and W. Bruce Allen, Verified Statement in Ex Parte 347, April 27, 1981, page 25.
6. Witness McCormack, quoted in the Southern Electric System's statement, July 27, 1981, page 31.
7. Sylvester Damus, " Two-Part Tariffs and Optimum Taxation: The Case of Railway Rates," AMERICAN ECONOMIC REVIEW, 711, March 1981, 65-79.
8. William J. Baumol and Robert D. Willig, VS No. 1 in Ex Parte 347 Sub-No. 1. May 11, 1981, pages 33 and 68; Ingo Vogelsang and Jörg Finsinger, "A Regulatory Adjustment Process for Optimal Pricing by Multiproduct Monopoly Firms," BELL JOURNAL OF ECONOMICS, 101, Spring 1979, 157-71.
9. W. J. Baumol, Dietrich Fischer, and Thijs ten Raa, "The Price Iso-Return Locus and Rational Regulation," BELL JOURNAL OF ECONOMICS, 102, Autumn 1979, 648-58.
10. W. J. Baumol, Elisabeth E. Bailey, and R. D. Willig, "Weak Invisible Hand Theorems on the Sustainability of Multiproduct Monopoly," AMERICAN ECONOMIC REVIEW, 673, June 1977, 350-65.
11. W. J. Baumol and R. D. Willig, "Fixed Costs, Sunk Costs, Entry Barriers, and Sustainability of Monopoly," QUARTERLY JOURNAL OF ECONOMICS, 963, August 1981, 405-31.
12. Baumol, Fischer, and ten Raa,"The Price Iso-Return Locus."
13. Kenneth J. Arrow, VS in Ex Parte 347, April 1981, p. 12.
14. S. Damus, "Two-Part Tariffs," pp. 76-78.
15. Gerald R. Faulhaber, "Cross-Subsidisations Pricing in Public Enterprise," AMERICAN ECONOMIC REVIEW, 655, December 1975, 966-77.
16. Baumol, Fischer, and ten Raa, "The Price Iso-Return Locus," page 657.
17. G. Faulhaber, "Pricing in Public Enterprise," page 972.
18. S. Damus, "Two-Part Tariffs," page 71.
19. W. J. Baumol, "Contestable Markets, an Uprising in the Theory of Industry Structure," AMERICAN ECONOMIC REVIEW, 721, March 1982, 1-15.
20. S. Damus, "Two-Part Tariffs," page 69.

21. R. G. D. Allen, MATHEMATICAL ANALYSIS FOR ECONOMISTS, Macmillan, 1971, Example XIV-27, page 381.
22. W. J. Baumol, "On the Proper Cost Tests for Natural Monopoly," AMERICAN ECONOMIC REVIEW, 675, December 1977, 816-19.
23. D. J. Brown and Geoffrey Heal, "Two-Part Tariffs, Marginal Cost Pricing, and Increasing Returns in a General Equilibrium Model," JOURNAL OF PUBLIC ECONOMICS, 131, February 1980, 24-49.
24. Rosalind S. Seneca, "Inherent Advantage, Costs and Resource Allocation in the Transportation Industry," AMERICAN ECONOMIC REVIEW, 635, December 1973, 945-56.
25. Ronald R. Braeutigam, "Optimal Pricing with Intermodal Competition," AMERICAN ECONOMIC REVIEW, 691, March 1979, 38-49, introduced the concept of totally regulated second-best.
26. R. G. D. Allen, MATHEMATICAL ANALYSIS, Examples XIV 28 & 29, page 381.
27. Sylvester Damus, "A Two-Part Ramsey Optimum Railroad Tariff," University of Chicago doctoral dissertation, August 1979, chapter 7.
28. 49 U.S.C. 10706 a3A.
29. Sylvester Damus, "An Agenda for Research in Transport Pricing in an Era of Deregulation," ICC PRACTITIONERS' JOURNAL, 491, November 1981, 23-32.
30. Baumol and Willig, V8 No. I, Ex Parte 347, May 11, 1981, pages 33 and 68.
31. *Ibid.*, page 33.
32. *Ibid.*, page 36.
33. *Ibid.*, page 69.
34. Marion L. Hall, VS No. 3 in Ex Parte 347, May 11, 1981, pages 89-90.
35. Chessie System Railroads, Consolidated Rail Corporation, Family Lines Rail System, Norfolk and Western Railway Company, and Southern Railway System, "Comments of Five Railroads," Ex Parte 347 Sub-No. D, Vol. I, May 20, 1981, 111-112.
36. VS No. I, page 80.
37. *Ibid.*, page 78.
38. "Comments of Five Railroads," pp. 80-81.
39. Baumol and Willig, VS No. 1, page 46.
40. William E. Wecker, VS in Ex Parte 347, April 28, 1981.
41. Ronald Braeutigam, "Optimal Pricing with Intermodal Competition," which mas explicitly cited in several of the verified statements in Ex Parte 347 Sub-No. 1.
42. VS No. 1, pp. 54ff.